# Technical Note

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# Shipley Lakeside Plot A: Shallow Coal Mining Risk Assessment Review

## Introduction

The Shipley Lakeside site is located between the town of Heanor in the north-west and Cotmanhay and Ilkeston in the south-east in Derbyshire. The site has a legacy of opencast coal mining dated to the 1970s and is subject to a proposed mix use redevelopment including housing, business use, garden centre pub and hotel/conference facility, retirement village, health and care campus and a training/leisure/education facility.

A planning application (AVA/2023/0562) was submitted for the erection of a 66-bed care home with associated car parking, landscaping and other relevant works within Plot A at the Shipley Lakeside site. During the consultation review period, The Coal Authority submitted a response to the planning application requesting further information on the potential risks associated with shallow unrecorded coal mine workings beyond the extent of the opencast highwall. AECOM was instructed by LNT Construction Limited to undertake a review of existing information to determine the risks associated with potential shallow coal workings beyond the extent of the opencast highwall within Plot A.

This Technical Note provides a review of existing information and summarises the potential risk of shallow coal workings beyond the opencast highwall within Plot A.

## Review of Existing Information

The following sources of information and documents were reviewed for this Technical Note:

- URS (2012) Shipley Lakeside Development Phase I Assessment Report;
- AECOM (2017) Shipley Lakeside Development Phase II Geo-Environmental Assessment Report;
- AECOM (2019) Technical Note on the Delineation of Supplementary Foundation Design Zone over Opencast Highwall at Shipley Lakeside;
- AECOM (2019) Opencast Highwall Ground Investigation Report;
- BGS Solid and Drift Map for Derby (Sheet 125) 1:50,000; and
- BGS Solid and Drift Map Sheet SK44SW (1:10,560).

## Previous Reports

### URS (2012) Shipley Lakeside Development Phase I Assessment Report

Key points with regards to shallow coal mining risks from the URS (2012) Shipley Lakeside Development Phase I Assessment Report are summarised below:

- A Phase I Assessment was undertaken for the whole Shipley Lakeside site for a proposed mixed development including housing, business use, garden centre pub and hotel/conference facility, retirement village, health and care campus and a training/leisure/education facility at the Shipley Lakeside site.

- The review of geological mapping indicated the presence of the following coal seam outcrops: Dunsil, Top Hard Coombe and Mainsmut.
- A Coal Mining Risk Assessment (CMRA) was undertaken as part of the Phase I Assessment which identified the following:
  - Opencast mining of shallow coal seams was undertaken within the wider Shipley Country Park site during the 1970's to depths between 30m bgl and 35m bgl to extract the Dunsil, Lower Coombe, Top Hard and Mainsmut coal seams.
  - Within the Shipley Lake opencast site, the following coal seams were mined: Seam above Top Hard (S.A.T.H.), Top and Lower Coombe and Top Hard.
  - Within the Shipley Lake and Slack Lane opencast site, the following coal seams were mined: Seam above Top Hard and Top Coombe, Lower Coombe, Top Hard and Dunsil.
  - Within the Shipley South and Northwest Extension opencast site, the following coal seams were mined: First Waterloo Upper, First Waterloo Lower, Waterloo Marker, Second Waterloo Upper, Second Waterloo Lower and Third Waterloo.
  - Twelve mine shafts were identified within the site or within 20m of the site, of which eight are located in the development site boundary. Of the eight within the site boundary, four do not have treatment details or were filled to an unknown specification. No recorded mine shafts are located within Plot A. The nearest recorded mine shaft to Plot A is located approximately 40m east. The CMRA suggested there was a low risk associated with unidentified mine entries as the whole site has undergone opencast coal mining. However, it was noted that there is potential for a highwall in the northern extent of the site.
  - The site is within the likely zone of influence of mine workings in ten coal seams at a shallow depth to 470m depth, including the Dunsil, Coombe (Upper and Lower), Top Hard and Mainsmut seams near the surface.
  - The site is within the likely zone of influence of known or recorded underground workings at depths of 30m bgl or less.
  - The CMRA noted that there is a very low likelihood of coal seams at depths shallower than 30m bgl due to the extent of opencast coal mining in the 1970s. It is noted that the shallowest coal seam at the Shipley Colliery was the Upper Coombe coal seam present at 21m below ground level (bgl). The Lower Coombe, Top Hard and Dunsil Seams were recorded between 21m bgl and 48.2m bgl. At the Shipley Colliery mine shaft located to the north of the site, the Mainsmut, Top Hard and Dunsil coal seams were recorded between 32m bgl and 63.7m bgl. It is noted that there is a need to clarify if there is adequate depth of competent rock between the base of the infilled opencast mine area and the underlying worked coal seams.
  - There is a possibility that a strip of land exists on the northern boundary of the site which was not opencast mined for coal. It is suggested that this strip of land may also contain a highwall associated with the opencast mining.
  - It is noted that a ground stability assessment will be undertaken if subsequent intrusive investigations identify shallow workings beneath the base of the opencast mine backfill, which may require mitigation measures such as consolidation drilling and grouting. It is also recommended that the mine shafts within the site boundary which have not been capped should be investigated.
  - A ground investigation was recommended to assess the full extent of opencast coal mining and to record the thickness of the shallowest coal seam beneath the opencast. The CMRA also noted that there is a possibility of encountering a highwall which would be subject to further investigation. Furthermore, it is noted that there may be shallow coal seams within the strip of land potentially containing the high wall which have not been mined by opencast methods.
- The report concluded there is a possibility of worked coal seams close to the base of the former opencast excavation, and noted the potential for an opencast highwall close to the northern site boundary. It noted that underground coal mining is considered a risk which requires investigation.

## AECOM (2017) Shipley Lakeside Development Phase II Geo-Environmental Assessment Report

Key points with regards to shallow coal mining risks are summarised below:

- A ground investigation was undertaken across the entire Shipley Lakeside site between 16th May and 14th June 2016. The Pennine Middle Coal Measures bedrock were encountered between 1.2m bgl and 53m bgl, with coal bands encountered between 21.7m bgl and 52.9m bgl. Coal seams were not encountered in the exploratory holes advanced within Plot A.
- The Shipley Lake Opencast Report was reviewed within the Phase II Report which identified mine workings in the Top Coombe seam in the south-eastern area of the Shipley Lakeside site, and both the Top Coombe and Top Hard seams in the north-western area. Information in the Opencast Report indicates the mine workings within the Top Coombe seam are located to the east of Plot A, although the report alludes to old workings in the lower extent of the Top Hard seam within area 'A' which includes Plot A.
- It was noted that the dragline of the opencast operations extended to the Top Hard seam (approximately 35m bgl) in most areas of the site indicating most shallow workings were exposed during the opencast operations. Therefore, it was concluded that there is a low risk from shallow workings within the footprint of the opencast operations. However, the report noted that there was a residual risk associated with shallow workings in areas of the proposed development outside of the opencast footprint.
- During the GI, coal seams were encountered outside of the opencast footprint at approximately 22m below the existing ground level. Across the entire site, coal seams were encountered in four locations in the wider Shipley Lakeside site towards the north-west and south-east extents. However, the coal seams were not encountered within Plot A. The shallowest coal seam in the north-west area of the site was encountered at 22.11m bgl in CP16081A (approximately 30m north-west from Plot A) and was interpreted to be the Top Coombe coal seam. A void (0.77m in thickness) was also encountered at 0.84m above the seam, which was suggested to be associated with the worked Mainsmut seam. Four coal seams were encountered between 36.5m bgl and 52m bgl in CP16080 approximately 230m north-west from Plot A with '*possible workings / void'* between 50m bgl and 52m bgl. Exploratory hole CP16080 is located outside of the opencast highwall boundary.
- Nine rotary boreholes recorded voids and zones of core losses which could be associated with the presence of shallow coal workings or potentially weak rock disturbed by the drilling operations. It should be noted that rotary coring was not undertaken within the exploratory holes in Plot A.
- It was recommended that a confirmatory ground investigation should be undertaken to prove the extent of the opencast highwalls.

## AECOM (2019) Technical Note on the Delineation of Supplementary Foundation Design Zone over Opencast Highwall at Shipley Lakeside

Key points with regards to shallow coal mining risks are summarised below:

- A technical note was produced by AECOM to determine the potential areas affected by differential settlement due to the presence of the highwall using historical formation from the previous ground investigation and the Coal Authority abandonment plans.
- The report noted that the Coal Authority abandonment plans indicate opencast mining of three coal seams (Top Coombe, Top Coombe and Top Hard) within the Shipley Lakeside boundary which may have resulted in highwalls within the site.
- The review of historical data and Coal Authority abandonment plans indicated that the highwalls do not extend to the surface.
- The report concluded that supplementary ground investigation was required to delineate the buried highwall for the purposes of foundation design.

## AECOM (2019) Opencast Highwall Ground Investigation Report

Key points with regards to shallow coal mining risks are summarised below:

- A ground investigation was undertaken at the Shipley Lakeside site between 18th February and 19th March 2019 to confirm and delineate the buried opencast highwall. The investigation comprised fifty-six

rotary boreholes along seven probe lines in the southern area and nine probe lines in the northern area of the site (including the Plot A area) along the extent of the worked seams shown on the Coal Authority Abandonment Plan.

- Rockhead level data from the ground investigation, the 2016 ground investigation and the Coal Authority mine abandonment plans were used to generate 3D mapping of the buried opencast highwall. The report suggested that the worked seam extents denoted on the Coal Authority mine abandonment plans were likely surveyed from the toe of the highwall.
- Across the entire site, the depth of burial of the highwall was recorded between 3m bgl and 26m bgl and the height of the highwall ranges from 6.5m to 28m. Within Plot A, the depth of burial of the highwall, and the height of the highwall were recorded as 3m to 18m bgl and 10.5m to 28m respectively.
- The location of the exploratory holes advanced to the delineated position of the opencast highwall is presented as Drawing SPLA-AEC-XX-DR-GE-0251.

## Risk of Unrecorded Shallow Coal Mining Beyond the Highwall

To determine the potential risk of worked shallow coal seams beyond the extent of the highwall, the 2017 and 2019 ground investigation data within Plot A and the Coal Authority abandonment plans (Drawing SHLK-AEC-XX-XX-DR-GE-0013) contained within the AECOM (2017) Phase II Report were reviewed. A summary of the exploratory holes and encountered coal seams is presented in Table 1. The location of the exploratory holes reviewed with regard to the delineated position of the opencast highwall is presented as Drawing SPLA-AEC-XX-DR-GE-0251.

## Table 1. Summary of Exploratory Holes and Encountered Coal Seams within Plot A

| GI | Exploratory Hole | Distance (m) and Direction from Plot A | Grid Reference | Position Relative to the Top of the Highwall | Completion Depth (m bgl) | Encountered Coal Seams | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Depth From (m bgl) | Depth to (m bgl) | Thickness (m) | Interpreted Coal Seam |
| 2017 GI | TP-16005 | Onsite | 444532.8 344479.4 | Within highwall | 4.5 | | Not encountered | | - |
| | TP-16006 | Onsite | 444634.5 344474.3 | Within highwall | 4.5 | | Not encountered | | - |
| | TP-16008 | Onsite | 444662.9 344427.3 | Within highwall | 4.5 | | Not encountered | | - |
| | TP-16013 | Onsite | 444700.3 344366.2 | Within highwall | 4.5 | | Not encountered | | - |
| | CP-16054 | Onsite | 444675.8 344382.7 | Within highwall | 9.95 | | Not encountered | | - |
| | CP-16069 | 25 N | 444722.6 344429.2 | Outside highwall | 10.24 | | Not encountered* | | - |
| | CP-16076A | Onsite | 444683.6 344463.5 | Potentially outside / on the boundary | 10.12 | | Not encountered | | - |
| | CP-16076 | Onsite | 444690.4 344461.1 | Outside highwall | 2.41 | | Not encountered | | - |
| | CPR-16081A | 30 NW | 444496.3 344532.3 | Within highwall (near to the boundary) | 25 | 22.11 | 22.5 | 0.39 | Top Coombe |
| | CPR-16080 | 230 NW | 444348.0 344663.7 | Outside highwall | 53 | 36.5 | 37.20 | 0.70 | Seam Above Top Hard (S.A.T.H) |
| | | | | | | 47.67 | 47.90 | 0.23 | Top Coombe |
| | | | | | | 49.45 | 50.00 | 0.55 | Lower Coombe |
| | | | | | | 52.00 | 52.90 | 0.90 | Top Hard or Dunsil |
| 2019 GI | N601 | Onsite | 444553.6634450 1.86 | On the boundary | 21 | 18.57 | 19.39 | 0.82 | Seam Above Top Hard (S.A.T.H) |

| | | | | | | Encountered Coal Seams | | | |
|---|---|---|---|---|---|---|---|---|---|
| **GI** | **Exploratory Hole** | **Distance (m) and Direction from Plot A** | **Grid Reference** | **Position Relative to the Top of the Highwall** | **Completion Depth (m bgl)** | **Depth From (m bgl)** | **Depth to (m bgl)** | **Thickness (m)** | **Interpreted Coal Seam** |
| | N602 | Onsite | 444559.94<br>344479.75 | Within highwall | 33 | | Not encountered | | - |
| | N603 | Onsite | 444558.07<br>344466.43 | Within highwall | 33 | | Not encountered | | - |
| | N701 | Onsite | 444675.11<br>344452.67 | Within highwall | 16.5 | 14.18 | 15.06 | 0.88 | Seam Above Top Hard (S.A.T.H) |
| | N702 | Onsite | 444668.76<br>344444.53 | Within highwall | 22.5 | | Not encountered | | - |
| | N703 | Onsite | 444658.23<br>344435.07 | Within highwall | 34.5 | | Not encountered | | - |
| | N704 | Onsite | 444652.11<br>344430.14 | Within highwall | 34 | | Not encountered | | - |
| | N800 | 10E | 444732.33<br>344380.94 | Within highwall | 21 | | Not encountered | | - |
| | N801 | 8E | 444727.04<br>344372.68 | Within highwall | 22 | | Not encountered | | - |
| | N802 | 6E | 444722.41<br>344366.27 | Within highwall | 31 | | Not encountered | | - |
| | N803 | Onsite (eastern boundary) | 444715.06<br>344364.16 | Within highwall | 33 | | Not encountered | | - |

*Source: AECOM (2017) Shipley Lakeside Development Phase II Geo-Environmental Assessment Report and AECOM (2019) Opencast Highwall Ground Investigation Report*

** Base of made ground not proven*

As noted in Table 1, coal seams were only encountered in exploratory holes located on the boundary of the top of the highwall within Plot A (N601) and near to the boundary (N701). The thickness of the encountered coal seam was similar in both holes, with 0.82m recorded in N601 and 0.88m recorded in N701. The coal seams in N601 and N701 were both described as "*medium strong bituminous pyritic coal*". Therefore, this indicates that the coal encountered in N601 and N701 is likely to be the same seam. The Coal Authority abandonment plan (provided as Drawing SHLK-AEC-XX-XX-DR-GE-0013) indicates that this coal seam is likely the Seam Above Top Hard (S.A.T.H.). No indications of working were evident in the seams in N601 and N701, with near to total core recovery reported for both locations. The depth at which the coal seam was encountered is deeper in N601 (18.57m bgl) located in the eastern extent of Plot A compared to 14.18m bgl in N701 located in the western extent of Plot A. The AECOM (2017) Phase II Report also indicated that the coal seam encountered in CPR-16080 (approximately 230m north-west from Plot A) at 36.5m bgl is the S.A.T.H. This therefore suggests that the S.A.T.H coal seam within Plot A is dipping in a north-westerly direction.

The remainder of the exploratory holes within Plot A are located within the highwall extent and did not encounter intact coal seams. This therefore suggests that the coal seams within the highwall boundary have been subject to opencast mining. The only locations where coal seams were encountered within Plot A was in those exploratory holes on the boundary of the highwall in N601 and N701. Therefore, this indicates that the S.A.T.H. seam on the highwall boundary was not subject to unrecorded mine working. The encountered depths of the S.A.T.H. seam indicate a dip direction towards the north-west which suggests that intact coal seams are likely present beyond the highwall extent within Plot A. Therefore, it is considered that there is a very low risk of unrecorded shallow coal mining activity within Plot A beyond the extent of the highwall. A void was identified in N602 between 22.3m bgl to 28.5m bgl which is within the former open cast area, which indicates workings below the base of the former opencast.

Exploratory holes N601 and N701 were drilled to maximum depths of 21m bgl and 14.18m bgl respectively. Therefore, the coal seams underlying the S.A.T.H. such as the Top Coombe, Lower Coombe, Top Hard and Dunsil were not encountered. It is considered that these coal seams are present at greater depths as in exploratory hole CPR-16080, the Top Coombe, Lower Coombe and Top Hard or Dunsil coal seams were encountered between 47.67m bgl and 52m bgl. Therefore, if shallow unrecorded mine workings are present in these deeper coal seams beyond the extent of the highwall, there is sufficient depth between the coal seams and the ground level which minimises the risk to the proposed development. Furthermore, an intact coal seam was encountered in CPR-16081A near to the boundary of the highwall approximately 30m north-west of Plot A at 22.11m bgl, which was interpreted as the Top Coombe seam. This therefore suggests that the Top Coombe seam was not subject to unrecorded shallow mine workings.

One exploratory hole (CP-16076) is located beyond the extent of the highwall within Plot A. However, the exploratory hole was only drilled to a depth of 2.41m bgl (the borehole refused on Siltstone bedrock) and was repositioned further west to location CP-16076A which is potentially outside, or on the boundary of the top of the highwall. However, CP-16076A did not encounter coal seams which is likely a result of the shallow depth of the borehole (10.12m bgl). Exploratory hole N701 is located near to CP-16076A and recorded a coal seam (interpreted as the S.A.T.H.) at 14.18m bgl. Therefore, it is possible that the termination depth of exploratory hole CP-16076A was too shallow to encounter the intact S.A.T.H. seam.

Overall, it is considered that there is a very low risk of unrecorded shallow mine workings beyond the extent of the highwall in Plot A based on the available ground investigation data and Coal Authority abandonment plans.

# Conclusions

Following a consultation review of planning application AVA/2023/0562 for the erection of a 66-bed care home with associated car parking, landscaping and other relevant works within Plot A, the Coal Authority submitted a request for additional information with regards to the potential for unrecorded shallow coal mining beyond the extent of the opencast highwall. AECOM have reviewed the existing ground investigation data, geological maps and Coal Authority abandonment plans under the instruction of LNT Construction Limited.

The review of existing ground investigation data indicates that the vast majority of Plot A is within the extent of the former opencast (i.e. with the top highwall boundary) and that there is a very low risk of unrecorded shallow coal mining workings within Plot A beyond the extent of the highwall. Coal seams were not encountered in exploratory holes drilled to depths of up to 34.5m bgl within the highwall boundary in Plot A, with the exception of N701 which is located near to the top highwall boundary.

Coal seams were only encountered in N601 and N701, which are located on the top boundary of the highwall and close to the top boundary, at depths of 18.57m bgl and 14.18m bgl respectively. The descriptions provided on the exploratory hole logs and similar thicknesses (0.82m in N601 and 0.88m in N701) indicates the coal is intact, part of the same seam (interpreted as the S.A.T.H.) and dips in a north-westerly direction. This suggests that the coal seams are intact along the top highwall boundary and to the north-west of the highwall resulting in a very low risk of unrecorded shallow mining activity beyond the extent of the highwall in Plot A.

# References

AECOM (2017) Shipley Lakeside Development Phase II Geo-Environmental Assessment Report.

AECOM (2019) Technical Note on the Delineation of Supplementary Foundation Design Zone over Opencast Highwall at Shipley Lakeside.

AECOM (2019) Opencast Highwall Ground Investigation Report.

British Geological Survey (1968) Solid and Drift Map Sheet SK44SW 1:10,560.

British Geological Survey (1972) Solid and Drift Map for Derby (Sheet 125) 1:50,000.

URS (2012) Shipley Lakeside Development Phase I Assessment Report.