Environmental
Geotechnical
Specialists

COAL INVESTIGATION

job number	date
C1913/21/E/3053	02/09/2021

site address
Westfield Farm
Barnsley Road, Flockton, WF4 4DW

written by	checked by
C. R. Campion	R. A. Palmer

issued by
C. R. Campion

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GEOTECHNICAL ENVIRONMENTAL

Environmental Geotechnical Specialists

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Appendices

Environmental Geotechnical Specialists

Report on Rotary Probing

Location:	Westfield Farm Barnsley Road, Flockton, Wakefield, West Yorkshire, WF4 4DW
For:	Paul Brown
Consultants:	-
Report No.	C1913/21/E/3053
Report date:	September 2021

For and on behalf of **Rogers Geotechnical Services Ltd**

Charlotte Campion MGeoSci FGS
Geo-environmental Engineer

Rob Palmer MSc FGS ACIEH
Senior Geo-environmental Engineer

1. Introduction

It is understood that the current development plans include the construction of four new residential units and the extension of the existing farmhouse building at the site. As part of the planning process a site investigation has been undertaken to establish if coal workings are present beneath the area of the proposed works. This report presents the data obtained and discusses the ground conditions in relation to the proposed development.

2. Limitations

The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site and of the laboratory test results. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between borehole positions, these are for guidance only and no liability can be accepted for their accuracy.

This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

3. Preliminary Desk Study

The following information has been considered during the works.

- Appraisal of available on-line British Geological Survey and Coal Authority data, including sheet 77: Huddersfield geological map and accompanying memoir.
- Review of the Phase 1 Desk Study, containing a Coal Mining Risk Assessment provided by the client, produced by Met Consultancy Group (ref: P18-00854) and dated July 2018.
- Rogers Geotechnical Services Phase 2 Geo-environmental Report (ref: C1913/21/E/2940), dated August 2021.
- The Coal Authority Shaft Plan and Data Sheets for shaft 423414-007 (ref: 51002565984001), dated 3rd August 2021.

4. Fieldworks

4.1 Acquisition of Coal Authority Permit

In order to undertake this investigation, it was necessary to obtain permission to enter or disturb Coal Authority interests. This permission was granted on the 9th August 2021 as permit reference number 22642, which is presented in Appendix 1 to this report. In accordance with the joint Coal Authority and Health and Safety Executive positioning statement, and under the requirements of the permit, the works were undertaken employing water flush drilling techniques with gas monitoring of the boreholes during the fieldworks.

4.2 Rotary Open-hole Boreholes

The fieldworks were undertaken during the period 14th, 15th and 30th August 2021in accordance with the instruction to proceed issued by the client. These works were required in order to prove that workings were not present to a depth of up to 30m beneath this site.

The boreholes were sunk using a Comacchio 205 rotary drilling rig using rotary open-hole drilling techniques and employing 130mm diameter drag and tricone roller bits. Where necessary, 140mm diameter casing was temporarily installed through the overburden to support the bore. The investigation was undertaken using water flush drilling techniques in accordance with the Coal Authority and Health and Safety Executive positioning statement. Drill chippings brought to surface in the flush returns were inspected by the driller on a screen, which forms part of the re-circulation tanks. The borehole positions are shown on the site plan, which is presented in Appendix 2 and the strata conditions are presented on the borehole records and illustrative cross section of strata in Appendix 3.

Whilst it was necessary to ensure at least one borehole position was drilled to 30m depth, the required termination depth of the other position was reviewed during the course of the fieldworks. In this case,

borehole BH02 was sunk to 30m and boreholes BH01 and BH03 were curtailed at depths of 16.5m and 24.5m, respectively, on the basis that sufficient data had been obtained.

5. Geological Appraisal

The available published geological data for the site has been examined and the following table presents the anticipated geology.

Table 1: Geological Data for the Site

Strata Type	Strata Name[1]	Previous Name[2]	Description[3]
Superficial Geology	-	-	None recorded.
Solid Geology	Pennine Lower Coal Measures Formation	Grey Measures of Yorkshire and Nottingham Lower Coal Measures Formation	Interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part.
	Birstall Rock	Cropper Gate Rock	The Birstall Rock is a fine-grained, thickly bedded, cross bedded sandstone with common pebbles of ironstone, coal sandstone and mudstone, and common streaks of shaly coal.

It should be appreciated that the majority of the site is recorded to be underlain by undifferentiated strata of the Pennine Lower Coal Measures Formation strata, with the outcrop of the Birstall Rock recorded to be limited to the very northern boundary of the site.

It should be noted that a north-east south-west trending fault is located approximately 50m north of the site, with the site located within the footwall block, with the fault indicated to downthrow to the north. As such, there is a potential for brecciated/broken ground to be present in the site area, which should be taken into consideration during any intrusive investigation.

[1] Sources: British Geological Survey (NERC) Map Sheet 77; Huddersfield; Solid and Drift Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[2] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

The Second Brown Metal Coal seam is recorded to outcrop on the southern boundary of the site and then again approximately 140m south of the site. The repetition of this seam appears to be a topographical effect, with the seam outcropping in each side of the Flockton Beck valley. The details of the Second Brown Metal Coal are summarised below:

Table 2: Summary of Coal Seams within the Vicinity of the Site.

Seam name	Seam thickness*	Outcrop distance from site*
Second Brown Metal Coal (2BM)	0.0m – 1.0m	On site and 140m

*All distances are given as approximations only. It should be noted that coal seam thicknesses may vary over relatively short distances

The geological data suggests that the Second Brown Metal Coal seam will be observed at shallow depths (within the top 15m) of the site surface. It is considered that any coal seams within 30m bgl, if worked, could pose a risk of instability to the proposed development. Taking the above information into consideration, it was deemed likely that an intrusive investigation would encounter one coal seam (anticipated to represent the Second Brown Metal Coal) at relatively shallow depth.

6. Strata Conditions

In accordance with the geology of the area, the succession has been shown to include the following:

Table 3: Generalised Strata Profile

Depth to base (m)	Strata type	Positions strata was revealed	Groundwater strikes (m)
0.40 – 1.00	MADE GROUND	All	None
1.40 – 2.50	Yellow CLAY	BH02 &BH03	None
3.00 – 4.20	SANDSTONE	All	None
4.00 – 4.60	VOID	BH02 & BH03	None
4.50	MUDSTONE and SANDSTONE	BH01	None
7.50 – 9.50	SANDSTONE	All	None
10.00	SILTSTONE	BH01	None
9.70 – 11.80	MUDSTONE	All	None
10.30 – 12.50	COAL	All	None
+16.50 – +30.00m	Interbedded SILTSTONE and MUDSTONE with bands of SANDSTONE. Sandstone dominates in BH03.	All	15.0m (BH01) 13.5m (BH02)
14.20	VOID	BH03	14.00

'+' Denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

Initially, concrete hardstanding was encountered to depths of between 0.1m and 0.3m at BH01 and BH02, respectively. In BH03 hardstanding of fine chippings was encountered to a depth of 0.5m. In BH01 and BH02 cohesive made ground was then recorded to depths of between 0.4m and 1.0m.

Below the hardstanding and made ground, generally similar ground conditions were encountered in boreholes BH02 and BH03. These comprised yellow clay to depth of between 1.4m and 2.5m, underlain by sandstone to depths of between 7.5m and 9.5m, in turn underlain by interbedded mudstone, siltstone and sandstone to the termination depths of the boreholes. The strata in these boreholes were noted to be fractured and poor flush returns and occasional flush loss was noted during drilling. Casing was progressed to depth of between 19.4m and 20.0m, in order to progress these boreholes.

In BH01 sandstone was encountered to a depth of 9.0m, bisected by a band of mudstone and sandstone at depths between 3.0m and 4.5m. Below the sandstone, interbedded mudstone and siltstone was encountered to the termination depth of the borehole.

A void was encountered at between 3.7m and 4.0m in BH02 and between 4.2m and 4.6m in BH03, the top of this void was encountered at approximately 165.3m above ordnance datum (aOD[3]) and 165.9m aOD. Based on the geological mapping data the level of the outcrop of the 2BM coal is approximately 166.9m aOD, this suggests the void is at a similar level to the recorded outcrop of the 2BM, albeit with a slight dip down towards the north. It should be noted that no such void was encountered in BH01, thus these workings may be intermittent across the site.

A ‘void’ was noted between 14.0m and 14.2m in BH03 and heavy fracturing was noted between 13.5m and 15m in BH02, although such features were not present at a similar level in BH01. It is anticipated that the voiding in BH03 represents a distinct fracture or joint, as opposed to voiding associated with illicit workings. Indeed, no distinct coal seams or evidence of workings were identified within any of the boreholes at these depths.

In general, throughout the drilling poor flush returns and occasional flush loss (without apparent voids) was noted. This suggests the strata underlying the site are fractured and may be related to past faulting. Indeed, a normal fault is recorded to the north west of the site. It is considered unlikely that this fault will have any future impact on site surface stability, based on the UK’s current geological setting and based on past experience with faults and fault reactivation in the UK.

An intact coal seam was encountered at depths between 9.7m and 12.5m depth, varying between 0.3m and 0.7m in thickness. It is likely that this seam relates to the Third Brown Metal (3BM) coal seam recorded as the next seam below the 2BM in the stratigraphic sequence.

It is considered that the shallow yellow to white sandstone encountered to depths of between 7.5m and 9.5m represents the Birstall Rock recorded to underlie the northern part of the site, the strata conditions encountered suggests this sandstone unit is more extensive and underlies much of the site.

Interbedded mudstone siltstone and sandstone was encountered below the Birstall Rock sandstone unit, it is considered that these strata represent the undifferentiated Pennine Lower Coal Measures Formation recorded to underlie the site.

[3] aOD estimated utilising GIS and Google software.

Groundwater strikes were recorded at depths of between 13.5m and 15.0m in all boreholes during drilling. However, it is possible that the use of water flushing techniques may have masked the presence of other water strikes at other depths. In general, it appears that the depth to groundwater increases to the south, suggesting a flow down gradient in line with topography. In any event, it should be appreciated that groundwater levels are subject to seasonal variation or changes in local drainage conditions.

In addition, no methane or carbon dioxide was detected, with levels of oxygen measures at 20.8% being recorded during the drilling phase.

7. Discussion of Ground Conditions

On the basis of all of the information provided above it is noted that a void was encountered at between 3.7m and 4.6m, with void thicknesses between 0.3m and 0.4m. This void likely represents former workings of the 2BM coal.

A second 0.2m thick void was noted at a depth of 14.0m in BH03 only, this is likely a fracture within the rock rather than related to past coal working.

An intact 0.3m to 0.7m thick coal seam was encountered at depths of between 9.7m and 12.5m, this likely represents the 3BM coal seam. Due to its thickness, this seam would prove commercially viable for extraction. However, this horizon of coal was proven to be intact at all borehole positions. Consequently, it is considered that it is highly unlikely that shallow coal workings are present beneath or in close proximity to the area of the proposed development associated with this seam.

In addition, the results of the gas monitoring conducted during the drilling phase suggest that there is a negligible risk of gasses associated with mine workings being present below the proposed development.

8. Mine Entry

The Phase 1 Desk study included a Coal Authority (CA) CON29M Non-Residential Mining Report which indicated that one mine shaft was present approximately 9.3m east of the site (mine entry reference: 423414-007). As such, a CA Shaft Plan and data Sheets report was obtained for the site (Ref: 51002565984001, dated 3rd August 2021), a copy of which is included in Appendix 4, to gain information on the dimensions and treatment details. In summary the CA state that the shaft is centred on grid coordinates 423419, 414851 and is 1.2m in diameter. In addition, the CA state that the thickness of superficial deposits is 0.4m in the area of the shaft and that the shaft has been treated. The treatment is recorded as the excavation and capping at 1.2m depth with a 3m x 3m x 0.3m thick reinforced concrete cap, with an inspection chamber and manhole cover installed above.

In the context of the guidance given by CIRIA C758 – Abandoned mine w*orkings manual* it should be appreciated that the minimum distance for siting structures from open or poorly filled shafts depends primarily on the nature and thickness of the surface deposits. This would presumably be on the basis

that a significant ground collapse within intact rock would be improbable, therefore the crater associated with a collapse shaft would be located within the soils above the rock. Figure 5.1 of CIRIA C758 goes on to suggest that a realistic collapse crater within such soils would repose to an angle of 90°- ϕ, where ϕ is the angle of shearing resistance for the soil and the resulting angle is taken from a vertical projection at the outer edge of the shaft. From the shaft wall, the zone of collapse would extend to z x tanϕ, where z is the depth to competent bedrock.

It may be noted that the near surface made soils at the site generally comprise gravelly clays and it is assumed the soils in the area of the shaft are similar. For a collapse crater within these soils, an effective angle of shearing resistance of say 25° should be employed. Consequently, it is considered that a collapse crater (zone if influence) associated with these soils would repose to an angle of 65° from the vertical (i.e. 25° up from horizontal). With this in mind and on the basis that the thickness of the soil above rockhead in the area of the shaft is indicated by the CA to be 0.4m and a shaft diameter of 1.2m, in the worst case scenario the lateral extent of a crater (zone of influence) at the site would be 2.06m (0.4 x tan 65°+1.2) away from the centre of a collapsed shaft.

Given that the shaft is recorded to have been located and treated in the past, it is reasoned that such treatment will have been designed to ensure that a collapse relating to these features represents a low[4] risk to surface structures, or human health. Furthermore, the shaft is located some 9.3m east of the site and the Zone of Influence extends only 2.06m to wards the site. As such, additional remedial measures are not considered necessary as the shaft appears to be at sufficient distance from the site as to not affect surface stability, were it to collapse. It would, however, be prudent to consider confirming the location of the shaft and inspecting the chamber to assess if the current remediation is effective and the shaft is not closer to the site, so as to be within influencing distance.

9. Risk Assessment

It may be noted that guidance available from both the NHBC and the CIRIA publication, SP32 - *construction over abandoned mine workings,* suggests that competent overburden thickness above a coal seam should be greater than 10 times the thickness of a seam / void plus seam / void thickness in order that the collapse of workings would pose a low risk to surface structures.

On this basis, the table below suggests the thickness of competent overburden required above each void and seam, were voids present not encountered during drilling, to mitigate instability at the surface.

Table 4: Required Thickness of Competent Overburden

Seam Name	Void thickness	Depth below site	Depth to Rockhead	Required thickness of competent overburden.	Thickness of Competent Cover Present
Second Brown Metal (2BM)	0.3 – 0.4	3.7m to 4.6m	1.4m to 2.5m	4.40m	1.7m to 2.3m
Third Brown Metal (3BM)	0.3m to 0.7m	9.7m and 12.5m	1.4m to 2.5m	7.7m	9.2m to 10.0m

[4] Where Low risk is taken to mean the possibility of instability is unlikely therefore no further action is necessary.

Based on the above information, it is considered that there will not be a sufficient thickness of competent overburden above the workings in the 2BM seam in order to prevent the risk of instability posed by any upwards void migration and potential collapse / crown holing. However, a sufficient thickness of competent overburden is present above the 3BM coal seam. Therefore, a high risk rating has been assigned to the workings encountered in the 2BM coal seam and a low risk is assigned to the deeper intact coal seam encountered, as sufficient cover would exist even if voids not encountered during drilling are present.

In light of the findings of this investigation, the risk to the proposed development is considered with reference to the following ratings and definitions:

Low - The possibility of instability is unlikely therefore no further action is necessary.

Moderate - The possibility of instability is likely and further investigation or remedial action may be required.

High - The possibility of instability is highly likely and further investigation or remedial action will be necessary.

Table 5: Development Specific Risk Assessment

Item	Risk of Instability	Coal Seam(s) Considered	Risk Rating
1	Shallow coal workings	Second Brown Metal	High
		Third Brown Metal	Low
2	Off-site Mine Shaft	N/A	Low

It may be noted that guidance available from both the NHBC and the CIRIA publication, SP32 - *construction over abandoned mine workings,* suggests that competent overburden thickness above a coal seam should be greater than 10 times the thickness of a seam / void plus seam / void thickness in order that the collapse of workings would pose a low risk to surface structures.

In view of all the information obtained in this investigation, it is considered that there is a high risk of ground movement as a consequence of shallow coal workings beneath the site associated with the 2BM coal seam and remediation will be required.

10. Remediation

In view of the above, remedial measures will be required. Normal practice would be to undertake grouting. However, given the very shallow depth of the workings encountered within the boreholes, it is anticipated that it will be more cost-effective and practical to excavate the workings and reinstate with a suitably compacted material.

In the first instance, discussions should be held with the Coal Authority to the efficacy of this approach. The entirety of the site will have to be subject to excavation to the underside of the workings, which will

result in the excavation of any remaining intact coal. The Coal Authority may suggest that the coal is sold for re-use. However, no remaining coal was encountered at shallow depth so an insufficient quantity may remain on site to consider sale. Furthermore, it would be necessary to establish the calorific value of the coal in order to determine the quality of the coal to any prospective buyer.

It should be appreciated that if the coal workings were found to extend off site, i.e. voids extended laterally to the neighbouring property and are revealed at site the boundaries, it may be prudent to construct a suitable plug, possibly with concrete and stone blocks.

Once any coal and underside of the workings are reached, the excavation would then be filled with approved and compacted granular material such that a raft foundation could be constructed at shallow depth. In principal this method of construction is considered viable, provided that:

- Testing of the source material (grading and dry density moisture content relationship) be undertaken to assess its suitability. It may be possible to use site won materials.
- The excavation faces are battered to a slope not exceeding 45^0.
- The formation level is subject to compaction using a suitable vibratory roller.
- A suitable granular fill is brought up and compacted in layers not exceeding say 300mm.
- Each layer is subject to insitu density testing to ensure that it has been adequately compacted.

If the works are undertaken with due diligence then it is considered that settlement of the completed structure will be well within tolerable limits.

If the excavations are required to stand open for any period of time then a blinding layer of lean-mix concrete should be placed in the excavation bases. This expedient will reduce softening or loosening of the sub-grade due to the ingress of surface water.

In the event that water seepages enter the excavation, it is possible that such seepages could be controlled using a simple form of de-watering. Such a system could include the excavation of sumps from which the water could be pumped. However, it would be prudent to excavate some deep trial pits at the time the works are to start in order to establish if groundwater is likely to represent a significant issue during construction.

It is re-iterated that the stability of the excavation faces cannot be guaranteed thus temporary support to the excavation faces or battering the faces to a safe slope angle will be required. Under no circumstances should operatives be allowed to enter unsupported excavations.

In order to complete the above, an approach will need to be submitted to the Coal Authority and appropriate permits may need to be obtained in order to complete the works, particularly if coal is to be removed. Moreover, a report will need to be undertaken by a suitably qualified engineer in order to validate the works. The works will need to include regular site visits to inspect the base of the workings and to inspect the nature and compaction of the engineered fill. This will likely be outlined within a planning condition.

It should be noted that Rogers Geotechnical Services would be happy to assist with the above where possible.

11. References

- British Standards Institution (2015 +A1: 2020) BS 5930: *Code of practice for ground investigations*, B.S.I., London.
- Healy, P. and Head, J., 1984. *Construction over abandoned mine workings*. London: Construction Industry Research and Information Association [for] Directorate of Civil Engineering Services, Property Services Agency, Dept. of the Environment.
- Parry, D. and Chiverrell, C., 2019. *Abandoned mine workings manual*. London: CIRIA.
- British Geological Survey (NERC) (2021), BGS, Keyworth.
  - Geology of Britain Viewer: (*http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html*)
  - Borehole Scans: *(http://www.bgs.ac.uk/data/boreholescans/)*
  - Lexicon of Named Rock Units: (*http://www.bgs.ac.uk/lexicon/*)

Appendix 1

Coal Authority Permit

The Coal Authority

Permit to Enter or Disturb Coal Authority Interests

Permit 22642

Name and Address of Permit Holder:

Paul Brown
9 Rock Road
Birchencliffe
Huddersfield
HD3 3BU

Site Location:

Land at
Westfield Farm
Barnsley Road
Flockton
Wakefield
WF4 4DW

This certificate hereby grants the above named Permit Holder a Permit to carry out:-

Ground investigation by three boreholes to 30m

within the Authority's interests at the identified site location above as shown on the Grant Permit Boundary (overleaf) for the period of 12 months from the granted date shown below. *The granting of this Permit does not constitute advice given by the Authority in relation to the proposed operations. It is the Permit Holder's responsibility to obtain appropriate health, safety, environmental, technical and legal advice.*

Conditions:

- *Manned entry (i.e. into mine entries/workings) is strictly prohibited.*
- *Water flush*
- *Gas Monitoring CO, CH_4, CO_2, O_2, H_2S at borehole and rig*
- *Operators undertaking the work must be in possession of this certificate and the Permit boundary plan at the time of works*
- *Appropriate borehole sealing without delay and to withstand site level changes*

Signed: _____ Granted Date: ***09 August 2021***

For and on behalf of The Coal Authority

Nominated Representative: Paul Hobson, Permitting Manager;
The Coal Authority, Permitting Office, 200 Lichfield Lane, Mansfield, Notts, NG18 4RG
Tel: 01623 637450; E-Mail: permissions@coal.gov.uk

The Coal Authority

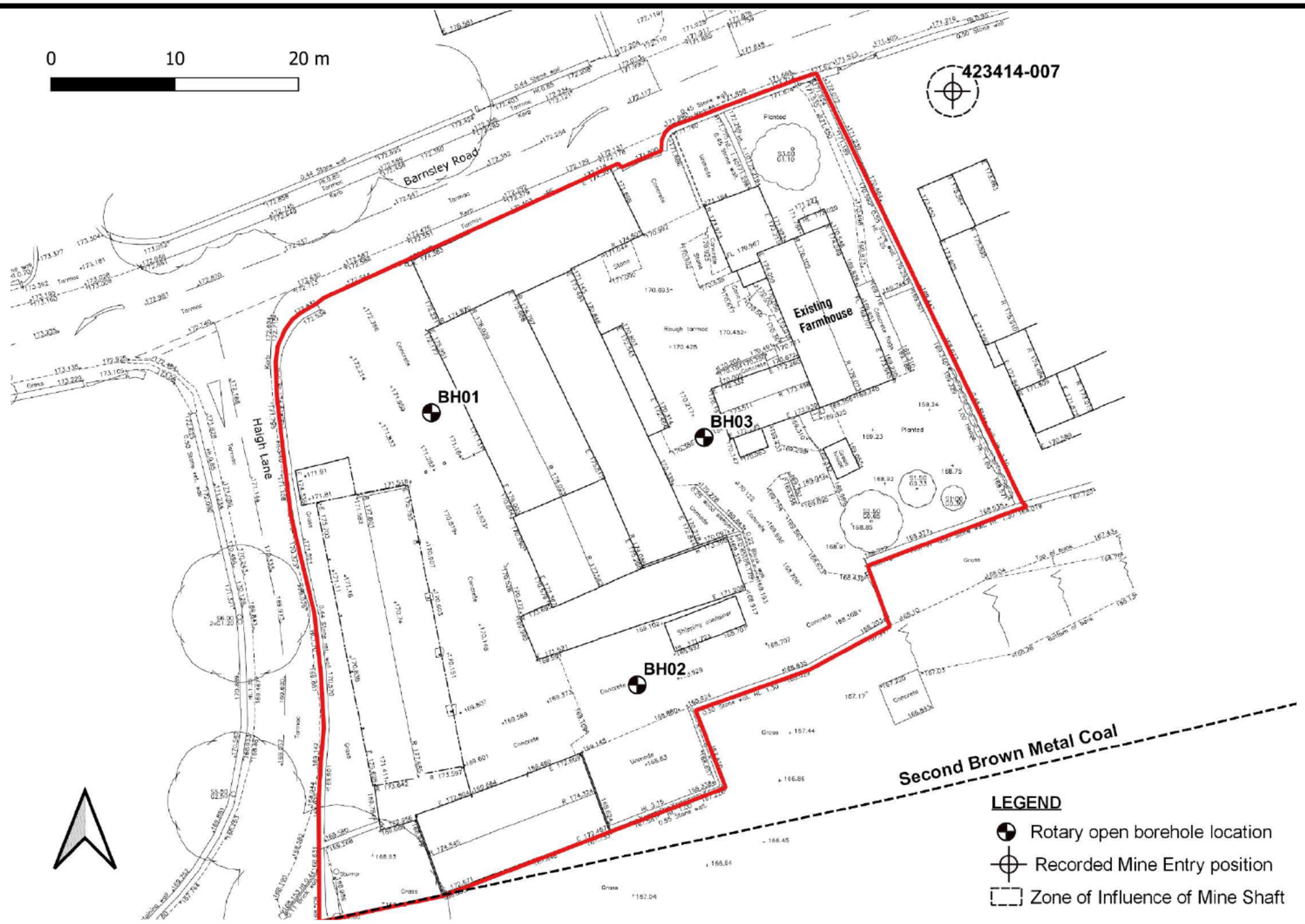
Granted Permit Boundary

Permit Ref: 22642

Permit Boundary:

Appendix 2

Site Plan



Notes:
Investigation positions approximated from site operative's notes.

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Near Bank,
Shelley,
Huddersfield,
HD8 8LU

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www.rogersgeotech.co.uk

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Client:
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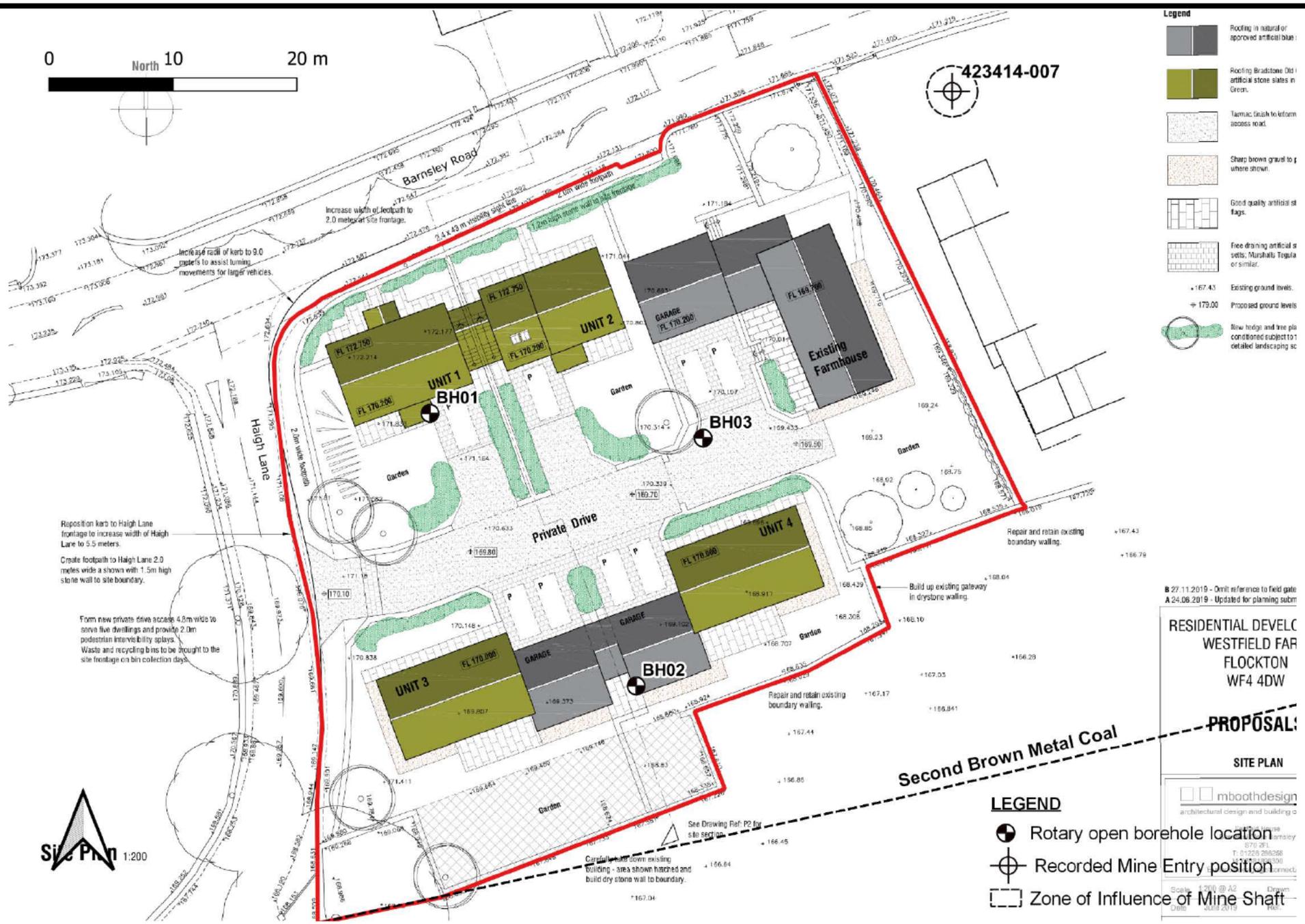
Project Details:
Westfield Farm, Flockton

Scale: Not to scale – reference only



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ground investigation | drilling & excavation | insitu testing
laboratory testing & gas monitoring | engineering consultancy
surveying & flood risk assessments | training, CPD & expert witness
... delivered using our own drilling rigs / crews / soils lab / engineers

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Appendix 3

Rotary Borehole Records and Illustrative Cross Section

Borehole Log

Borehole No. **BH01**

Sheet 1 of 2

Project Name:	Westfield Farm, Flockton	Project No. C1913/21/E/3053	Co-ords:	423377.00E - 414825.00N	Hole Type RO
Location:	Westfield Farm, Barnsley Road, Flockton, WF4 4DW		Level:	171.50m aOD	Scale 1:50
Client:	Paul Brown		Dates:	30/08/2021	Logged By DG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.10	171.40		CONCRETE.
					0.40	171.10		MADE GROUND (black clayey fill with brick fragments [driller's description]).
								Yellow clayey fine grained SANDSTONE [driller's description].
					1.80	169.70		fine grained SANDSTONE [driller's description].
					2.00	169.50		White fine grained SANDSTONE [driller's description].
					3.00	168.50		Grey MUDSTONE with SANDSTONE bands [driller's description].
					4.50	167.00		Light grey and white SANDSTONE [driller's description].
					6.00	165.50		Fractured yellow SANDSTONE [driller's description].
					6.60	164.90		White fine grained SANDSTONE [driller's description].
					7.00	164.50		Yellow SANDSTONE [driller's description].
					7.70	163.80		White fine grained SANDSTONE [driller's description].
					8.00	163.50		Yellowish brown fractured SANDSTONE [driller's description].
					9.00	162.50		Grey SILTSTONE [driller's description].
					10.00	161.50		Continued on Next Sheet

Remarks

1) Groundwater encountered at 15m depth. 2) Ground Levels are approximate. 3) Casing progressed to 9.0m depth.

Borehole Log

Borehole No. **BH01**

Sheet 2 of 2

Project Name:	Westfield Farm, Flockton	Project No. C1913/21/E/3053	Co-ords: 423377.00E - 414825.00N	Hole Type RO
Location:	Westfield Farm, Barnsley Road, Flockton, WF4 4DW		Level: 171.50m aOD	Scale 1:50
Client:	Paul Brown		Dates: 30/08/2021	Logged By DG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Grey MUDSTONE [driller's description].
					11.50	160.00		Dark grey MUDSTONE [driller's description].
					11.80	159.70		COAL [driller's description].
					12.50	159.00		Light grey MUDSTONE [driller's description].
					13.50	158.00		Grey SILTSTONE [driller's description].
	▼	15.00			15.00	156.50		Grey MUDSTONE [driller's description].
					16.50	155.00		End of Borehole at 16.50m

Remarks

1) Groundwater encountered at 15m depth. 2) Ground Levels are approximate. 3) Casing progressed to 9.0m depth.

Borehole Log

Borehole No. **BH02**

Sheet 1 of 3

Project Name:	Westfield Farm, Flockton	Project No. C1913/21/E/3053	Co-ords:	423394.00E - 414803.00N	Hole Type RO
Location:	Westfield Farm, Barnsley Road, Flockton, WF4 4DW		Level:	169.00m aOD	Scale 1:50
Client:	Paul Brown		Dates:	15/08/2021	Logged By DG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								MADE GROUND (Concrete).
					0.30	168.70		MADE GROUND (Black clayey fill [driller's description]).
					1.00	168.00		Yellow CLAY [driller's description].
					1.40	167.60		Heavily weathered SANDSTONE [driller's description].
					3.70	165.30		VOID.
					4.00	165.00		Assumed fractured SANDSTONE, flush lost no void evident, drilling resistance recorded [DRILLER'S DESCRIPTION].
					4.50	164.50		Fractured SANDSTONE [driller's description].
					7.50	161.50		Grey MUDSTONE [driller's description]. *.. flush loss at 7.5m, no marked void.*
					9.70	159.30		COAL.
								Continued on Next Sheet

Remarks

1) Groundwater encountered at 13.5m depth. 2) Poor flush returns and fractured rock encountered at certain depths. 3) Ground Levels are approximate. 4) Casing progressed to 20.0m depth.

Borehole Log

Borehole No. **BH02**

Sheet 2 of 3

Project Name:	Westfield Farm, Flockton	Project No. C1913/21/E/3053	Co-ords: 423394.00E - 414803.00N
Location:	Westfield Farm, Barnsley Road, Flockton, WF4 4DW		Level: 169.00m aOD
Client:	Paul Brown		Dates: 15/08/2021

Hole Type: RO

Scale: 1:50

Logged By: DG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					10.30	158.70		Grey MUDSTONE / SILTSTONE [driller's description].
	▼	13.50			13.50	155.50		Fractured light grey MUDSTONE/ SILTSTONE with bands of SANDSTONE, poor flush returns with drilling resistance noted [driller's description]. *.. flush lost at 13.5m and returned at 15m.*
					18.00	151.00		Drak grey MUDSTONE [driller's description].
					19.00	150.00		Light grey SILTSONE [driller's description].

Continued on Next Sheet

Remarks

1) Groundwater encountered at 13.5m depth. 2) Poor flush returns and fractured rock encountered at certain depths. 3) Ground Levels are approximate. 4) Casing progressed to 20.0m depth.

Borehole Log

Borehole No. **BH02**

Sheet 3 of 3

Project Name:	Westfield Farm, Flockton	Project No. C1913/21/E/3053	Co-ords: 423394.00E - 414803.00N
Location:	Westfield Farm, Barnsley Road, Flockton, WF4 4DW		Level: 169.00m aOD
Client:	Paul Brown		Dates: 15/08/2021

Hole Type: RO

Scale: 1:50

Logged By: DG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					21.70	147.30		Fractured grey SILTSTONE/MUDSTONE with bands of SANDSTONE, poor flush returns [driller's description]. *.. flush lost at 21.7m, no marked void. Drilling resistance noted.*
					30.00	139.00		End of Borehole at 30.00m

21 22 23 24 25 26 27 28 29 30

Remarks

1) Groundwater encountered at 13.5m depth. 2) Poor flush returns and fractured rock encountered at certain depths. 3) Ground Levels are approximate. 4) Casing progressed to 20.0m depth.

Borehole Log

Borehole No. **BH03**
Sheet 1 of 3

Project Name:	Westfield Farm, Flockton	Project No. C1913/21/E/3053	Co-ords: 423399.00E - 414823.00N	Hole Type RO
Location:	Westfield Farm, Barnsley Road, Flockton, WF4 4DW		Level: 170.10m aOD	Scale 1:50
Client:	Paul Brown		Dates: 14/08/2021	Logged By DG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								MADE GROUND (hardstanding of fine chippings) [driller's description].
					0.50	169.60		Yellow CLAY [driller's description].
					2.50	167.60		White SANDSTONE [driller's description].
					3.10	167.00		Yellowish brown SANDSTONE [driller's description].
					3.30	166.80		White SANDSTONE [driller's description].
					4.20	165.90		VOID.
					4.60	165.50		Fractured yellow/orange SANDSTONE. Poss ble roof collapse / goaf material, rods dropping 40mm to 50mm every 50mm [driller's description].
					5.60	164.50		Fractured yellow/orange SANDSTONE [driller's description].
					9.50	160.60		Light grey MUDSTONE [driller's description].
								Continued on Next Sheet

Remarks

1) Groundwater encountered at 14.0m depth. 2) Poor flush returns and fractured rock encountered at certain depths. 3) Ground Levels are approximate. 4) Casing progressed to 19.4m depth. 5) Borehole terminated at 24.5m as sufficient data had been obtained.

Borehole Log

Borehole No. **BH03**

Sheet 2 of 3

Project Name:	Westfield Farm, Flockton	Project No. C1913/21/E/3053	Co-ords: 423399.00E - 414823.00N	Hole Type RO
Location:	Westfield Farm, Barnsley Road, Flockton, WF4 4DW		Level: 170.10m aOD	Scale 1:50
Client:	Paul Brown		Dates: 14/08/2021	Logged By DG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					11.70	158.40		COAL.
					12.00	158.10		Grey MUDSTONE/SILTSTONE [driller's description].
	▼	14.00			14.00	156.10		VOID (anticipated to be a fracture or joint).
					14.20	155.90		Assumed fractured SANDSTONE, flush lost no void evident and drilling resistance noted [DRILLER'S DESCRIPTION].
					15.00	155.10		Fractured SANDSTONE, poor flush returns [driller's description].
					18.00	152.10		Assumed fractured SANDSTONE, no flush returns, no voids evident and drilling resistance noted [driller's description].
					19.00	151.10		Fractured SANDSTONE/SILTSTONE [driller's description].

Continued on Next Sheet

Remarks

1) Groundwater encountered at 14.0m depth. 2) Poor flush returns and fractured rock encountered at certain depths. 3) Ground Levels are approximate. 4) Casing progressed to 19.4m depth. 5) Borehole terminated at 24.5m as sufficient data had been obtained.

Borehole Log

Borehole No. **BH03**

Sheet 3 of 3

Project Name:	Westfield Farm, Flockton	Project No. C1913/21/E/3053	Co-ords: 423399.00E - 414823.00N
Location:	Westfield Farm, Barnsley Road, Flockton, WF4 4DW		Level: 170.10m aOD
Client:	Paul Brown		Dates: 14/08/2021

Hole Type: RO

Scale: 1:50

Logged By: DG

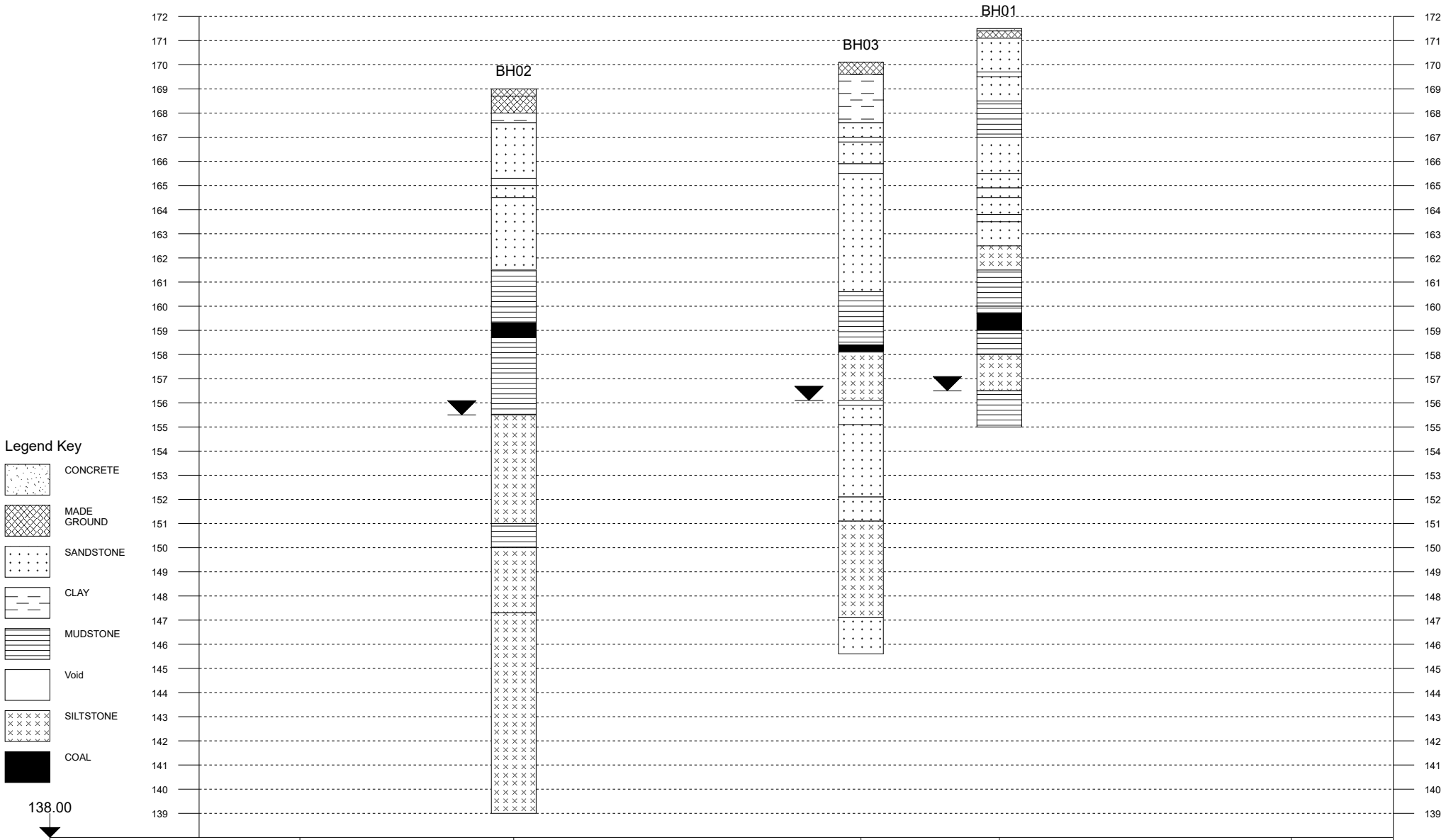
Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					23.00	147.10		Assumed fractured SANDSTONE, no flush returns but resistance on rods, no voids evident [driller's description].
					24.50	145.60		End of Borehole at 24.50m

21 22 23 24 25 26 27 28 29 30

Remarks

1) Groundwater encountered at 14.0m depth. 2) Poor flush returns and fractured rock encountered at certain depths. 3) Ground Levels are approximate. 4) Casing progressed to 19.4m depth. 5) Borehole terminated at 24.5m as sufficient data had been obtained.

Project Id: C1913/21/E/3053	Title: Section line 2
Project Title: Westfield Farm, Flockton	Vertical Scale: 1:222
Location: Westfield Farm, Barnsley Road, Flockton, WF4 4DW	Horizontal Scale: 1:281
Client: Paul Brown	Engineer: CRC



Chainage (m)	0.00	11.21	29.41	36.67	51.97
Elevation (mAOD)		169.00	170.10	171.50	

Appendix 4

Coal Authority Shaft Plan and Data Sheets

The Coal Authority

Issued by:
The Coal Authority, Property Search Services, 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire, NG18 4RG
Website: www.groundstability.com Phone: 0345 762 6848

ROGERS GEOTECHNICAL SERVICES LTD
BARNCLIFFE MILLS
NEAR BANK
SHELLEY
HUDDERSFIELD
KIRKLEES
HD8 8LU

Our reference:	**51002565984001**
Your reference:	**C/1913/21/E/3053**
Date of your enquiry:	**03 August 2021**
Date we received your enquiry:	**03 August 2021**
Date of issue:	**04 August 2021**

This report is for the property described in the address below and the attached plan.

Shaft Plan and Data Sheets

WESTFIELD FARM, BARNSLEY ROAD, FLOCKTON, WAKEFIELD, KIRKLEES, WF4 4DW

I refer to the enquiry dated 03 August 2021, received 03 August 2021, in connection with the above.

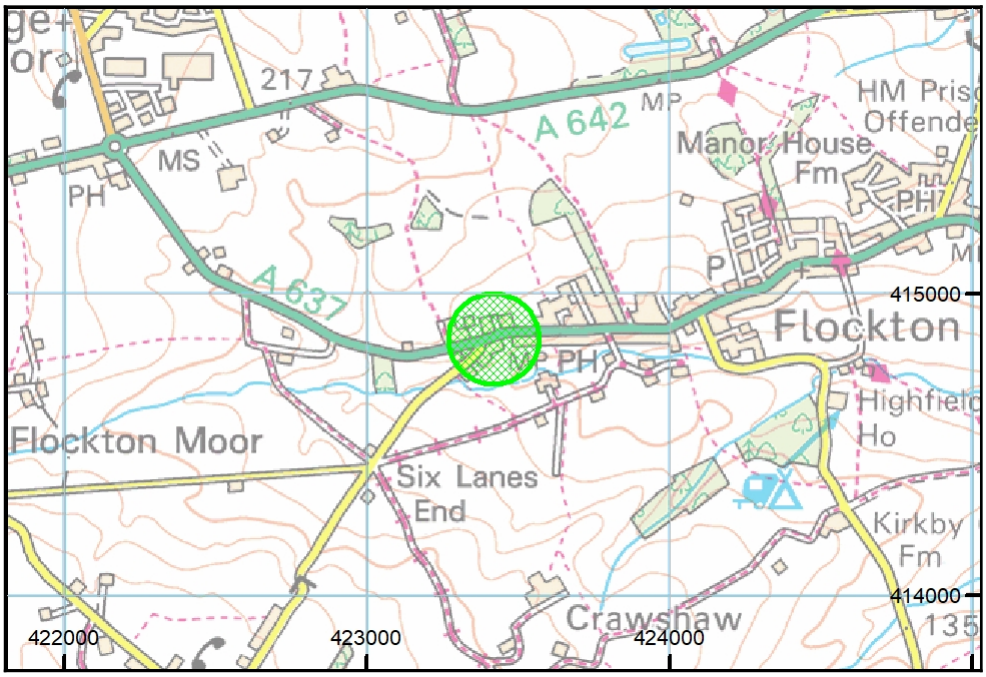
As requested I enclose the mine entry data sheet(s) held for the mine entry/entries referred to.

Mine Entry Data

Shaft/adit:	Shaft
Reference:	423414-007
Source:	Ab plans 9776, FGB202, Located
Colliery name:	Unknown
Entry name:	Unknown
Date abandoned:	Unknown
Depth of superficial deposits (m):	0.4
Depth of shaft (m):	Unknown
Diameter of shaft (m):	1.2
Probable adit azimuth:	Not Applicable
Treatment details:	has been filled to an unknown specification. It was found and subsequently excavated and capped (3m x 3m x 0.3m thick reinforced concrete) at 1.2m bgl. An inspection chamber and manhole cover was also installed. This work was undertaken by the Coal Authority in July 2010
Conveyance:	Not Applicable
Easting:	423419
Northing:	414851
Other information:	None

Location map

Approximate position of enquiry



This plan shows the approximate location of the disused mine entry / entries referred to in the attached mining report. For reasons of clarity, mine entry symbols may not be drawn to the same scale as the plan.

Property owners have the benefit of statutory protection (under the Coal Mining Subsidence Act 1991). This contains provision for the making good, to the reasonable satisfaction of the owner, of physical damage from disused coal mine workings including disused coal mine entries. A leaflet setting out the rights and obligations of either the Coal Authority or other responsible persons under the 1991 Act can be obtained by visiting www.groundstability.com.

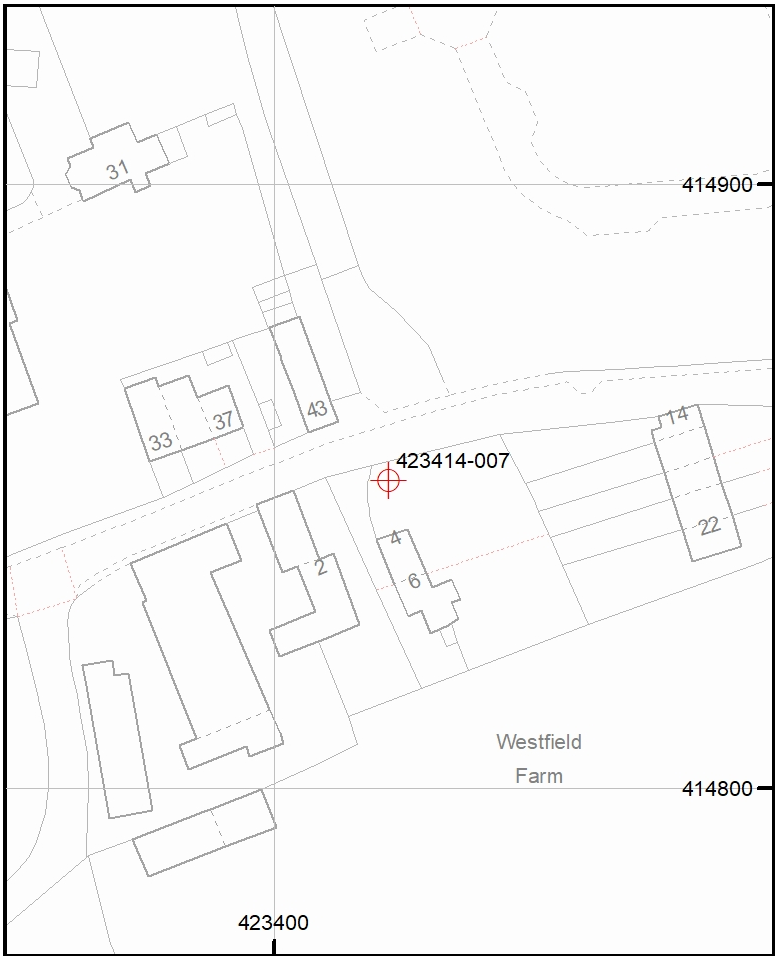
If you wish to discuss the relevance of any of the information contained in this report, you should seek the advice of a qualified mining engineer or surveyor. If you or your advisor wish to examine the source plans from which the information has been taken, these are available to view, free of charge, at our Head Office in Mansfield. To book an appointment please ring 01623 637225. Should you or your advisor wish to carry out a physical investigation that may enter, disturb or interfere with any disused mine entry, prior permission of the owner must be sought. For coal mine entries, the owner will normally be the Coal Authority.

The Coal Authority, regardless of responsibility and in conjunction with other public bodies, provide an emergency call out facility in coalfield areas to assess the public safety implications of mining features (including disused mine entries).

Our emergency telephone number is 01623 646333.

Key

Disused Adit or Mineshaft



Mapping sourced from Ordnance Survey