WYG Engineering

UK Coal

Review of the Diglake Colliery Disaster in Respect of the Proposed Great Oak Surface Mining

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1 Introduction

This review was carried out by WYG Engineering Ltd at the request of UK Coal. The following report is independent of any findings by UK Coal and assesses the causes and site of the original Diglake mining disaster of 1895. The report also evaluates UK Coal's in-house assessment of the impact of its proposed surface mining site on the areas of underground workings within which the disaster site is contained.

2 Background

Coal mining in the area around Bignall End dates back to the late 18th or early 19th century when two main collieries, Diglake (later known as Old Diglake) and Rookery, were developed. The mines were worked prior to the statutory requirement to record all mine workings in 1872. Plans of the workings from Diglake Colliery (Abandonment Plan 4967/9) exist but as a copy (see Figure 1), made in 1933, of the original plan and presented to the Bignall Hill Collieries Company. The plan shows extensive workings in the Ten Feet Seam (in blue) and smaller areas of workings in the Hams Seam (yellow) and Two Row (Bowling Alley or Holly Lane) Seam (red). There are 11 shafts shown on the plan, along with two roadways and two drainage levels (gutters or soughs), one annotated as "old gutter". The drainage level driven to the northwest from the main shaft site has three air shafts marked close to its mouth. It is recorded that a new steam pump was installed at Diglake, in 1820, to raise mine water up to the level of this gutter. The date of the plan is not known, but it is likely to be close to the date of the abandonment of Diglake Colliery, in 1854.

The original Rookery Colliery was also abandoned in 1854, reportedly due to problems with shaft stability. The closure of Diglake Colliery was reportedly because it was uneconomic, possibly due to high water pumping costs. After the closure of Diglake Colliery the high water inflow to the workings (mainly from the sandstone above the Ten Feet Seam) would, fairly quickly, have filled up the mine void to the level of the drainage sough (circa 135m AOD) that would then have discharged mine water to Brierly Brook.

The next phase of underground mining in the Bignall End area was the sinking of the deep shafts for Audley Colliery (Audley Diglake) to access the seams down dip and below the old shallow workings. Audley Colliery was sunk in 1870 and was linked underground to the former Boyles Hall

Pits. The Audley shafts were sunk close to two Old Diglake Colliery shafts that worked an isolated area of the Ten Feet Seam that was drained by means of the "old gutter" (see Figure 1).

As well as the presence of old, poorly recorded workings from Old Diglake, Audley Colliery also encountered a more structurally complex area with increased faulting and folding of the strata. For instance, the Bullhurst Coal, in the Audley No. 2 Shaft, is in the form of a large monoclinal ('S' shaped) fold with low-angle thrust faulting. In the No. 1 Shaft, there is a later, large normal fault upthrowing about 80 metres to the west. Despite these difficulties, the colliery worked several areas in seams between the Ten Feet and the Bullhurst (see Figure 2).

3 The Diglake Colliery Disaster

The Diglake Colliery disaster occurred at about 10.30am on the 14th January 1895, when a heading from Audley Colliery in the Ten Feet seam approached near to an old roadway in the abandoned Old Diglake workings. The coal pillar separating the two workings failed due to the high pressure of water in the flooded Old Diglake workings (about 100 psi). The failure resulted in a very large, rapid flow of water from the up-dip Old Diglake workings into the Audley Ten Feet workings that, under current legislation, would have been classified as an "inrush" (Mines (Precautions Against Inrushes) Regulations 1979). Figure 2 shows a cross-section through Diglake Shaft on the line of the drainage sough and cross measure drivage with the roadway driven from the shaft bottom through faulted ground and into the Ten Feet Seam where the inrush of mine water occurred. Figure 3 shows the original plan of the Ten Feet workings from Audley Colliery at the time of the inrush with the heading from Old Diglake, now known to be in the Ten Feet seam, marked as being in an "unknown place". Figure 4 shows the same area of Ten Feet workings after they were re-accessed and worked from Rookery Colliery (Bignall Hill), in the 1930s, confirming the site and cause of the 1895 disaster.

The force and speed of the inrush of mine water resulted in the deaths of 77 men and boys. Two bodies were recovered from close to No. 1 Shaft, prior to the rescue operations being abandoned, and three bodies were recovered in 1932, when the Audley Ten Feet workings were re-accessed from Rookery Colliery. The other 72 casualties remain in the flooded mine workings.

4 Areas of Workings at Audley Diglake

The areas of working at Audley Diglake Colliery at the time of the disaster were in the New Ten Feet area (see Figure 3), the East Seven Feet (Banbury) area (see Figure 5) and the two areas (West and East) in the Eight Feet (Cockshead) (see Figures 6 and 7 respectively). The exact detailed position of the 72 casualties remaining in the mine is not known. However, it was reported that 19 were working in the New Ten Feet area, 40 in the East Seven Feet area and 12 in the West Eight Feet area. It is considered likely that, due to the reported high flow, most of those working in the New Ten Feet area (where the "inrush" occurred) would have been rapidly overcome by the inflow. It should be assumed, therefore, that any of the working areas, the roadways leading to the shafts or other areas worked from Audley Diglake could contain the remains of casualties and should remain undisturbed.

5 Proximity of the Proposed Surface Excavations to Audley Diglake Workings

The coal seams worked from Audley Diglake Colliery (including Audley Boyles Hall) were, in descending order, the Hams, the Ten Feet, the Two Row (Bowling Alley or Holly Lane), the Seven Feet Banbury (Banbury), the Eight Feet Banbury (Cockshead) and the Bullhurst. The underground mine workings at Audley Diglake were divided into east and west workings, the division being the large fault (80 metres throw) that passes through Audley Diglake shafts. All the proposed UK Coal surface excavations are in the "East Area" of Audley Diglake on the downthrow side of the fault (see Figure 8).

There will be no impact on the abandoned Audley Diglake mine workings in the "West Area" from either the surface excavation or the dewatering of the void. The nearest that the proposed surface workings would approach to any of the "West Area" workings is to the West Eight Feet Banbury workings (Cockshead). The surface void (Area B West, Rough Seven Feet), at its closest, is 150 metres above the West Eight Feet Banbury workings in a vertical plane, offset by 80 metres horizontally (see Figures 2 and 6).

The "East Area" mine workings from Audley Diglake, in the Ten Feet and the Seven Feet Banbury (Banbury), both lie below the proposed UK Coal surface void and, in the case of the Ten Feet, the workings lie down dip from the proposed surface workings.

The Seven Feet Banbury mine workings (see Figure 5) lie some 145 metres below the proposed Ten Feet excavation, about 200 metres below the proposed Bellringer excavation and some 220 metres below the proposed Hams excavation. In none of these cases will the proposed excavations make contact with the Seven Feet Banbury, or the ground (mine) water pumping have an impact on the Seven Feet Banbury (Banbury) workings below.

The Audley Colliery workings in the Ten Feet where the "inrush" occurred (the New Ten Feet area) lie down dip from a proposed surface excavation area in the Ten Feet (to the southeast of the "inrush" site) and below a proposed excavation area in the Hams. The surface excavation will also work the remnant coal associated with the Old Diglake Ten Feet workings, the source of the inrush water. There is no possibility of any of the casualties having been able to gain access into the Old Diglake Ten Feet workings due to the force of water that would have been flowing through the workings and the connection and also lack of any breathable atmosphere in the Old Diglake workings. However, it would have been possible for anyone trapped in the Audley Ten Feet workings by the "inrush" to have moved to the highest workings in the Ten Feet to avoid the rising water levels. Therefore, whilst unlikely, due to the speed and force of the inrush, it is feasible that the remains of casualties could remain in the highest Audley Ten Feet workings immediately adjacent to the proposed exploration void.

The original UK Coal plan for working the Ten Feet seam in Area B2 was to approach within 55 metres (in the horizontal plane) of the Audley Ten Feet workings (see Figure 9) as shown on Abandonment Plan 14306/2 (see Figure 4) at the southern end of Area B2 (55 metres in plan view being equivalent to 57 metres along the dip of the Ten Feet Seam). In addition to the coal excavation, there was a level extension of the void above the unmarked Ten Feet Seam that would, at its closest, have been 30 metres from the edge of the recorded Audley Ten Feet workings (see Figure 9).

The current regulations to prevent the interconnection of underground mine workings with surface workings (The Mines (Precautions Against Inrushes) Regulations 1979) takes into account, in part, the uncertainty regarding the accuracy of old mine plans. In the regulations, no working would be

allowed within 37 metres (in any plane) of abandoned workings to ensure there is no connection between the two sets of workings. In the absence of any rules or regulations regarding surface excavations and abandoned mine workings known to contain human remains, this rule might be adopted in this case to define the minimum distance between the two sets of workings to ensure there is no accidental connection. UK Coal has, therefore, amended its proposed working plan in the southern end of Area B, by adjusting the planned coaling and excavation areas to ensure that a 37m stand-off zone would be adhered to.

The proposed area of surface workings in the Bellringer does not overlie any workings from Audley Colliery. It does lie about 45 metres above Old Diglake Ten Feet workings (Figure 1) but, as previously noted, there is no possibility of any of the casualties having accessed these workings. The Bellringer surface void will have no impact on the Audley Colliery workings.

The Audley Colliery New Ten Feet workings where the "inrush" occurred lie below the proposed surface excavation in the Hams/Rough Seven Feet in Area B3. The geological structure in the area of the inrush is complex and may, in part, explain why it occurred. A low-angle fault seen in lower Audley workings (West Seven Feet and West Eight Feet) is probably the same fault that passes close to the base of Old Diglake shaft (see Figure 2). This fault lies between the base of the proposed surface excavation in the Hams / Rough Seven Feet and the New Ten Feet workings from Audley.

The heading from Old Diglake that caused the inrush was driven through this low angle fault zone. This type of low-angle fault is unusual and could have contributed to the confusion as to which seam was contacted on the other side of the fault zone. The normal interval between the Hams and the Ten Feet seam is approximately 80 metres. However, due to the low-angled fault, this interval is reduced to a minimum of 50 metres at the southern end of the area of proposed Hams workings.

The working of the Hams / Rough Seven Feet coal from surface will not make any physical contact with the Audley Ten Feet workings and will have no impact on the abandoned Audley New Ten Feet workings below. However, dewatering of the mine workings to allow working of the Hams / Rough Seven Feet will result in a lowering of the mine/ground water levels in the abandoned up dip Audley New Ten Feet workings to a level of about 100 metres AOD. The de-watering would be very gradual due to the extensive area of abandoned mine workings and would not result in any

movement or disturbance of the mine void. Mine water, resulting from surface inflow, is currently flowing slowly through the Audley Diglake workings from Old Diglake and the mining connections resulting from the later mining in several seams from Rookery and Jamage (see Figure 4). The mine water from this area flows via Audley Diglake and Boyles Hall to Minnie Pit where it combines with mine water from the other abandoned mine workings in the area to discharge at surface. The total amount discharged at Minnie Pit is approximately 30 l/s (400 gpm). It is considered that the gradual lowering of the mine water in the Audley New Ten Feet workings would not disturb the remains of any casualties that may lie in these workings above a horizon of 100 metres AOD. Groundwater lowering to allow the surface excavations will not dewater any other mine workings at Audley Diglake.

6 Conclusions and Recommendations

- The remains of the 72 casualties of the Diglake Mining Disaster that still remain within the workings could be in any part of the abandoned workings of Audley Diglake Colliery.
- No physical connections should be made between the proposed surface mining voids and the abandoned Audley Diglake workings nor any works undertaken that could physically disturb those workings.
- To ensure that no contact or physical disturbance occurs to the Audley Diglake workings from the planned surface excavations it is proposed that a minimum stand-off distance of 37 metres between the Audley Diglake workings and the surface void (in any plane) be applied. (Based on the Precautions Against Inrushes Regulations, 1979).
- All the proposed workings by UK Coal, apart from the Ten Feet workings in Area B2, lie well outside such a minimum distance and will have no impact on the underlying Audley Diglake workings.
- The original plan of proposed workings in the Ten Feet in Area B2 encroached slightly within the 37 metres stand-off distance but was subsequently amended to ensure that this would not take place.
- The dewatering of the surface void to allow workings of the Hams seam in Area B is likely also to result in the dewatering of the Audley Ten Feet workings above a level of about 100 metres AOD.

- There is currently a slow flow of water through the abandoned Audley Diglake mine workings and water levels vary with rainfall. It is considered that the dewatering of the Audley Ten Feet workings during the working of the Hams will not disturb the mine workings or the remains of any of the casualties that may lie in those workings.

Appendices

Appendix A

List of mine plans held by the Coal Authority Mining Records Office in the area of Audley Colliery, Bignall End, Staffordshire

References

1 Circumstances attending the Inundation of Audley Colliery, Staffordshire on January 14th 1895. HM Stationery Office 1896

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4 Mines (Precautions Against Inrushes) Regulations 1979

5 The prevention of inrushes in mines. Approved code of practice. Health and Safety Commission HMSO 1993

6 British Geological Survey. Geology of the Kidsgrove District. Technical Report W.A/90/C NERC 1990.