

17 Meadowhead Road
Plains
Airdrie

Coal Mining Risk Assessment



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Ref: DAM 4776

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Assessment Summary

Assessment Result	There are mining issues for this site due to shallow mine workings at the horizon of the Virtuewell Coal seam abutting the south-western edge of the site.
Recommended Further Work	A mining investigation is recommended to clarify the extent, state and condition of the underlying mine workings in the Virtuewell Coal. One borehole should be carried out within the south-western corner of the site with a second undertaken at the northern boundary of the site, to confirm that the workings do not extend into the site. A third borehole may be required if workings are encountered within the first bore.

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1.0 Introduction

DAM Geotechnical Services were commissioned to prepare a Coal Mining Risk Assessment (CMRA) Report in connection with the proposal to construct three (3) new housing plots at 17 Meadowhead Road, Plains, North Lanarkshire, hereinafter referred to as 'the site'. This report follows guidelines provided in the document entitled Risk Based Approach to Development Management¹, published by the Coal Authority.

1.1 Site Location and Description

The site is rectangular in shape bounded on the east by Meadowhead Road, to the south by No. 15 Meadowhead Road and to the west and north by open ground. The southern part of the site comprises No. 17 Meadowhead Road with an out-building located within the northern part of the site. The National Grid Reference (NGR) for the site is 279136E, 666708N. The approximate elevation of the site is 174m above Ordnance Datum (OD).

1.2 Description and Proposed Layout of Development

The proposed development comprises the construction of three (3) new housing plots.

1.3 Scope of the Coal Mining Risk Assessment

The purpose of this Coal Mining Risk Assessment Report is to:

- Present a desk-based review of all available information on potential coal mining issues which are relevant to the proposed development area.
- Use that information to identify and assess the risks to the proposed development from coal mining legacy, including cumulative impact of issues.
- Set out appropriate mitigation measures to address the coal mining legacy risks affecting the proposed development area, including any necessary remedial works and/or demonstrate how coal mining issues have influenced the proposed development; and
- Demonstrate to the Local Planning Authority that the proposed development area is, or can be made, safe and stable to meet the requirements of national planning policy with regard to development on unstable land.

¹ The Coal Authority, Risk Based Approach to Development Management, Resources for Developers, Version 4, 2017

2.0 Geological Information

2.1 Drift and Solid Geology Summary

A summary of the drift and solid geology is provided below.

Sheet / Map Ref	Date	Comments
Lanarkshire Sheet VIII: 1:10,560	1874	The superficial deposits are noted as boulders underlying strata belong to the Coal Measures. The conjectural outcrop of the Blackband Ironstone is noted to the north and the conjectural outcrop of the Virtuewell Coal noted to the south. Meadowhead Pit (disused) is shown to the north-east and records the Virtuewell Coal at 26 fathoms (47.50m). Brownieside Colliery (Pit No. 1) is annotated some distance to the east and recorded the Lower Drumgray at 50 fathoms (91.40m). Three (3) Old Pits are shown to the far north-west of the site.
Lanarkshire Sheet VIII NE: 1:10, 560	1911	The superficial deposits are recorded to be boulder clay. The underlying strata belong to the Productive Coal Measures of the Carboniferous Period. As mentioned above the conjectural outcrops of the Blackband Ironstone and Virtuewell Coal are shown to the north and south of the site respectively. Brownieside Colliery is noted to the east. A borehole located to the north-west of the site records the Virtuewell Coal at 15.5 fathoms (26.52m), the top of a whinstone sill at 25.5 fathoms (46.63m) with the bottom of the sill at 36.5 fathoms (66.75m), the Upper Drumgray Coal at 50.5 fathoms (92.36m) with the Lower Drumgray at 55.5 fathoms (101.50m). The geological section records the Virtuewell Coal as 2 ft (0.61m) thick. Figure 1 refers.
NS76NE: 1:10,000	1996	The strata underlying the site belong to the Lower Coal Measures of the Upper Carboniferous. The conjectural outcrop of the Airdrie Blackband Coal is shown trending south-west to north-east to the north of the site crossing Meadowhead Road just north of Annieshill View. The conjectural outcrop of the Virtuewell Coal is shown some distance to the south of the railway line. Further south the conjectural outcrop of the top of a dolerite sill is shown. The dip of the strata is to the north-west. According to the geological section the thickness of the Virtuewell Coal ranges from 0.60 to 1.00m in thickness. Figure 2 refers.

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Figure 1 Extract from Lanarkshire VIII NE 1911

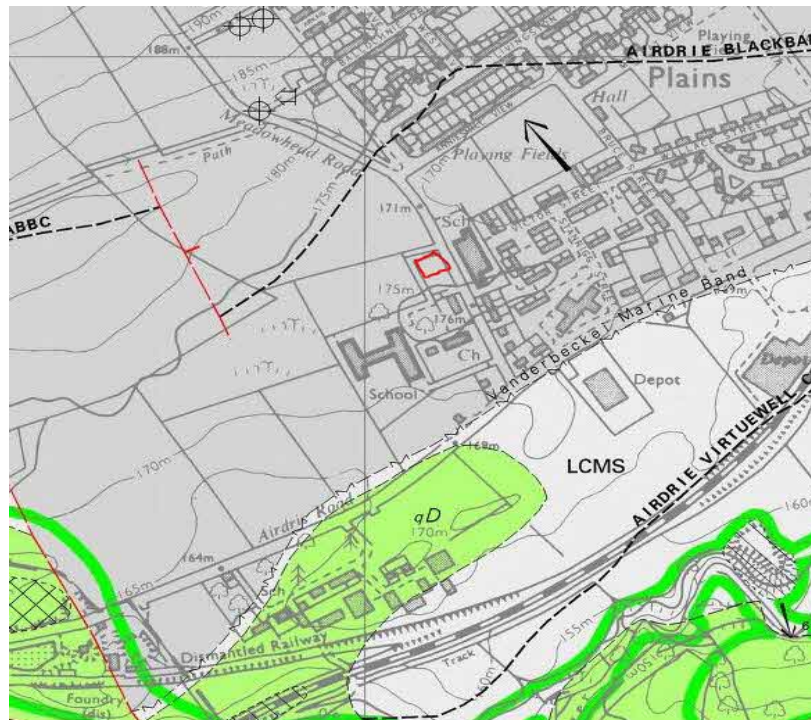


Figure 2 Extract from NS76NE 1996

3.0 Coal Authority Information

According to the Coal Authority Interactive Map Viewer² the site lies within a *Development High Risk Area*. Within development high risk areas there are coal mining legacy risks which pose a public safety and/or ground instability risk to the surface for example: mine entries, shallow mine workings (recorded and probable),

² <http://mapapps2.bgs.ac.uk/coalauthority/home.html>

workable seam outcrops, mine gas sites and areas, recorded mining related hazards, geological features (fissures and break lines), former surface mining sites / high wall (sometimes using historic opencast extraction methods). There are no mine entries, coal outcrops or probable shallow coal mine workings within or adjacent to the site. The site has been undermined prior to 1911 with levels of 149mOD to the west and 71mOD to the east indicating depths of 25 and 103m respectively. A number of abandonment mine plans are recorded for the site.

A Con29M Coal Mining Report³ obtained from the Coal Authority records that *The property is in a surface area that could be affected by underground mining in 3 seams of coal at shallow to 120m depth, and last worked in 1927. The property is in a surface area that could be affected by underground mining in 1 seam of ironstone at 170m depth, and last worked in 1885.*

The Professional Opinion of the report states *According to the official mining information records held by the Coal Authority at the time of this search, evidence of, or the potential for, coal mining related features have been identified. In view of the coal mining circumstances we would recommend that any planned or future development should follow detailed technical advice before beginning work on site.*

Future development

If development proposals are being considered, technical advice relating to both the investigation of coal and former coal mines and their treatment should be obtained before beginning work on site. All proposals should apply specialist engineering practice required for former mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or coal mines without first obtaining the permission of the Coal Authority.

MINE GAS: *Please note, if there are no recorded instances of mine gas within the enquiry boundary, this does not mean that mine gas is not present within the vicinity. The Coal Authority Mine Gas data is limited to only those sites where a Mine Gas incident has been recorded. Developers should be aware that the investigation of coal seams, mine workings or mine entries may have the potential to generate and/or displace underground gases. Associated risks both to the development site and any neighbouring land or properties should be fully considered when undertaking any ground works. The need for effective measures to prevent gases*

³ Con29M Coal Mining Report, 17 Meadowhead Road, Plains, North Lanarkshire, Ref: 51003388675001, 11-11-2023.

migrating onto any land or into any properties, either during investigation or remediation work, or after development must also be assessed and properly addressed. In these instances, the Coal Authority recommends that a more detailed Gas Risk Assessment is undertaken by a competent assessor.

4.0 Economic Mining

4.1 Geological Memoirs

The relevant memoirs⁴ note with regard to the Virtuewell Coal that *In parts of Meadowhead Colliery the Virtuewell is a good anthracite. This is often ascribed to the proximity of a whin float, which in No. 2 Pit is 12 fms. thick, with its top about 6 fms. below the coal.* The List of Mines for 1873 provided by the Scottish Mining Website⁵ records that Brownieside (Colliery) worked an ironstone seam and that Brownsie No. 1 worked the Lower Drumgray Coal by the longwall method of mining. Meadowhead No. 5 (Colliery) is recorded to have worked the Main, Humph and Splint Coal seams by the stoop and room/longwall methods.

5.0 Previous Reports

The British Geological Survey GeoIndex Report Database⁶ has records of three (3) boreholes sunk to the north, west and south-west of the site. Borehole NS76NE974/OH2 located to the north at 279020E, 666790N recorded the superficial deposits as dominantly boulder clay to 6.20 metres below ground level (mbgl). A packed waste (horizon of the Virtuewell Coal) was passed through from 23.20 to 24.50mbgl before termination of the borehole at 26.00mbgl. A heavy body of water was noted at 23.20mbgl with an air loss at 23.50mbgl.

Borehole NS76NE82 sunk in 1874 at 278880E, 666690N proved rockhead at 7.30mbgl. A coal seam 0.15m in thickness was passed through at 8.08mbgl and according to the borehole record the Virtuewell Coal, 0.74m thick was proven at 26.98mbgl; a coal 0.46m was noted at 35.30mbgl; a coarse sandy ironstone 0.20m at 45.34mbgl; whinstone 19.74m in thickness was proven at 66.85mbgl; coal 0.33m at 81.30mbgl; coal, foul 0.23m at 83.74mbgl; coal (noted as Upper Drumgray) 0.46m at 92.22mbgl;

⁴ The Economic Geology of the Central Coalfield of Scotland, Area V, HMSO, 1926

⁵ [List of Mines - Scottish Mining Website](#)

⁶ www.bgs.ac.uk/geoindex.

coal 0.25 (Lower Drumgray) at 101.00mbgl; coal 0.28m at 108.69mbgl; ironstone 0.08m at 110.49mbgl and coal .030m at 115.77mbgl before termination of the borehole at 117.96mbgl.

Borehole NS76NE974/OH1 located at 278920E, 666550N proved rockhead at 3.55mbgl. Whinstone was recorded from 34.00 to 34.30mbgl at which depth the drilling operations were terminated.

6.0 Abandonment Mine Plans

Details of the abandonment mine plans obtained from the Coal Authority are provided below.

Plan 10689: records workings in the Virtuewell Coal from Brownieside Mine prior to 1931: Figure 3 refers. The method of mining is longwall (historical shortwall). The site does not appear to be directly undermined by workings in the Virtuewell Coal but workings from the south-west are shown to abut the south-western edge of the site. Workings from the Meadowhead Pits to the north are shown just to the north of the site, with the note that these workings are flooded to a level of 530ft (161.55m) to Ordnance Survey Datum (OSD). The dip of the strata is shown as 1 in 50 to the north-east. The seam level is noted as 472.9ft above Ordnance Datum. With a ground level of 174mOD the depth to the seam is estimated at 28.86m: at the junction of Meadowhead Road and Airdrie Road/Main Street the depth to the Virtuewell Coal is estimated at 26.82m. The working thickness of the seam ranges from 24 to 29 inches (0.61 to 0.74m). The seam section shown on the plan records a fireclay roof 36" (0.91m), Coal 32" (0.81m), split 4" (0.10) onto a pavement of fireclay & balls.

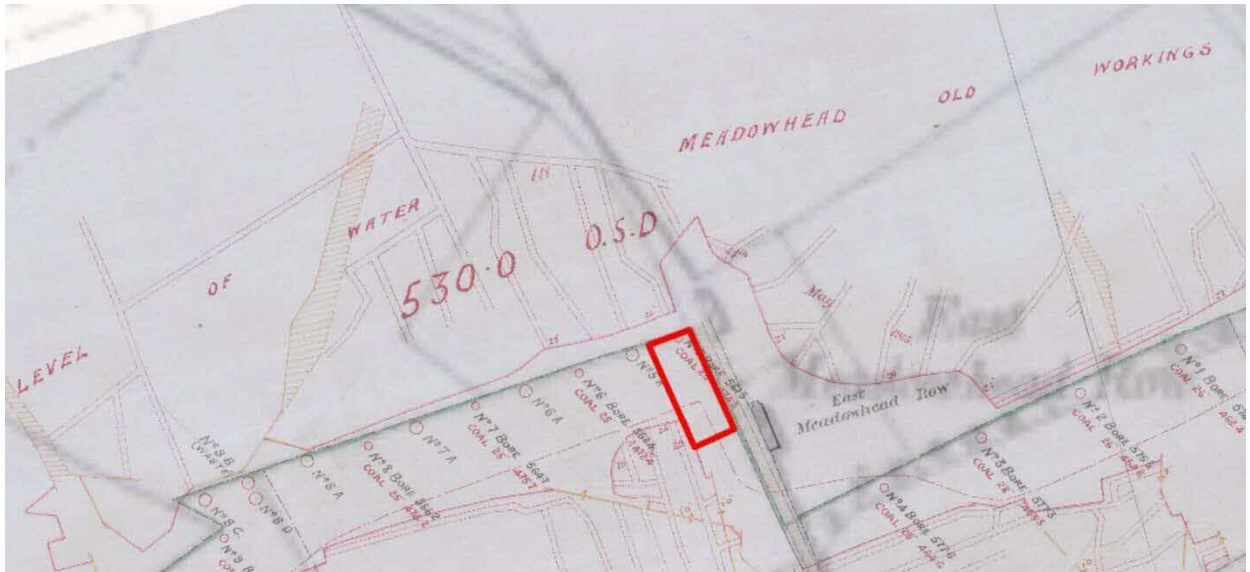


Figure 3 Mine Plan 10689 Virtuewell Coal Workings

Plan 5426: shows that workings have been carried out below most of the site in the Lower Drumgray Coal prior to 1893 from Brownieside Colliery: Figure 4 refers. The method of mining is longwall (historical shortwall). The seam thickness ranges from 23" (0.58m) to 30" (0.76m). A seam level of 1205.31ft just south of the intersection of Meadowhead Road and Airdrie Road/Main Street indicates a depth of 107.21m. The seam section notes rock 48" (1.22m), Coal 17" to 27" (0.43 to 0.68m) on to a hard fireclay floor.



Figure 4 Mine Plan 5426 Lower Drumgray Coal Workings

Plan 6421: records workings in the Musselband Coal, Virtuewell Coal, Upper Drumgray Coal and the Splint Coal from the Meadowhead Pits prior to 1916: Figure 5 refers. At Meadowhead No. 4 Pit the depth to the Musselband Coal is recorded as 10fms (18.28m), 26fms (47.55m) to the Virtuewell Coal and 370.4ft (112.90m) to the

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Upper Drumgray Coal. Old workings in the Virtuewell seam lie to the north and east of the site, dated 1911 and 1916 respectively, but do not extend into the site. The plan records the Virtuewell section as blaes, faikes 27" (0.68m), clay faikes 1" (0.03m), Coal 24" (0.61m), daugh 1" (0.03m) on to pavement of fireclay & balls. The site lies within the area encompassed by workings in the Upper Drumgray Coal extracted prior to 1901 with a section of Mussel Bed, Coal 2" (0.05m), faikes 12" (0.30m), faikes & rock 36" (0.91m), blaes 6" (0.15m), Coal 17" (0.43m), sclit 2" (0.05m) on to pavement of hard fireclay. The workings in the Splint Coal lie to the far north. Annotation on the plan notes that the "*Line of Lower Drumgray Faces shewn on Old Working Plan not be taken as accurate. Precautions will therefore have to be taken in approaching same*" (plan 5426 refers).

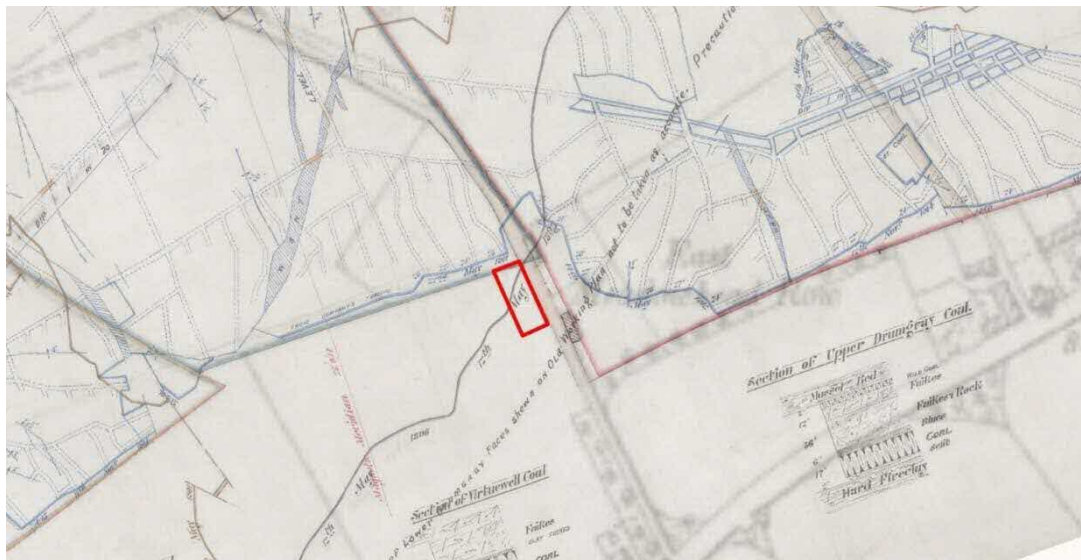


Figure 5 Mine Plan 6421 Virtuewell Coal Workings

7.0 Potential Mining Instability

According to the Coal Authority information the site lies within a *Development High Risk Area*. Based on the borehole information the superficial deposits are thought to be in the order of 3.55 to 7.30m in thickness. Borehole NS76NE974/OH2, sunk to the north of the site, recorded a packed waste 1.30m thick at 26.00mbgl. Thus, the Virtuewell workings lie within 30m of the surface. Whilst it would appear from mine plan information that the Virtuewell Coal workings do not directly underlie the site, the zone of influence from the Virtuewell workings to the north and those abutting the south-western edge of the site, will extend into the site. As explained below, maximum subsidence only takes place at the centre of the panel and as such there exists the potential that at the edge of the panel the mine workings may be open.

Accordingly, the Virtuewell workings may be open where they abut the south-western edge of the site. Furthermore, in such circumstances the edge of the workings might have extended into the site due to time dependant failure of the coal at the edge of the panel. Workings at the horizon of the Upper Drumgray underlie all of the site at an estimated depth of 93m. The workings in the Lower Drumgray underlie all of the site at an estimated depth of 101.75m. In all instances the method of mining has been historical longwall (shortwall).

Longwall mining involves the extraction of the coal in one operation by formation of a 'wall of coal', between two or more main entries, which is bodily removed in line by advancing the wall or face. As the coal is removed any stone available, from 'ripping' or 'brushing' the roads, is built into dry-stone walls or packs some 2m to 6m wide, arranged in parallel lines to the advancing face. Historically, the purpose of these packs was to cushion the lowering of the roof after its supporting coal is removed and to provide support at the coalface. According to Alexander⁷ typical panel widths varied from 20 to 30 yards (18m to 27m) with pack walls formed to maintain the roadways on the one side and solid coal on the other. The length of face could range from 20 yards (18m) to 100 yards (90m) depending upon the type of roof; if the roof was strong and did not break readily then a considerable length of face could be opened out, however if the roof was tender and apt to fall the length had to be diminished and the works advanced more rapidly. It must be remembered that prior to the mid-20th Century mining was by hand-drawn methods, which was much slower and required more care and attention to roof support. The main entries are pillared at the sides with stone taken from the roof of the roadways, which are thus made of extra height, in order to prevent being reduced by the overburden pressure and to allow access for men and materials.

In general, subsidence or ground deformation from recent longwall mining occurs very quickly after extraction and is usually complete within a few years. The amount of subsidence that might have occurred will depend upon seam thickness, depth, configuration of the panels, the amount of packing employed in the extraction process and the geology above the mine working. At shallow depth complete compaction of the workings may not have taken place due to insufficient in-situ vertical stress, the amount of packing and or a thick overlying post of hard rock such as sandstone. At depth, where the in-situ vertical stress is higher closure of the mine workings may have taken place due to the application of constant stress over time.

⁷ Alexander, W. (1862) On Mining by Longwall, Transactions of the Institution of Engineers in Scotland, vol. 5.

Maximum subsidence (vertical displacement) occurs over the centre of the excavation and displacement extends well beyond the limit of excavation.

Given the depth and method of mining of the Upper and Lower Drumgray workings stability issues are not anticipated from these horizons.

The strata immediately overlying the Virtuewell coal is recorded as fireclay overlain by blaes (shale), or faikes (laminated sandy shale). The abandonment plan indicates an approximate road width of 10.5ft (3.2m) with panel widths ranging from 26ft (7.92m) to 37ft (11.28m). With such dimensions failure of the roof of the panels would likely occur on the basis that the tensile strength of the overlying rock is unlikely to be sufficient to span distances of 7.92 to 11.28m with a sufficient factor of safety and as such roof collapse would be anticipated: the detail recorded in borehole NS76NE974/OH2 is taken to confirm the is view. Notwithstanding, at a depth of 29 metres the in-situ vertical stress is only 0.73MPa and as such there can be no guarantee that complete closure of the mine workings at the horizon of the Virtuewell Coal have taken place, particularly at the edge of the workings and as such open or partial voids, albeit likely unconnected, could be present. However, the flooded nature of the workings would have had an impact on the strength of the roof and floor, reducing their compressive and tensile strengths making failure more likely, hence the description of a packed waste in the aforementioned borehole. Whilst the roadways may have had packs along their sides, to allow access to the working face, the working panel would transfer the stress to these packs placing an 'abutment' stress on the packs, which being man-made, would have limited strength and as such compression of the packs would be anticipated, albeit at a lower rate than the working panel. With a combination of roof failure along the roadway and pack compression closure or partial closure of the roadways would be anticipated. Assuming a typical cohesive strength of 1.0MPa for the coal at the panel edge suggests that at a depth of 29m the abutment stress could be in the order of 3.7MPa indicating that failure of the edge would be expected over time and as such the possibility that the edge of the workings might have extended eastwards into the site cannot be ruled out. A similar situation might exist for the Virtuewell workings to the north of the site, albeit they lie at a greater distance than those abutting the south-western edge of the site.

7.1 Mine Entries

There are no mine entries within or close to the site.

8.0 Potential Mine Gas Risk Assessment

Abandoned mine workings form a void or reservoir in which mine gasses may accumulate. Through various factors (type of mineral, method of working, presence of water etc.), the mine atmosphere may differ significantly in terms of composition from one site to another⁸. Depending on the type and the composition of mine gas, surface gas emissions may constitute several risks or nuisances for people and property. The safety of people may be affected if the gas is trapped in non-ventilated spaces (cellars, underground networks, etc.). The main dangers for people are: ignition or explosion (methane) and asphyxia / intoxication (carbon dioxide, carbon monoxide & hydrogen sulphide). A general description of mine gases and the cause for their presence in mine workings can be found in various publications^{9,10,11,12,13} relating to the subject. The likelihood that gas emissions will appear at ground surface from old workings depends on three main factors (1) the gaseous nature of the abandoned mine working, the type of gas present and the volume of the voids within the working (2) the degree of differential pressure between the mine working and the surface generated by the above mechanisms and (3) the resistance of the environment to gas migration e.g. mine-surface links, covering strata and water bearing horizons. Deep worked-out zones and zones that are completely flooded at the time of the assessment can be discounted on the assumption that the water will prevent the release of methane from the residual coal. An *initial* risk assessment, following the stages recommended by Pokryszka et al., is provided below.

8.1 Potential Pathways for Mine Gases

Employing the methodology outlined by Pokryszka et al., indicates that:

Data relating to the underground reservoir:

the mine gas characteristics of the seams are unknown. The site does not appear to have been undermined at the horizon of the Virtuewell Coal but workings abut the south-western edge of the site. With the method of mining by historical longwall (shortwall) failure of the overlying strata would be

⁸ Pokryszka, Z., Tauziède, C., Lagny, C., Guise, Y., Gobillot, R., Planchenhault, J.-M. and Lagarde, R., Gas Migration from Closed Mines to the Surface. Risk Assessment Methodology and Prevention Means, *Post-Mining, 2005*, November 16-17, Nancy, France.

⁹ Beard, J. T., *Mine Gases and Ventilation*, 2nd Ed. McGraw-Hill Book Company, Inc, 1920.

¹⁰ www.therhondda.co.uk. Mine Gases.

¹¹ Robinson, R. Mine gas hazards in the surface environment, *Trans, Instn Min. Metall. (Sect. A: Min. technol)*, 109, 2000.

¹² Sizer, K., Creedy, D. and Sceal, J., Methane and other gases from disused coal mines: the planning response, Summary Report, DOE, 1996.

¹³ Purdue, A. and Armstrong, H. Mine gas-a local authority view of stythe (blackdamp), *Trans, Instn Min. Metall. (Sect. A: Min. technol)*, 109, 2000.

anticipated, thereby closing off the mine workings but creating vertical fractures that could lead to the movement of mine gas. A borehole to the north of the site recorded collapsed workings at the horizon of the Virtuewell Coal from 23.20 to 24.50mbgl.

Data relating to covering strata:

The superficial deposits are in the order of 3 to 7m in thickness, dominantly boulder clay.

Information relating to hydrogeology:

The borehole to the north of the site recorded a heavy body of water noted at 23.20mbgl, the top of a packed waste at the horizon of the Virtuewell Coal, indicating that the workings at this horizon are flooded. Mine plan 10689 notes that the workings from the Meadowhead Pits to the north are flooded to a level of 530ft or 161.55m to OD. The presence of a number of collieries within the general area which worked the various seams provides an interconnection between the seams and as such there is the likelihood that the lower coal workings are also flooded.

Elements relating to seam structure:

Details of the seam(s) structure(s) and composition are unknown.

Data relating to ground occupation:

Existing property at 17 Meadowhead Road.

According to Tauziède et al¹⁴ *it is considered that a covering strata thickness of more than 200m is sufficient to form a barrier to the rise of gases other than through diffusion. This value has been adopted on the basis of models established in Europe for predicting the release of firedamp from longwall faces with caving – the mining method with greatest consequences in terms of destressing and fracturing of overlying strata. These models envisage no effect on strata beyond a height of 150 – 170 m above the caving.*

Guidance provided by CL:AIRE¹⁵ points out that *below 30m the risk of mine gas emissions reduces with increasing depth of the workings. Gas migration through the overlying ground from deep workings is not likely to cause significant emissions*

¹⁴ Tauziède, C., Pokryszka, Z and Barriere, J.-P. Risk assessment of surface emission of gas from abandoned coal mines in France and techniques for prevention, *Trans, Instn Min. Metall. (Sect. A: Min. technol)*, 111/Proc. Australas. Instn. Min. Metall. 307, 2002.

¹⁵ CL:AIRE, (2021) Good Practice for Risk Assessment for Coal Mine Gas Emissions.

at the surface (Appleton, 2011) unless there are shafts, faults or other pathways linking the workings to the surface. Significant pressure driven gas migration will not occur from workings below 200 m depth (Pokryszka et al., 2005). This is based on the assumption that rock above the workings will be highly fractured because of the subsidence to a height between 150 m and 170 m above the seam and that this releases gas from coal during mining (the point at which the highest methane emissions will occur). For older workings in the UK that have now been closed for over 15 years (i.e. the vast majority) a shallower depth is reasonable, given that the Lower and Middle Coal Measures tend to be dominated by mudstones.

Whilst the statement provided in the CL:AIRE guidance reiterates, in essence, the view expressed by Tauziède et al it must be remembered that the preface to the CL:AIRE guidance states that: *This document is a collation of current understanding of coal mine gas risks and seeks to assist in the formulation of appropriately robust mine gas risk assessments in the UK. Its contents cannot be considered as definitive, and the reader may wish to use additional methods to those presented. However, consideration of the guidance contained in this document and following the assessment procedures outlined, would demonstrate the reasonable practice and care expected of professional assessors.* Furthermore, the assumption is made *that rock above the workings will be highly fractured because of the subsidence to a height between 150 m and 170 m above the seam* which assumption does not take into account geomechanics applicable to longwall mining, nor does the guidance describe or refer to the zones of deformation and the height to which they may extend above a longwall working and whether the presence of such zones will permit or prohibit the movement of mine gas. Importantly, however, the guidance does point out that for older workings a shallow depth may be reasonable.

8.1.1 Conceptual Site Model

The simplified initial conceptual site model has taken into account that Virtuewell mine workings at circa 29 metres depth are present only along the south-western edge of the site and have been worked by the longwall method of mining. Based on the available information the workings ceased in 1931, 92 years ago, whilst the older workings to the east ceased some 108 years ago. Borehole and mine plan information indicates that the mine workings from the Meadowhead Pits are flooded. The workings in the Upper and Lower Drumgray seams lie at an estimated depth of 93m and 102m and ceased 122 and 130 years ago respectively. Recourse has therefore been made to consider the potential for mine gas to migrate from the

underlying workings to the ground surface through the application of geomechanics applicable to longwall mining.

8.1.2 Form of Deformation above Longwall Mining

In longwall mining with wide open excavated areas and large tensile stresses in the roof (in excess of the tensile strength), rock failure will result in mining subsidence. As described by numerous researchers, such as Bieniawski¹⁶ and Kendorski¹⁷ subsidence results in the formation of a number of zones above the mine working comprising a Caved Zone immediately above the workings, overlain by a Fractured Zone overlain by a Continuous Deformation Zone as described by the former author or a Caved Zone overlain by a fractured Zone, overlain by a Dilated Zone and in turn a Constrained or Aquiclude Zone overlain by a Surface Fracture Zone by the latter author. Through research the extent or height of each of these zones above the mine working can be related to the seam thickness.

Research published by Palchik¹⁸ with particular regard to the movement of mine gas above longwall mining refers to the zones previously mentioned and noted that the maximum heights of the zones of interconnected fractures may reach 19 to 41 times the seam thickness with the maximum heights to separate horizontal fractures (resulting from bed separation) ranging from 53 to 92 times the seam thickness, with both zones located within the fractured zone described earlier. From the information provided by Palchik the estimated mean and medium heights for the zone of interconnected fractures was 31.2 and 30.5 respectively, whilst for the separate horizontal fractures the estimated mean and medium heights were 71.8 and 73 respectively. The zone of interconnected fractures allows movement of the mine gas whereas the horizontal fractures only trap the gas. According to Palchik the ratio of the maximum values of the height of the interconnected fractures and thickness of the coal seam was linked with the thickness and stiffness (elastic modulus) of the overlying rock layers and the number of rock layer interfaces. This is a fundamental tenet of mining subsidence in that greater subsidence will occur if the overlying strata are less stiff with decreasing subsidence if the overlying strata are stiffer. Thus, the maximum height of the zone is dependent upon the stiffness (elastic modulus) of the immediate roof and overlying strata and the seam thickness and cannot be

¹⁶ Bieniawski, Z. T., (1987), *Strata control in mineral engineering*. A. A. Balkema, Rotterdam

¹⁷ Kendorski, F. (2006) Effect of Full-Extraction underground Mining on Ground and Surface Waters A 25 – Year Retrospective, *25th Int. Conf. on Ground Control*.

¹⁸ Palchik, V. (2003), Formation of fractured zone in overburden due to longwall mining, *Environmental Geology*, 44:28-

related to a single 'rule of thumb' such as 150m of overburden. Applying a ratio of 31 times a workings section of 0.74m for the Virtuewell seam would suggest that the maximum height of the zone of interconnected fractures could lie 23m above the workings i.e. within the superficial deposits. Assuming an excavated thickness of 0.58m for the Upper Drumgray would suggest that the height of the separate horizontal fractures might have extended to 42.34m above the seam and as such would not intersect the Virtuewell workings. With a working section of 0.75m the maximum height of the zone of interconnected fractures could lie 23.25m above the Lower Drumgray; applying the median factor of 73 would suggest that the height of the zone for the interconnected and separate horizontal fractures could extend to 54.75m above the seam, and as such would intersect with the Upper Drumgray workings, some 9 metres above. However, the dates of the workings indicate that the Lower Drumgray was worked first, circa 1893 followed by the Upper Drumgray circa 1901 and then by the Virtuewell circa 1931. The effect of mining at the horizon of the Lower Drumgray would have affected the strata at the horizon of the Upper Drumgray which in turn would have extended the deformation zones above. Notwithstanding, it is estimated that these zones would not extend to the Virtuewell workings above. With several collieries within the local area and the seams interlinked it is likely that mine gas might have / had pathways to allow it to move between the seams. However, given the flooded nature of the workings movement of mine gas can now be discounted on the assumption that the water will prevent the release of methane from the residual coal.

Accordingly, taking into account the age of the workings, method of mining, the indication from the borehole to the north and mine plan information that the underlying mine workings are flooded and that failure of the overlying strata has taken place thereby reducing movement of any mine gas and the presence of boulder clay at surface, it is considered the risk of mine gas, if present within the Virtuewell mine workings, migrating to the surface is low. The risk of mine gas, should it be present, within the Upper and Lower Drumgray workings migrating to the surface is considered very low.

8.2 Potential Receptors

Potential human receptors could include nearby residential properties to the east and south and occupiers of the proposed new development albeit as mentioned above, the level of risk is low.

8.3 Source-Pathway-Receptor Linkages

Based on the available information mine gases may be present in the coal mine workings. Accordingly, and in line with current guidance, it should be presumed that there is a potential source-pathway-receptor mine gas linkage from coal mine workings within the site. However, based on the available information it is considered that the level of risk is low.

9.0 Spontaneous Combustion

A reasonable search revealed very little information on spontaneous combustion of coal mines within the United Kingdom (UK) however an information circular published by the United States Bureau of Mines¹⁹ gives an insight into the causes of spontaneous combustion whilst Smith et al.,²⁰ provide a methodology to predict the spontaneous combustion potential of an underground coal mine. Research by Kayakci and Didari²¹ and Wang et al²² give an insight into the relationship between coal properties and spontaneous combustion parameters and coal oxidation at low temperatures. The latter authors indicate that research substantiates that the major product of the oxidation of coal is carbon dioxide and not carbon monoxide as historically thought.

The Coal Authority website which lists those coal seams with a history of spontaneous combustion²³ makes no reference to the Virtuewell, Upper Drumgray and Lower Drumgray Coals within the Scotland area and as such it is not possible to determine directly from this source whether or not these seams are susceptible to spontaneous combustion. However, it is to be noted that the guidance on hazardous gases points out that the list is by no means exhaustive and as such efforts should be made to establish whether or not a particular seam is known to be prone to spontaneous combustion. The historical reference²⁴, makes no mention of these seams, thus the risk of spontaneous combustion of these seams is considered low.

¹⁹ United States Bureau of Mines Information Circular/1995, Analysis of Underground Coal Mine Fire Incidents in the United States From 1978 Through 1992. Department of the Interior.

²⁰ Smith, A. C., Rumancik, W. P. and Lazarra, C. P., Sponcom- A computer program for the prediction of the spontaneous combustion potential of an underground coal mine, (undated).

²¹ Kayamci, E. and Didari, V, Relations between Coal Properties and Spontaneous Combustion Parameters, *Turkish J. Eng. Sci.*, 26, (2002), 59-64.

²² Wang, H., Dlugogorski, B. Z. and Kennedy, E. M., Coal oxidation at low temperatures: oxygen consumption, oxidation products, reaction mechanism and kinetic modelling, *Progress in Energy and Combustion Science*, 29 (2003), 487-513.

²³ <https://www.gov.uk/government/publications/coal-seams-with-a-history-of-spontaneous-combustion>

²⁴ First Report of the Departmental Committee on Spontaneous Combustion of Coal in Mines, Home Office 1914.

10.0 Conclusions and Recommendations

It is considered that the designation of the site as lying within a *Development High Risk Area* is due to the presence of shallow recorded mine workings at the horizon of the Virtuewell Coal seam at a depth less than 30m below ground level. However, information from the abandonment appears to indicate that the site is not directly undermined at the horizon of the Virtuewell Coal but workings in this seam appear to abut the south-western edge of the site. The workings were conducted by the longwall method of mining. Whilst borehole records indicate that the workings have collapsed and are flooded there can be no guarantee at this juncture that the workings do not present a stability problem. It is therefore recommended that a mining investigation be carried out to determine the depth, extent, state and condition of the underlying Virtuewell Coal workings, particularly within the south-western corner of the site. In this regard it is recommended that one rotary cored borehole be carried out within the south-western corner of the site to determine the limit of the workings and whether they are open and extend into the site. A second rotary cored borehole is recommended at the northern boundary of the site to confirm the accuracy of the limit of workings from the north and to ensure that they are not open and do not extend into the site. Depending on the returns of the first two boreholes, a third borehole may be required to clarify the mineral position. Given the flooded nature of the workings it is suggested that drilling be carried out using air mist as opposed to water in order to allow confirmation that the workings are flooded. It is also suggested that the core of strata recovered be logged per lithology.

11.0 Identification and Assessment of Mining Risks

Workings in the Virtuewell Coal seam abut the south-western edge of the site. Mine gas may be present in the coal mine workings however, the potential for migration to the ground surface is considered to be low.

A summary of the risk identified is summarised in Table 1

Assessment of Cumulative Impact of Mining Issues:

Table 1: Coal Mining Risk Assessment						
Sources of Information Used in the Assessment: Refer to Section 2 of the Mining Risk Assessment.						
Mining Issue	Recorded		Comment	Potential Hazard(s)	Potential Affect(s)	Potential Mitigation Measure(s)
	Yes	No				
a) Underground mining recorded at shallow depths (<30m).	✓		Not according to the Coal Authority Interactive Map View Available borehole information suggest that the Virtuewell could lie at a depth less than 30m.	Ground subsidence. Formation of crown holes.	Subsidence from unrecorded mine workings may result in ground instability, damage to any new development and or infrastructure on the development area. Harm to human health, injury or death of site users.	A mining investigation is recommended in order to determine the depth, extent, state and condition of the workings within the south-western corner of the site and along the north boundary.
b) Underground mining probable (unrecorded) at shallow depths (<30m).		✓	The Coal Authority Interactive Map View discloses that the mine does not lie within the area of probable (unrecorded) shallow mine workings.	Ground subsidence. Formation of crown holes.	Subsidence from unrecorded mine workings may result in ground instability, damage to any new development and or infrastructure on the development area. Harm to human health, injury or death of site users.	Not applicable
c) Mine entries (shafts and adits) within or within 20m of the site.		✓	The Coal Mining report and examination of geological map indicate that there are no recorded mine entries within or close to the site.	Collapse (possibly sudden) of pit shaft, formation of large open void at surface or partial collapse of shaft leading to subsidence above/adjacent to pit shaft. Mine Gas Emissions.	Collapse of a pit shaft/adit may cause the formation of an open void or subsidence of ground surface within or adjacent to the site. Harm to human health, injury or death to members of the public and or occupiers/owners.	Not applicable.

d) Mining geology (faults and fissures)		✓	Not applicable	<p>Ground subsidence.</p> <p>Mixtures of noxious of explosive gases react ground surface via superficial deposits, faulted strata, or zones of fractured strata overlying the mine workings and entering confined spaces in structures when an explosive or asphyxia hazard may be generated.</p> <p>Stepped rockhead prof where there has been subsidence across faults impacting settlement of proposed structures.</p>	<p>A fault can provide zones of weakness due to broken damaged rock which may lead to ground movement and where coal mine workings are present can provide the potential for mine gas to migrate to ground surface via the fault zone.</p>	<p>The potential for mine gas should form part of any proposed investigation for the site.</p>
e) Record of past mine gas emissions or potential		✓	Not according to the Coal Mining Report	<p>Mixtures of noxious of explosive gases reaching ground surface via superficial deposits, faulted strata, or zones of fractured strata overlying the mine workings and entering confined spaces in structures where an explosive or asphyxiating hazard may be generated.</p>	<p>Harm to human health, injury or death of potential site users, the public and or maintenance staff.</p>	<p>The potential for mine migrate to the surface should be considered as part of any development proposal on a mineral field. As workings underlie the site any proposal to develop the site must consider the potential for mine gas to ground surface.</p>
f) Recorded surface hazard		✓	Not applicable	<p>Backfilled opencast sites / Presence of slurry ponds / deep fill.</p>	<p>Harm to human health, injury or death of potential site users and or the public.</p>	<p>Not applicable.</p>

g) Surface mining opencast workings: is the site within the boundary of a surface mining/opencast site from which minerals have been removed.		✓	Not according to Coal Authority Interactive Map View or the Coal Mining Report.	Ground subsidence. Thick deposits of backfill may provide a pathway for mine gas.	Subsidence from backfill may result in long-term ground movement / subsidence causing damage to any new development and or infrastructure on the site. Harm to human health, injury or death of potential site users, the public and or maintenance staff.	Not applicable.
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Assessment of Cumulative Impact of Mining Issues:

The site lies within a *Development High Risk Area* due to the presence of shallow recorded mine workings at the horizon of the Virtuewell Coal seam at a depth less than 30m below ground level. Whilst the site does not appear to be undermined at the horizon of the Virtuewell Coal it is noted that workings in this seam abut the south-western edge of the site. Borehole records and mine plan information indicate that the workings have collapsed and are flooded, however, there can be no guarantee at this juncture that the workings do not present a stability problem. It is therefore recommended that a mining investigation be carried out to determine the depth, extent, state and condition of the underlying mine workings at the horizon of the Virtuewell Coal, particularly within the south-western corner of the site and at the northern boundary to confirm that the limit of the workings does not extend into the site. One rotary cored borehole is recommended for the south-western corner with a second rotary cored borehole to be undertaken at the northern boundary of the site. Depending on the returns of the first two boreholes, a third may be required.

Mine gas may be present in the coal mine workings however, the potential for migration to the ground surface is considered to be low.

Prior to carrying out any works which may intersect, disturb or enter any coal seams, coal mine workings or mine entries (within the ownership of the Coal Authority), the written permission of the Coal Authority shall be obtained.

APPENDIX A

CON29 COAL AUTHORITY REPORT



The Coal
Authority

CON29M

coal mining report

17 MEADOWHEAD ROAD, PLAINS, NORTH LANARKSHIRE, ML6 7JF



Known or potential coal mining risks

Past underground coal mining	Page 4
Future underground coal mining	Page 4
Mine entries	Page 5



Further action

No further reports from the Coal Authority are required. Further information on any next steps can be found in our Professional opinion.

For more information on our reports please visit www.groundstability.com



Professional opinion

According to the official mining information records held by the Coal Authority at the time of this search, evidence of, or the potential for, coal mining related features have been identified. In view of the coal mining circumstances we would recommend that any planned or future development should follow detailed technical advice before beginning work on site. Please see page 3 for further details on Future development.

Your reference: MEAO
Our reference: 51003388675001
Date: 11 November 2023

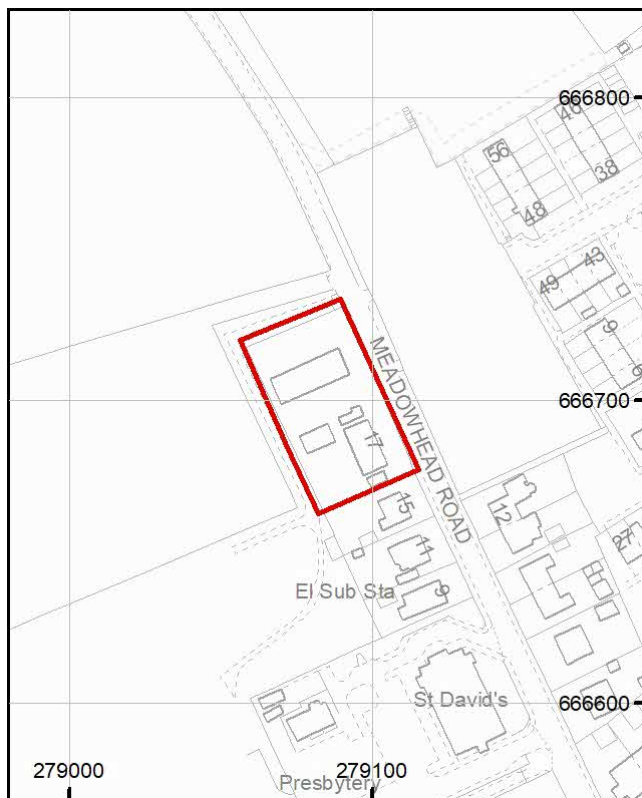
Client name:
Andy Whyte

If you require any further assistance please
contact our experts on:
0345 762 6848
groundstability@coal.gov.uk

Enquiry boundary

Key

Approximate position of enquiry boundary shown



We can confirm that the location is **on the coalfield**



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This report is prepared in accordance with the latest Law Society's Guidance Notes 2018, the User Guide 2018 and the Coal Authority's Terms and Conditions applicable at the time the report was produced.



Accessibility

If you would like this information in an alternative format, please contact our communications team on 0345 762 6848 or email communications@coal.gov.uk.

Professional opinion



Future development

If development proposals are being considered, technical advice relating to both the investigation of coal and former coal mines and their treatment should be obtained before beginning work on site. All proposals should apply specialist engineering practice required for former mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or coal mines without first obtaining the permission of the Coal Authority.

MINE GAS: Please note, if there are no recorded instances of mine gas within the enquiry boundary, this does not mean that mine gas is not present within the vicinity. The Coal Authority Mine Gas data is limited to only those sites where a Mine Gas incident has been recorded. Developers should be aware that the investigation of coal seams, mine workings or mine entries may have the potential to generate and/or displace underground gases. Associated risks both to the development site and any neighbouring land or properties should be fully considered when undertaking any ground works. The need for effective measures to prevent gases migrating onto any land or into any properties, either during investigation or remediation work, or after development must also be assessed and properly addressed. In these instances, the Coal Authority recommends that a more detailed Gas Risk Assessment is undertaken by a competent assessor.

If you are looking to develop, or undertake works, within a coal mining development high risk area your Local Authority planning department may require a Coal Mining Risk Assessment to be undertaken by a qualified mining geologist or engineer. Should you require any additional information then please contact the Coal Authority on 0345 762 6848 or email cmra@coal.gov.uk.

Detailed findings

Information provided by the Coal Authority in this report is compiled in response to the Law Society's CON29M Coal Mining enquiries. The said enquiries are protected by copyright owned by the Law Society of 113 Chancery Lane, London WC2A 1PL.

The Coal Authority owns the copyright in this report and the information used to produce this report is protected by our database rights. All rights are reserved and unauthorised use is prohibited. If we provide a report for you, this does not mean that copyright and any other rights will pass to you. However, you can use the report for your own purposes.

1 Past underground coal mining

The property is in a surface area that could be affected by underground mining in 3 seams of coal at shallow to 120m depth, and last worked in 1927.

The property is in a surface area that could be affected by underground mining in 1 seam of ironstone at 170m depth, and last worked in 1885.

2 Present underground coal mining

The property is not within a surface area that could be affected by present underground mining.

3 Future underground coal mining

The property is not in an area where the Coal Authority has received an application for, and is currently considering whether to grant a licence to remove or work coal by underground methods.

The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.

The property is not in an area likely to be affected from any planned future underground coal mining.

However, reserves of coal exist in the local area which could be worked at some time in the future.

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

4 Mine entries

There are no recorded coal mine entries known to the Coal Authority within, or within 20 metres, of the boundary of the property.

This information is based on the information that the Coal Authority has at the time of this enquiry.

Based on the Coal Authority's knowledge of the mining circumstances at the time of this enquiry, there may be unrecorded mine entries in the local area that do not appear on Coal Authority records.

5 Coal mining geology

The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.

6 Past opencast coal mining

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

7 Present opencast coal mining

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

8 Future opencast coal mining

There are no licence requests outstanding to remove coal by opencast methods within 800 metres of the boundary.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

9 Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

10 Mine gas

The Coal Authority has no record of a mine gas emission requiring action.

11 Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Coal Authority, under its Emergency Surface Hazard Call Out procedures.

12 Withdrawal of support

The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

13 Working facilities order

The property is not in an area where an order has been made, under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

14 Payments to owners of former copyhold land

The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Statutory cover



Coal mining subsidence

In the unlikely event of any coal mining related subsidence damage, the Coal Authority or the mine operator has a duty to take remedial action in respect of subsidence caused by the withdrawal of support from land or property in connection with lawful coal mining operations.

When the works are the responsibility of the Coal Authority, our dedicated public safety and subsidence team will manage the claim. The house or land owner (“the owner”) is covered for these works under the terms of the Coal Mining Subsidence Act 1991 (as amended by the Coal Industry Act 1994). Please note, this Act does not apply where coal was worked or gotten by virtue of the grant of a gale in the Forest of Dean, or any other part of the Hundred of St. Briavels in the county of Gloucester.

If you believe your land or property is suffering from coal mining subsidence damage and you need more information on what to do next, please use the following link to our website which sets out what your rights are and what you need to consider before making a claim.

www.gov.uk/government/publications/coal-mining-subsidence-damage-notice-form



Coal mining hazards

Our public safety and subsidence team provide a 24 hour a day, 7 days a week hazard reporting service, to help protect the public from hazards caused by past coal workings, such as a mine shaft or shallow working collapse. To report any hazards please call 0800 288 4242. Further information can be found on our website: www.gov.uk/coalauthority.

Glossary



Key terms

adit - horizontal or sloped entrance to a mine

coal mining subsidence - ground movement caused by the removal of coal by underground mining

Coal Mining Subsidence Act 1991 - the Act setting out the duties of the Coal Authority to repair damage caused by coal mining subsidence

coal mining subsidence damage - damage to land, buildings or structures caused by the removal of coal by underground mining

coal seams - bed of coal of varying thickness

future opencast coal mining - a licence granted, or licence application received, by the Coal Authority to excavate coal from the surface

future underground coal mining - a licence granted, or licence application received, by the Coal Authority to excavate coal underground. Although it is unlikely, remaining coal reserves could create a possibility for future mining, which would be licensed by the Coal Authority

mine entries - collective name for shafts and adits

mine gas - reports of alleged mine gas emissions received by the Coal Authority within the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission. Please note, if there are no recorded instances of mine gas reported, this does not mean that mine gas is not present within the vicinity. The Coal Authority Mine Gas data is limited to only those sites where a Mine Gas incident has been recorded

payments to owners of former copyhold land - historically, copyhold land gave rights to coal to the copyholder. Legislation was set up to allow others to work this coal, but they had to issue a notice and pay compensation if a copyholder came forward

shaft - vertical entry into a mine

site investigation - investigations of coal mining risks carried out with the Coal Authority's permission

stop notice - a delay to repairs because further coal mining subsidence damage may occur and it would be unwise to carry out permanent repairs

subsidence claim - a formal notice of subsidence damage to the Coal Authority since it was established on 31 October 1994

withdrawal of support - a historic notice informing landowners that the coal beneath their property was going to be worked

working facilities orders - a court order which gave permission, restricted or prevented coal mine workings