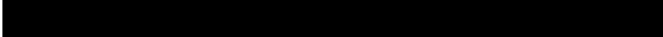


Our Ref 

22/03/2022

Chris Allen
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Heage
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Dear Chris,

Trinity Academy Sports Pitches – Coal Mining Assessment

Further to the completion of the intrusive investigation on the proposed Trinity Academy Sports Pitches we have pleasure in submitting our specific report in relation to the Coal Mining legacy on the site as follows.

1. Background

- § 1.1 The proposed site for the sports pitches is part of a wider development site, referred to as the *Trinity Academy, Barnsley*, which is proposed for development as an educational facility with associated car parking, MUGA, landscaping and sports pitches. The site under consideration (hereafter referred to as the site) within this report, forms the sports pitches for the wider development site (see Figure 1).



Figure 1 – Wider development site Boundary shown in red and “the site” boundary shown in blue.

- § 1.2 The site can be approximately located on National Grid Reference SE 33355 05502 and is located within the south-west of the wider development site.
- § 1.3 The site is a grassed area with trees present on the north-east, south-east and south-west boundaries; the north-west boundary is formed by Keresforth Close. Buildings are present to the north-west, north-east, and south-east with a dual carriageway present to the south-west.

- § 1.4 Curtins have undertaken a ground investigation across the wider development area, which included several deeper exploratory holes undertaken on the site. The ground investigation works in the wider development site comprised shallow window sampler holes to enable the monitoring of potential ground gas risk to proposed buildings. The ground investigation is reported in Trinity Academy, Barnsley Phase 2 Ground Investigation document reference 079532-CUR-XX-XX-T-GE-00002-P01 dated 01 March 2022 (Ref.1).
- § 1.5 The site is known to be in a Coal Mining High Risk Development Area as shown on Figure 2 which has been extracted from the Coal Authority Interactive Map.



Figure 2 – Site Boundary shown in red and as High Risk Development Area
Source: <https://mapapps2.bgs.ac.uk/coalauthority/home.html>, accessed on 20/01/2022

- § 1.6 A Coal mining Risk Assessment has been undertaken by Waterman in October 2020, document reference WIE17125-100-R-7.1.3-CMRA, October 2022 (Ref.2)).

2. Aim and Objective

- § 2.1 The aim of this report is to assess the potential impact of the shallow coal workings accounting for a proposed use of the site as sports pitches with no structures, buildings or otherwise, being proposed on the site.
- § 2.2 This report will provide advice on remedial works required to mitigate the significant risks regarding shallow worked coal seams and a proven shaft. This report does not, otherwise cover the suitability of the ground conditions for construction of the sports ground.

3. Coal Mining Risk Assessment Summary

- § 3.1 A Coal Mining Risk Assessment (CMRA) has been completed by Waterman, document reference WIE17125-100-R-7.1.3-CMRA (Ref.2)). A Coal Authority Report is appended to the CMRA, Coal Authority reference 51002307645001. In relation to this assessment pertinent information contained within the CMRA is discussed below. For more detailed information, reference should be made to the CMRA (Ref.2).
- § 3.2 The site is underlain by bedrock of the Pennine Middle Coal Measures Formation. Generally, the unit's lithology is described as Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams.
- § 3.3 The site is in an area where the Barnsley Coal is expected to sub-outcrop on the site with the overlying Barnsley Rider Coal at around 40m above not expected to outcrop and the underlying Dunsill Coal being too deep to present a risk of disturbance at the ground surface.
- § 3.4 The Barnsley Coal seam is recorded as being around 2.29m to 3.1m thick. The record for Hound Hill No.2 Colliery further describes the seam as,

Day Bed – 305mm
Middle Bed – 380mm
Low Bed – 381mm
Dirt over Clay – 355mm
Hards – 685mm
Bottom Softs – 560mm
Total thickness = 2.67m

- § 3.5 The Coal Authority Report indicates that the Barnsley Coal has been worked between 10m and 21m below the site dipping to the east. The thickness is approximately 2.74m and it has been last worked in 1925.
- § 3.6 Abandonment plans obtained from the Coal Authority report indicates that workings of the Barnsley Coal underlie the site as shown on Figure 3.

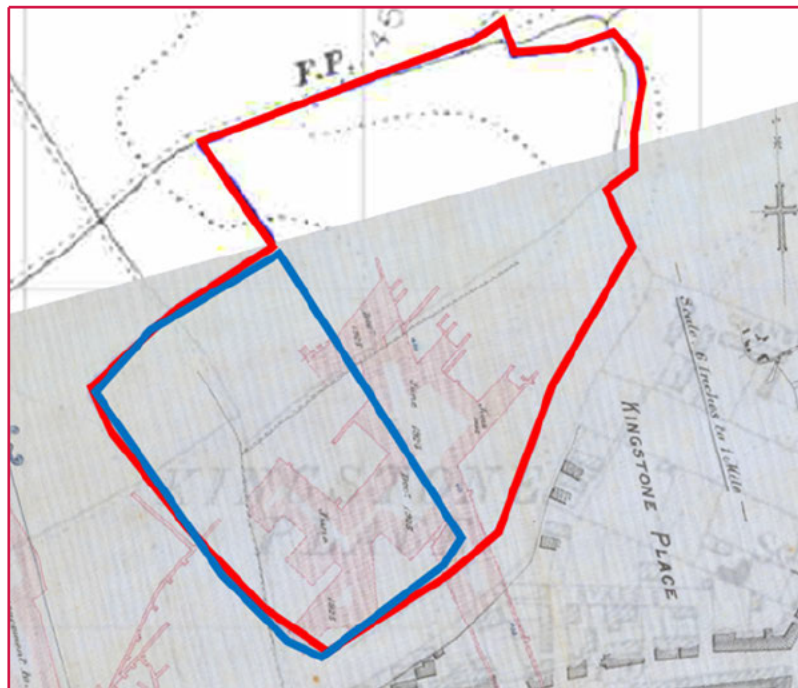


Figure 3 – Abandonment plans approximately overlayed on the site boundary (blue) and wider site boundary (red)

- § 3.7 Records also suggest that an unnamed colliery located on the Sports Pitches site mined the Barnsley Coal. This record also stated that the seam had a dip of 5° to 7.4° to the east; this is possibly the Keresforth Hill Pit.
- § 3.8 A geological fault is present within the site boundary along the northern boundary of the sports pitches striking in a south-west to north-east direction with a downthrow to the south-east.
- § 3.9 The Coal Authority record shaft no. 433405-010 on the site as shown on Figure 4 below. There are no records of its depth, diameter and whether it has been treated.

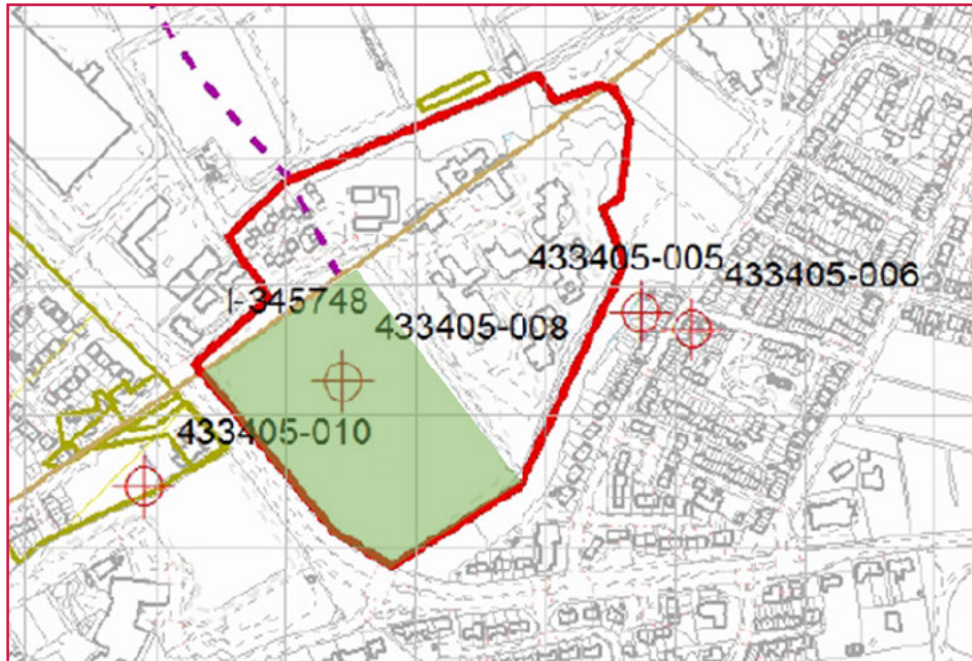


Figure 4 – Mine Shaft Record Plan (Site shaded green)

- § 3.10 Remedial works have been undertaken on the site by the Coal Authority further to the compilation of a Surface Hazard Incident Report. An area of collapse of 182 cm diameter (assumed although unitless in the Coal Authority report) was located to the north of the site as shown by reference 1-345748 on Figure 5 below.
- § 3.11 The Surface Hazard Incident Report has been obtained and it provides information about the work undertaken. The area of collapse has been treated by opening out the collapse to 2.2m by 1.5m and excavating to a depth of 4.5m below the surface to the base of the workings. A total of three potential roadways could be seen to run off from the base of the excavation in a north-east, south-east, and south-westerly direction.
- § 3.12 Remedial works comprised the placing of 12 Tonnes of clean 75mm to 150mm sized limestone compacted in layers not exceeding 300mm to within 1.5m of the surface. A layer of geo-textile has been placed across the fill and around the exposed sides. The as-dug sandy clay spoil has been then placed and compacted in layers not exceeding 150mm thickness to the underside of the existing turf. Finally, the existing topsoil was used to reinstate the surface to the pre-existing field profile.

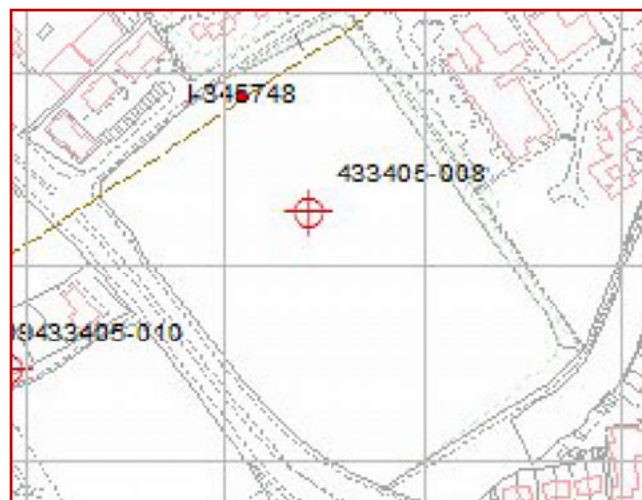


Figure 5 – Location of Feature 1-345748 requiring Remedial Action

4. Ground Conditions

- § 4.1 The relevant exploratory holes, undertaken during the 2021 Curtins ground investigations and as reported in Ref.1 are rotary cored boreholes RC01 to RC06 and trial pit TP01.
- § 4.2 The ground conditions revealed typically comprise topsoil overlying possible reworked natural soils and superficial deposits of variable thickness and composition. The reworked natural soils and superficial deposits are described as soft to firm cohesive soils and sands and gravel. The superficial deposits overlie solid geology of the Pennine Middle Coal Measures, which comprise interbedded sandstone, siltstone, and mudstone with a layer of coal and seat earth. Full detail and description of the geology is presented within the ground investigation report (Ref.1).
- § 4.3 The presence of coal, assumed zone of core loss and loss of flush (open hole), as a marker of possible workings that could present a risk of disturbance at the ground surface, are summarised in Table 1.

Table 1 – Summary of Coal Layers Encountered

Exploratory Hole	Top Depth (m bgl)	Bottom Depth (m bgl)	Thickness (m)	Notes
RC01	10.05	12.40	2.35	Assumed Zone of Core Loss (AZCL) between 10.5 to 11.5m.
	12.50	12.80	0.30	Likely extremely weak coal
RC02	10.80	12.50	1.70	Extremely weak, loose fragmented coal. AZCL
	13.90	14.05	0.15	Extremely weak, fragmented sub-bituminous COAL.
	14.05	14.35	0.30	Soft to firm light grey CLAY grading into sub-bituminous coal
	14.35	14.85	0.50	Extremely weak, fragmented sub-bituminous to bituminous COAL.
RC03	15.30	15.60	0.30	Extremely weak, very weathered sub-bituminous COAL retrieved as gravel.
RC04	16.80	18.00	1.20	Drillers Description: COAL
RC05	17.00	18.20	1.20	Drillers Description: COAL
RC06	15.50	17.00	1.50	Drillers Description: COAL due to no core retrieval
	17.00	17.85	0.85	Very stiff to stiff, light grey gravelly CLAY. Gravel comprised of angular to sub-angular grey mudstones with some rare coal towards the base.
	17.85	18.05	0.20	Extremely weak and fragmented black sub-bituminous COAL.

- § 4.4 Due to the methods of drilling utilised during the ground investigation and specifically the use of water flush, any groundwater strikes will have been masked. Consequently, groundwater levels during these works were not recorded.
- § 4.5 A summary of the groundwater levels recorded during the ground investigation works and subsequent monitoring visits, is presented in Table 2. It should be noted that the groundwater monitoring was completed

during November 2021 and January 2022. Post investigation monitoring to date has recorded the water level in shallow installations varying between dry and 4.85m below ground level (bgl) whilst in the deep installations the water level varied between dry and 7.65m bgl. However, the groundwater levels recorded are not likely to be representative of the natural background level of the geology. It is likely the water has infiltrated through the surface and is unable to drain through the cohesive soils.

Table 2 – Groundwater Levels

Exploratory Hole	Water Strikes During Ground Investigation		Post Investigation Monitored Water Levels	
	Strike Depth (m bgl)	Strata	Monitored Levels (m bgl)	Installation Strata
WS04	-	-	1.10 – 1.70	CLAY /SANDSTONE
WS05	-	-	Dry	CLAY/SANDSTONE
RC04S	-	-	Dry – 4.80	CLAY/SANDSTONE
RC04D	-	-	5.00 – 7.65	SANDSTONE/MUDSTONE
RC06S	-	-	4.50 – 4.85	CLAY/SANDSTONE
RC06D	-	-	Dry	SILTSTONE/MUDSTONE/CLAY

- No groundwater strikes recorded.

- § 4.6 Figure 5 shows the location of the rotary cored boreholes and shaft location trial pit. It should be noted that the playing fields were raised around 1966, the depth of fill being unknown. This may complicate the accurate determination of depth to workings and confirmation of dip.
- § 4.7 However, with interrogation of the boreholes logs as summarised within Table 1, solid strata are determined to generally dip to the east.

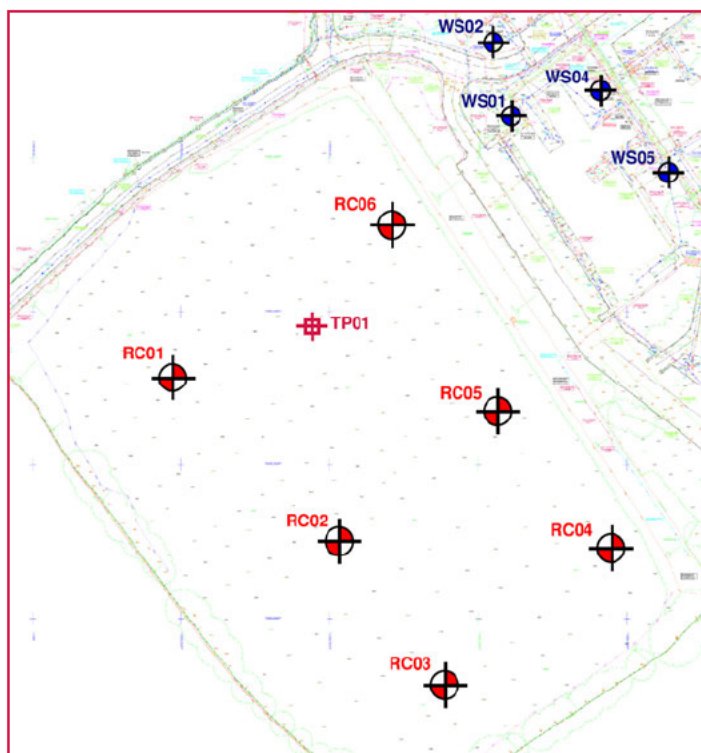


Figure 5 – Exploratory Hole Location Plan

- § 4.8 Coal, thought to be the Barnsley Coal seam was observed in exploratory holes RC01, RC02, RC03, RC04, RC05 and RC06; this is summarised in Table 3.

Table 3 – Summary of Barnsley Coal Levels

Exploratory Hole	Depth to top of Coal (m)	Approximate Level (m AOD)	Thickness (m)	Comment
RC01	10.05	139.58	2.35	Likely disturbed Barnsley Coal
RC02	10.80	137.82	4.05*	Likely disturbed Barnsley Coal
RC03	15.30	132.96	1.7*	Possibly disturbed Barnsley Coal
RC04	16.80	128.87	1.2	Possibly disturbed Barnsley Coal
RC05	17.00	129.32	1.2	Possibly disturbed Barnsley Coal
RC06	15.50	131.63	2.55*	Likely disturbed Barnsley Coal

* - May indicate a disturbed zone and not the original seam thickness

- § 4.9 The ground investigation does not conclusively prove workings in the Barnsley Coal due to variation in seam thickness and disposition, but it is considered likely in 50% of the exploratory holes and possible in the remainder. This suggests that unrecorded workings extended further north and west.
- § 4.10 Shaft record, Coal Authority no. 433405-010 was located by trial pit TP01 as shown in Figure 6 below.



Figure 6 – Encountered Mine Shaft

5. Assessment and Conclusions

- § 5.1 The coal seam encountered within the exploratory holes is considered to be the Barnsley Coal and it is possible to likely that this has been worked under most of the site at shallow depth; approximately 10m to 17m below existing ground level.

- § 5.2 The proposed development works comprise the construction of sports pitches across the site; there are no structures proposed, buildings or otherwise. In addition, it is understood that the levels across the site are to remain the same. An increase in load due to foundation loading and or increased depth of soils is not anticipated and therefore the total stress conditions across the site will not change. Therefore, an increased risk of collapse of the worked seam induced through this factor will not be mobilised.
- § 5.3 However failure of the seam crown or collapse due to degradation/deterioration of the seam and or surrounding strata cannot be discounted. Based on the thickness of the worked seam and the depth at which it is located, it is considered very unlikely that any failure would cause a catastrophic impact at the ground surface and would be manifested by a relatively local depression at the ground surface.
- § 5.4 With regard to any treatment of the Barnsley Coal and given its depth and the proposed use as sports pitches it is considered that employing grouting treatment for the site for this feature is overly onerous and against a sustainable approach.
- § 5.5 The final sports pitch surface construction should incorporate one or two layers of geogrid, to be designed by an specialist. This will provide some mitigation in minimising any settlement at the ground surface mobilised by any collapse of the Barnsley Coal workings. It is also recommended that a periodic inspection of the pitches in undertaken by a suitably qualified person.
- § 5.6 The previously mentioned Surface Hazard Incident Report identified the presence of shallow tunnels at around 4.5m below ground level on the northern boundary. Further investigation has shown that the remedial works undertaken has not completely addressed these voids and further investigation and remedial action will be required due to the proximity of the tunnels to the ground surface.
- § 5.7 The shaft recorded by the Coal Authority reference no. 433405-010 has been located on site. Failure of shaft infill and or collapse of the shaft (both recorded and unrecorded) could result in a catastrophic impact.
- § 5.8 It is recommended that initially the site is subjected to a geophysical survey to a) determine the extent of any tunnel network on the northern boundary and b) assess the site for possible unrecorded shafts.
- § 5.9 Should non-intrusive works prove to be inconclusive, intrusive works should be undertaken.
- § 5.10 All shafts are to be treated appropriately; CIRIA document C758D Abandoned mine workings manual (Ref.3) is recommended for reference and guidance.

Yours faithfully,



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For and on behalf of
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References

- 1) Curtins (2022) *Phase 2 Ground Investigation – Stage 1*. Document reference: 079532-CUR-XX-XX-T-GE-00002-P01.
- 2) Watermans (2020) *Coal Mining Risk Assessment (CMRA)*. Document reference: WIE17125-100-R-7.1.3-CMRA
- 3) CIRIA (2019) C758D – *Abandoned Mine Workings Manual*