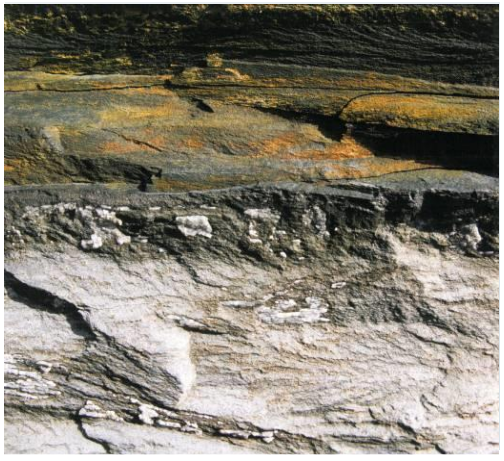
Windfarm development, Breezyhill West, East Ayrshire

Mining Stability Report Including Past Mining Risk Assessment

September 2023



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CONTROL SHEET

CLIENT: **Brockwell Renewable Solutions Ltd**

PROJECT TITLE: **Windfarm Development, Breezyhill West, East Ayrshire**

REPORT TITLE: **Mining Stability Report including Past Mining Risk Assessment**

PROJECT REFERENCE: **156265B/GL/J/R1**

	Issue 1 Final	Name	Signature	Date
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Appendices

1.0 Title

Report relative to the mining stability under and adjacent to the site of a proposed windfarm development at Breezyhill West, East Ayrshire (including Past Mining Risk Assessment).

2.0 Instructions

This Report has been prepared by JWH Ross as instructed by the Client, Brockwell Renewable Solutions Ltd; email instruction dated 20th July 2023 refers.

The extent of past mining in minerals other than coal, e.g., ironstone, fireclay and limestone, within Central Scotland is considerable, and often overlooked. This report addresses mining stability in relation to all mineral extraction. It is particularly noted that subsidence damage caused by the extraction of minerals other than coal is not covered by the Coal Mining (Subsidence) Act 1991.

This Report includes a Past Mining Risk Assessment, as may be required under the Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2008, where a project is located within a Coal Mining Development Referral Area.

3.0 Limitations

This Report is for the private and confidential use of the Client(s) for whom the Report is undertaken and should not be reproduced in whole or in part, or relied upon by third parties for any use whatsoever. JWH Ross accepts no duty or responsibility (including negligence) to any party other than the stated Client(s) and disclaims all liability of any nature whatsoever to any such party in respect of this Report.

The Report is based on the geological and mining records at present available. The contents of the Report are believed to be accurate but since mining records and information for this District may be incomplete, we cannot accept responsibility for any insufficiency or inaccuracy in the information provided.

We must advise that this Report only examines the solid geology and associated minerals; it is not to be construed as inferring that the engineering or chemical properties of the natural or man-made superficial deposits are satisfactory or otherwise, since these latter matters are outwith the scope of our Brief.

4.0 Subjects

The Subjects comprise approximately 850 hectares of land at a site known as Breezyhill West, the western boundary of the site is located approximately 1.7 km to the south-east of the village of Rankinston, East Ayrshire. The site currently predominantly comprises forestry land, the site area is shown outlined in red on appended Drawing No. 156265B/9001 and is approximately centred on National Grid co-ordinates NS 48296, 12476. At the time of reporting, we understand that the current proposals relate to the development of a new windfarm including turbines, working areas and associated access roads.

For the purposes of this assessment we have considered the Subjects in two discrete areas as indicated on appended Drawing Number 156265B/9001. These areas have been determined based the risk attributable to factors including the underlying geology, evidence of past mineral extraction and likelihood of unrecorded extraction which may affect the future surface stability.

5.0 Researches

In connection with this investigation we have researched and taken into account information from the undernoted sources:-

- Published geological maps, including:
    - County Series Ayrshire XL SE, Ayrshire XL NE, Ayrshire XLVI NE, Ayrshire XLI SW and Ayrshire XLI NW
    - National Grid Series NS 41 SE and NS 51 SW.
- Historical Ordnance Survey topographical maps prepared to scales of 1:2500 and 1:10560
- Memoirs of the Economic Geology of the Ayrshire Coalfields Area IV, published in 1932
- Abandonment plan catalogues, mine plan records and previous mineral investigation Reports held in the mining Archives of JWH Ross
- Non-confidential borehole data held by the British Geological Survey
- Previous Mineral Investigation Reports and borehole records held in the Archives of JWH Ross.

6.0 Background Geology

According to published geological information, the Subjects are underlain by solid strata belonging to two sedimentary rock formations, namely the Scottish Middle Coal Measures and the Scottish Lower Coal Measures. The sedimentary strata are inferred to dip in various directions throughout the site at very gentle gradients. The aforementioned published records also infer that areas of the site are underlain by later igneous rocks, which have been intruded into the surrounding sedimentary strata along with pyroclastic deposits.

We have shown the Geological setting and outcrop positions of significant mineral seams as derived from the National Grid Series Geological Plans (NS 41 SE and NS 51 SW) on appended Drawing No, 156265B/9002. A general description of each of these rock formations and mining operations undertaken within them is given below along as derived from the Economic Memoirs for the District, mining records and the published geological mapping, with detailed findings in each of the separate areas of the site described in section 8 of this report.

The aforementioned geological plans infer that the continuity of the strata across the site has been considerably disrupted due to a number of geological faults that traverse through the area under review. We have shown the conjectured line of these faults as derived from the National Grid Series Geological Plans on appended Drawing No. 156265B/9002.

We should explain the nature of geological faults and the uncertainties which attend their precise position underground and at the surface. Faults are planes of movement about which adjacent blocks of rock strata have moved relative to each other. They are seldom vertical and commonly consist of zones, perhaps up to several tens of metres wide, containing several fractures. The portrayal of faults as a straight line is therefore a generalisation.

Scottish Middle and Lower Coal Measures Formations

The rocks of the Scottish Middle and Lower Coal Measures are sedimentary in nature and comprise cycles of sandstones, mudstones and siltstones with numerous seams of coal.

In order that the relationships between each mineral horizon in the Scottish Middle and Lower Coal Measures may be better appreciated, we have shown below, in tabular form, the general succession together with the approximate depth to the principal seams. The succession is derived from the Economic Memoir for the District and it should be noted that, due to the diminished development of the seams in this area, some ambiguity exists as to the identification of some seams, these have been identified in parenthesis. A coal seam, understood to be the Ayr Hard Coal and inferred as such in the Economic Memoir for the District, has been taken as a convenient datum. This section is given as a rough guide only since the thickness of the seams and strata intervals can vary considerably over distance.

Seam	***Thickness (m)***	***Approx. Depth (m)***
Scottish Middle Coal Measures		
Coal (Ayr Hard?)	*0.7*	*0 - relevant datum*
Coal (Minnivey?)	*0.9*	*20*
Sloanstone Coal	*0.4*	*51*
Scottish Lower Coal Measures		
2'3" Pennyvenie Coal	*0.5*	*71*
2'7" Pennyvenie Coal	*0.6*	*82*
Low Camlarg Coal	*0.5*	*104*
Pennyvenie High Coking Coal	*1.0*	*117*
Pennyvenie Splint Coal	*0.7*	*126*
Pennyvenie Low Coking Coal	*0.7*	*135*

In the area under review the Economic Memoir for the District suggests that the mineral horizons are less developed hereabout than elsewhere in the Ayrshire Coalfield, noting "*they are as a rule thin in comparison with corresponding seams farther south-eastwards*".

Published geological plans covering the Subjects are notably devoid of outcrop positions for significant coal seams contained within the Scottish Middle and Lower Coal Measures, suggesting that little is known about the sequence in the area.

Igneous Rocks

In addition to the sedimentary strata underlying the Subjects, much of the site is inferred to be underlain by Intrusive igneous rocks of the Western Midland Valley Westphallian to Early Permian Sills. These rocks are noted to be composed of Quartz-microgabbro or Dolerite (whinstone) and were intruded into the surrounding sedimentary strata. We have shown the conjectured recorded extent of these igneous rocks as derived from the National Grid Series Geological Plans by means of green shading on appended Drawing No. 156265B/9002. The Economic Memoir for the District Notes that "*this portion of the Ayrshire Coalfield is notable for the number of thick whinstone sills that have been intruded in the Coal Measures, and for the extensive areas occupied by the surface outcrops*".

Under such circumstances, where intruded igneous rock is juxtaposed against much older sedimentary strata, it commonly results in the surrounding rock becoming heat affected and mineralogically altered. Where this strata contains coal seams and other workable minerals, the

resultant effect of the foregoing alters their characteristics, often reducing their quality and leaving them largely uneconomical to extract.

Moreover, there are two areas noted to be underlain by pyroclastic rocks of the Ayrshire Basanitic and Foiditic Plugs and Vents. These are also shown on the aforementioned drawing by means of orange shading.

While the intrusive sills are formed by magma exploiting lines of weakness within the surrounding strata, and cooling therein to form igneous layers, the pyroclastic deposits are related to volcanic eruptions and are those formed from clastic material ejected from volcanoes including ash and vent material.

7.0 Past Mining

This section of the report gives an overview of past underground and surface (opencast) mining in the area under review. Detailed findings for each area of the site are given in section 9 below.

Past underground mining has been undertaken in the wider District within mineral seams belonging to the Scottish Middle and Lower Coal Measures, mainly in the areas to the west near Rankinston and Bowhill, and to the south near Dalmellington and Pennyvenie.

Our search of Abandoned Mine Plan Catalogues, “Unsigned” Mining Plans held by the Coal Authority and records held within the Archives of JWH Ross however, has revealed no plan records pertaining to workings extending under or within influencing distance of the Subjects.

We should point out, however, that the winning and working of the minerals in this District commenced an extremely long time ago, before it became a statutory requirement to keep plans of mines (1850) and to lodge with the Secretary of State all plans of abandoned mines (1872). Consequently, the plan record information at our disposal may be incomplete and the possibility that early uncharted workings may have taken place must be fully considered.

As previously mentioned, the published geological plans are generally devoid of outcrop positions of any significant mineral horizons. This lack of information is perhaps suggestive of a lack of mineral exploration or extraction in the area.

The Economic memoir for the area suggests that the coal seams of the Scottish Middle and Lower Coal Measures in the area have been significantly altered by heat related to the intrusion of the igneous rocks, this process rendering them of inferior quality and in most cases valueless.

The memoir notes, “*Between the Headmark and Littlemill Faults the sills have produced much damage in the coal seams... As on consequence of this geological feature, little or no coal-mining has been possible in this area. All the Coal Measures coals have been ‘burnt’ to some extent*”. The Headmark fault being situated to the South-east of the Subjects and Littlemill Fault to the north-west.

Nevertheless, our research has revealed the positions of two mine entries within the southern area of the site. While we have uncovered no recorded workings in connection therewith, the presence of the mine entries suggests that there may have been localised unrecorded extraction in this area at an early date. These mine entries, and the possibility of underground workings relating thereto are discussed in sections 9 and 11 of this report.

We would note the presence of opencast workings in the Gibson’s Hill area of the site related to the north extension of the Chalmerston Opencast Mine, understood to have been excavated in the late 2000’s to early 2010’s. We have been unable to obtain completion records for these workings nor

information pertaining to the targeted mineral seam. We have shown on appended Drawing 156265B/9003 the approximate extent of the opencast working.

8.0 JWH Ross Past Mining Risk Assessment

8.1 Definition

"Risk" is a combination of the likelihood of an "occurrence" and the assessment of the severity of the consequences. This can be discussed with reference to a variety of scenarios, i.e., risk to life, risk to property and risk of financial loss.

The magnitude of risk relative to each scenario will depend on a number of factors (such as accessibility to personnel, existence of structures or the interruption of services). In addition the perception of risk will depend on such considerations as the background knowledge of the persons involved and the degree of their involvement.

The assessment of risk to proposed or existing surface development from subsidence effects due to historic mining is a difficult process requiring significant professional judgement and experience. This process is complicated by the fact that the information needed to make an assessment with a high degree of confidence is incomplete and involves uncertainty.

Unless otherwise stated, the JWH Ross risk rating of potential mining subsidence makes the following presumptions that the risk:

- is derived from underground mineral workings (including coal)
- excludes the risk of mine entries (covered separately in our separate section on old shafts and adits)
- relates to typical residential development
- excludes likelihood of occurrence within a timeframe

8.2 Recorded Mine workings

Where "Abandonment" or "Unsigned" mine plan record information exists, the principal contributing factors that influence the assessment of potential future mining subsidence are:

- The thickness of the mineral
- The inclination of the strata
- The extraction height of the workings
- The number of seams worked and any interaction between them
- The mining technique utilised
- The extraction ratio
- Roof conditions
- The date of the workings
- The extent of mine workings and the perceived accuracy thereof
- The layout of the workings in relation to the proposed development
- The thickness and nature of overlying rock strata

- The thickness and nature of overlying superficial deposits
- The condition of the working (void, collapsed, partially collapsed)
- The influence of geological faults and igneous intrusions
- Information obtained from boreholes

8.3 Unrecorded Mine Workings

Early mining was somewhat secretive due to lack of legislation regarding the keeping of plan records and rivalry between mining companies. Early mining was also generally at shallow depth in the best and thickest seams.

Under the "Past Mining" section of the Coal Authority Report may be/is contained the sentence *"However you may wish to know that the property is in an area where coal is believed to exist at or close to the surface that may have been worked at some time in the past"*. This is a direct reference to the possible presence of unrecorded extraction, i.e., workings that may have taken place prior to the time that it became a statutory requirement to keep or lodge Abandonment Plans.

An assessment of the potential for shallow unrecorded workings to exist must take into account additional wider ranging information sources and factors, including but not limited to:

- The degree of economic importance of the relevant seams to the early mineral operators
- Local thickness and quality of the seam(s) in question
- Evidence that may be obtained from plan record information in the wider surrounding area, e.g., did the up-dip recorded workings encounter "old waste"?
- The position of known old pit shafts and adits in the locality in relation to geological structure and recorded/unrecorded mining
- Borehole data on a wider basis providing information on the thickness and quality of the seam

8.4 JWH Ross Risk Rating

For the specific purposes of this Report, we have adopted the categories of high, moderate and low, to represent a simplified risk assessment of potential instability due to past mining activity. The sections of the site to which these categories apply are shown by means of red hatching (high risk), blue hatching (moderate risk) and green hatching (low risk) on the appended Drawings. Sections with negligible or no risk are unhatched.

These categories are based on:

a) a scale of likelihood of an abandoned underground mine working (recorded or unrecorded) being present within critical depth, beneath or within lateral influencing distance of the route. Critical depth is normally taken to equate to overlying rock strata being 10 times the extraction height, however, this can vary considerably due to the influence of other factors, e.g., the method of extraction.

b) the estimated depth range expressed as the thickness of overlying rock strata in relation to the extraction height.

The below table outlines the criteria for each of the risk ratings adopted.

JWH Ross Risk Matrix	Seam at or near outcrop	Seam with relatively low ratio of rock cover	Seam with relatively high ratio of rock cover	Seam outwith critical depth / not present
Recorded workings identified or unrecorded workings confirmed/suspected	High	High	Moderate	Negligible
Unrecorded workings possible	High	Moderate	Low	Negligible
Unrecorded workings unlikely	Moderate	Low	Low	Negligible
No workings suspected/ strata devoid of workable minerals	Negligible	Negligible	Negligible	Negligible

9.0 Results of Research

Our account of past mining and interpretation of the geological structure pertaining to the principal seams that influence the assessment of mineral stability is set out below. To facilitate our description of underlying conditions, we have considered the Subjects in two discrete areas as indicated on appended Drawing No. 156265B/9001. These areas have been determined based on the risk attributable to factors including the underlying geology, evidence of past mineral extraction and likelihood of unrecorded extraction which may affect the future surface stability.

9.1 Area 1

Area 1 is located in the southern half of the site, bound to the north by a geological fault which displaces the strata down to the south. The area contains the Brown Rig and Gibson's Hill areas along with the Shield Burn, Hawford Burn and Water of Coyle.

The National Grid Series plan infers that the strata hereabouts dip only at very gentle gradients, with horizontal bedding encountered in numerous localities throughout the area.

The Lower Coal Measures are inferred to underlie the eastern and central parts of the area, with the overlying Middle Coal Measures present in a strip trending north to south through the central western part of the area. This is illustrated on appended Drawing No. 156265B/9002.

The mapping pertaining to the area is largely devoid of outcrop positions for any significant mineral horizons, with only the conjectural outcrop positions of the 2'3" Pennyvenie Coal and 2'7" Pennyvenie Coal inferred to encroach beneath the southern site boundary. These conjectured outcrop positions are shown on appended Drawing no. 156265B/9002

In addition to the sedimentary strata, the geology of the area is characterised by the presence of igneous rocks, the majority of which comprise Dolerite (whinstone) sills. These sills are inferred by the National Grid Series mapping to be present at rockhead beneath the north-eastern and western parts of Area 1. We have shown the Dolerite Intrusive rocks by means of green shading on appended

drawing No. 156265B/9002. The mapping also infers the presence of a volcanic plug, which we have shown by means of orange shading on the aforementioned drawing, near the eastern boundary of the site. This is noted to comprise pyroclastic ash deposits.

We have found no plan records of any underground mineral extraction having taken place beneath Area 1. The general lack of mapped outcrops of mineral horizons may be indicative of a lack of exploration and workings which would lead to a greater understanding of the strata.

As noted in section 7, the Economic Memoir for the District suggests that the mineral seams within the area have been significantly heat altered by the intrusive igneous rocks. The National Grid Series geological plan indicates the position of several historic boreholes situated throughout the area. Annotations around these bores indicate that tany coal seams were encountered in a 'burnt' condition and that sills were commonly encountered. It is notable that the coals encountered have not been named according to the local general succession of strata, again suggestive of their alteration. This is concurrent with the inference that the seams have been rendered of little to no value in the area due to the interaction with the intrusive igneous rocks.

Despite the prevalence of igneous activity in the area, we hold in our possession a mine plan that provides the location of two former mine entries (adits) located within the southern half of the area, suggesting that some attempt may have been made to extract the minerals from this locality. We have shown the plotted positions of the two mine entries on appended Drawing No.156265B/9003.

While the corresponding plan provides no records of extraction carried out via these adits, extrapolating the conjectural outcrop lines of the two Pennyvenie Coals beyond the southern site boundary in the direction of Area 1, we might surmise that these features are broadly located upon the outcrop lines and served to extract these seams

After considering the foregoing factors, and with the general lack of site specific boreholes, as a conservative approach, we have assigned the area shown hatched in blue on appended Drawing No. 156265B/9003 as moderate risk.

Area 1 has also been subject to surface workings related to the Chalmerston North Extension Opencast Mine, excavated as recently as the early 2010's. We have shown on Drawing No. 156265B/9003 the approximate extent of the opencast excavations.

We understand that the opencast site has been earmarked for backfilling and restoration works, however we cannot confirm to what extent the works have been undertaken. Similarly, we cannot comment on the nature or suitability of and backfill materials, as this is related to geotechnical properties rather than mineral stability.

In terms of mineral stability risk, with the lack of underground workings, we have placed Area 1 in the category of negligible with the exception of the area hatched in blue on appended Drawing No 156265B/9003. The hazards posed by the opencast site are of a geotechnical nature.

9.2 Area 2

Area 2 is located in the northern half of the site, bound to the south by the above mentioned geological fault which displaces the strata down to the south.

According to published geological mapping, the solid strata underlying the site has been further disturbed by another fault , traversing the central part of Area 2 on an approximate north-west to south-east trend. Annotations around this fault on the National Grid Series Map infer that the movement attributable to this fault also displaces the strata down to the south.

The sedimentary strata underlying the site in Area 2 belong predominantly to the Lower Coal Measures, with only a small area inferred to be undrain by the Middle Coal Measures in the far west of the Area. As with Area 1, the National Grid Series plan infers that the strata hereabouts dip only at very gentle gradients, with horizontal bedding encountered in numerous localities throughout the area.

The mapping pertaining to the area is devoid of outcrop positions for any significant mineral horizons, with the Dalmellington Blackband Ironstone inferred to outcrop to the north of the Subjects on an approximate east to west trend. While the strata hereabouts are understood to dip only very gently, the geological structure and the topography of the area suggests that the aforementioned seam will dip away from the site and will not be present thereunder, having been eroded away at some time in the past.

Similarly to Area 1, the geology of the area is characterised by the presence of igneous rocks, the majority of which comprise Dolerite (whinstone) sills. These sills are inferred by the National Grid Series mapping to be present at rockhead the north-eastern and the western parts of the Area. We have shown the Dolerite Intrusive rocks by means of green shading on appended drawing No. 156265B/9002. The mapping also infers the presence of a volcanic plug at ‘Green Hill’, which we have shown by means of orange shading on the aforementioned drawing, near the eastern boundary of the site. This is noted to comprise pyroclastic ash deposits.

We have found no plan records of any underground mineral extraction having taken place beneath Area 2. The general lack of mapped outcrops of mineral horizons may be indicative of a lack of exploration and workings which would lead to a greater understanding of the strata.

Concurrent with Area 1 and the as outlined in section 7, mineral seams within the area are understood to have been significantly heat altered by the intrusive igneous rocks. The National Grid Series geological plan indicates the position of historic boreholes situated throughout the area and there are freely available boreholes held in the archive of the British Geological Survey located within Area 2. Annotations around the bores on the National Grid Plan and the journals pertaining to the BGS bores indicated that the any coal seams were encountered in a ‘burnt’ condition and that igneous sills were commonly encountered.

It is again notable that the coals encountered have not been named according to the local general succession of strata, again indicative of their alteration. This is concurrent with the inference that the seams have been rendered of little to no value in the area do to the interaction with the intrusive igneous rocks.

After considering the foregoing factors, we consider it unlikely that any workings will have taken place beneath Area 1 by unrecorded means.

In terms of mineral stability risk, with the lack of underground workings, we have placed Area 2 in the category of negligible.

10.0 Future Mining

It is our understanding that there is no underground mining presently taking place under or in proximity to the routes. On the basis of current economics, available technology and planning regulations, we consider that the possibility of underground mining can be ruled out in the foreseeable future.

11.0 Old Pit Shafts/Adits

Our research in respect to the Subjects has identified the position of 2 no. mine entries indicated to lie within or within influencing distance of the site boundary. The mine entries are recorded comprise two adits. In connection therewith, we have obtained Coal Authority Mine Entry Data Sheets for both of the adits, which we have appended to this report.

The Coal Authority identifies these mine entries within the site, assigning them a reference number corresponding with their internal archive system. We have shown by means of brown arrows, the approximate locations of these mine entries as derived from the positions as indicated by the Coal Authority and using the reference numbers provided by the Coal Authority, on appended drawing No. 156265B/9003. It should be noted that where adits are shown, the orientation of the corresponding symbol indicates the approximate azimuth of the roadway from surface.

The mine entries indicated to be positioned within or within influencing distance of the site, together with their approximately coordinated location, are detailed within the table below:

CA Reference	Type	Name	Orientation/ Azimuth	Approx. Coordinates
247610-003	Adit	Rankinston Old Mine	286	247702, 610881
247661-001	Adit	Rankinston Old Adit	257	247561, 611245

The mine entry locations have been derived from mine abandonment plan S3523, which does not show any recorded workings in connection with the entries. We have insufficient information to comment on the actual ground position or the present integrity of the mine entries listed above. Consequently, we consider that the approximate position of each shaft or adit shown on appended Drawing No. 156265B/9003 and its immediate environs should be regarded as a potential source of instability.

We have no knowledge of any measures taken to secure any of the entries referenced in the table above at the time of abandonment, but should advise that it was not uncommon to only partially infill such features when mining operations ceased. Subsequently, the filling in the entries may collapse as the superficial deposits gain entry thereto, often taking the form of a large cone shaped depression, with the shaft itself positioned at its centre. The final diameter of this cone of collapse (zone of influence) is dictated by a number of factors, but predominantly by the nature of the superficial deposits and the depth to rockhead at the individual shaft's locus.

While an adit does not conform to the same collapse mechanisms as a shaft, the surface subsidence effects are often broadly similar. The surface area affected by such a feature is restricted to the position of the mine mouth, extending along the direction of the corresponding roadway as it increases in depth until sufficient superincumbent strata is present atop to prevent a collapse manifesting at surface. The potential zone of influence attributable to such a feature begins at the recorded position of the adit and traverses laterally across the site in the direction of its recorded azimuth.

In order to make more specific comment on the possibility of movement arising from a possible collapse of any of the mine entries referenced above, we would recommend that, in the first instance, a further and more extensive search be undertaken to determine the originating plan source of the feature; this in an attempt to confirm the correctness of the plotted position.

Thereafter, and in normal course of events, site investigations are usually required to prove the exact ground position of the mine entry; such investigations comprising either probing or trenching of the ground surface to locate the feature and possibly followed by drilling to prove both the thickness and nature of the superficial deposits thereat together with the method of treatment (if any) adopted at the time of abandonment.

In the context of any proposed development, we would recommend in the first instance that roads and structures are positioned to avoid the areas suspected to be underlain by mine entries.

12.0 Concluding Remarks

Our overall past mining assessment has placed the Subjects at Breezyhill West, as outlined in red on appended Drawing No. 156265B/9001, in the category of Negligible in area 2 with Area 1 in the categories of Negligible and Moderate. This may be reasonably interpreted as follows;

In the context of mineral stability, cognisance need be taken of the potential presence of shallow mineworkings occurring within influencing depth of the surface. In this regard, we should advise that the upward transmission, nature and extent of subsidence movement is directly related, amongst other factors, to the extraction height, inclination of the strata, method of mining, percentage extraction, degree of natural consolidation of the wastes and the thickness, nature and bulking factor of the overlying deposits.

Insofar as we can determine, there have been no recorded underground mineral workings under any area of the Subjects. Additionally, published geological records including mapping, borehole information and anecdotal evidence gleaned from the Economic Memoirs for the District suggest that the coal seams belonging to the Scottish Middle and Lower Coal measures which underlie the site have been significantly heat altered due to intrusion of igneous rocks. According to the aforementioned memoir this has had the effect of rendering the coal of inferior in quality and of little to no value. After taking account of the foregoing factors, we consider it unlikely that unrecorded shallow mineral extraction will have taken place beneath the majority of the subjects.

Nevertheless, the presence of two old mine entries in the South of Area one raises the possibility that localised opportunistic extraction may have been undertaken in this area. Given the lack of records pertaining to any extraction in this area, and a general lack of site specific boreholes, we have, as a conservative approach, assigned the area shown in blue hatching on appended Drawing No. 156265B/9003 as moderate risk.

In line with the foregoing, it is our opinion that the site of the Subjects outlined in red on appended Drawing No. 156256B/9001 may be regarded as satisfactory from a mineral stability aspect in area 2. Where development is proposed in the parts of Area 1 designated as Moderate risk however, we would recommend that further investigation is undertaken in order to establish the geological structure thereunder, confirm the depth to and presence of mineral horizons and the past mining situation therein.

In addition to the foregoing, we understand that an area in the east of the site has been subject to opencast workings undertaken as recently as the early 2010's. In the context of mineral stability, the presence of opencast workings is, in many regards, a more favourable process of extraction with regard to later development. The total extraction of the underlying coal seams from surface removes all of the coal and with it, the possibility of any residual instability mining risk relating to underground workings. The potential for settlement in areas of former opencast is therefore predominantly related

to the characteristics of the backfill material rather than the upward migration of belated mineral subsidence from mineworkings at depth.

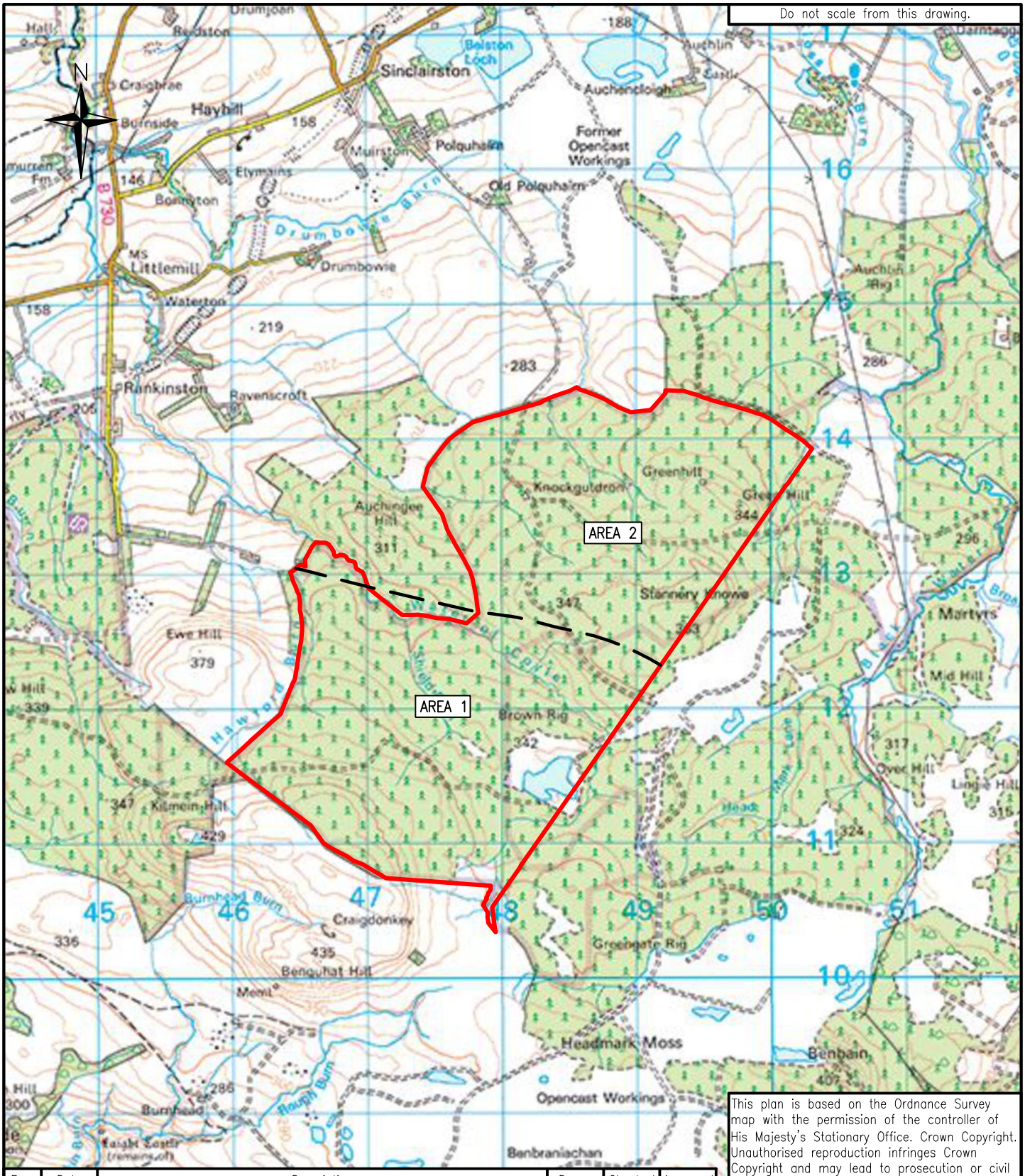
As previously mentioned, we are unaware of the nature and efficacy of the restoration undertaken at the opencast site and cannot comment on the suitability of the backfill materials. A geotechnical assessment of these areas should be undertaken ahead of any development.

N.B. for Old Pit Shafts see Section 11.

Appendix 1

Drawing No. 156265B/9001 – Site Location Plan

Do not scale from this drawing.



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Rev.	Date	Description	Drawn	Checked	Approved

Client:

brockwell energy

Project Title:

PROPOSED WINDFARM DEVELOPMENT, BREEZYHILL WEST, EAST AYRSHIRE

Drawing Title:

SITE LOCATION PLAN

JWHROSS

4th Floor, Tay House, 300 Bath Street,
GLASGOW, G2 4JR
Tel: 0141 285 8700

Scale at A4:	Status:	
NTS	For Report	
Drawn: CMCC	Checked: ST	Approved: DM
Date: 24/08/23	Date: 24/08/23	Date: 24/08/23
Drawing No.: 156265B/9001		Revision: –

Appendix 2

Drawing No. 156265B/9002 – Composite Geological Plan

Do not scale from this drawing.

N

Drumbowie

Greenhill Wood

314 Auchingee Hill

Hawford Burn

Water of Coyle

Shiels Burn

340 Gibson's Hill

Brown Rig

Shannery Knowe

Head Mark Lane

Hill

head Burn

Benquhat Hill
435

CONJECTURAL OUTCROP OF 2 FOOT 3 INCH PENNYVENNIE COAL

CONJECTURAL OUTCROP OF 2 FOOT 7 INCH PENNYVENNIE COAL

LEGEND
- SITE BOUNDARY
- CONJECTURAL MINERAL SEAM OUTCROP
- APPROXIMATE LOCATION OF GEOLOGICAL FAULT (ARROW DENOTES DOWNTHROWN SIDE)
- SCOTTISH MIDDLE COAL MEASURES
- SCOTTISH LOWER COAL MEASURES
- INTRUSIVE IGNEOUS ROCKS
- PYROCLASTIC ROCKS

Rev.	Date	Description	Drawn	Checked	Approved

Notes:

Client: brockwell energy

Project Title:
PROPOSED WINDFARM DEVELOPMENT, BREEZYHILL WEST, EAST AYRSHIRE

Drawing Title:
COMPOSITE GEOLOGICAL PLAN

JWHROSS
4th Floor, Tay House, 300 Bath Street,
GLASGOW, G2 4JR
Tel: 0141 285 8700

Scale at A1:	Status:	
1:8000	For Report	
Drawn: CMCC	Checked: ST	Approved: DM
Date: 24/08/23	Date: 24/08/23	Date: 24/08/23
Drawing No.: 156265B/9002		Revision: –

Appendix 3

Drawing No. 156265B/9003 – Composite Site Plan – Area 1

Do not scale from this drawing.

N

hord Burn

Water of Coyle

Water of Coyle

Shield Burn

Shield Burn

340 Gibson's Hill

Brown Rig

Knockreoch

343 Bro

Workings (dis)

Settling Pond

Track

Settling Pond

Gibson's Hill

Ponds

Ponds

Pond

Pond

Pond

Pond

Quarries (dis)

Quarry (dis)

Track

247661-001

247610-003

CONJECTURAL OUTCROP OF 2 FOOT 3 INCH PENNYVENNIE COAL

CONJECTURAL OUTCROP OF 2 FOOT 7 INCH PENNYVENNIE COAL

435 Benquhat Hill

LEGEND

- SITE BOUNDARY
- CONJECTURAL MINERAL SEAM OUTCROP
- APPROXIMATE LOCATION OF GEOLOGICAL FAULT (ARROW DENOTES DOWNTHROWN SIDE)
- COAL AUTHORITY MINE ENTRY LCOATIONS
- EXTENT OF OPENCAST WORKINGS
- RISK – MODERATE

Rev.	Date	Description	Drawn	Checked	Approved

Notes:

Client: brockwell energy

Project Title:
PROPOSED WINDFARM DEVELOPMENT, BREEZYHILL WEST, EAST AYRSHIRE

Drawing Title:
COMPOSITE SITE PLAN – AREA 1

JWHROSS
4th Floor, Tay House, 300 Bath Street,
GLASGOW, G2 4JR
Tel: 0141 285 8700

Scale at A1:	Status:	
1:4000	For Report	
Drawn: CMCC	Checked: ST	Approved: DM
Date: 24/08/23	Date: 24/08/23	Date: 24/08/23
Drawing No.: 156265B/9003		Revision: –

Appendix 4

Coal Authority Mine Entry Data Sheet Ref; 51003375993001, dated 4th September 2023

The Coal Authority

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

FAIRHURST
225 BATH STREET, 4TH FLOOR
GLASGOW
LANARKSHIRE
G2 4GZ

Our reference:	**51003375993001**
Your reference:	**156265B _ BHW**
Date of your enquiry:	**04 September 2023**
Date we received your enquiry:	**04 September 2023**
Date of issue:	**04 September 2023**

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

Shaft Plan and Data Sheets

BREEZY HILL WEST, EAST AYRSHIRE

I refer to the enquiry dated 04 September 2023, received 04 September 2023, in connection with the above.

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

Mine Entry Data

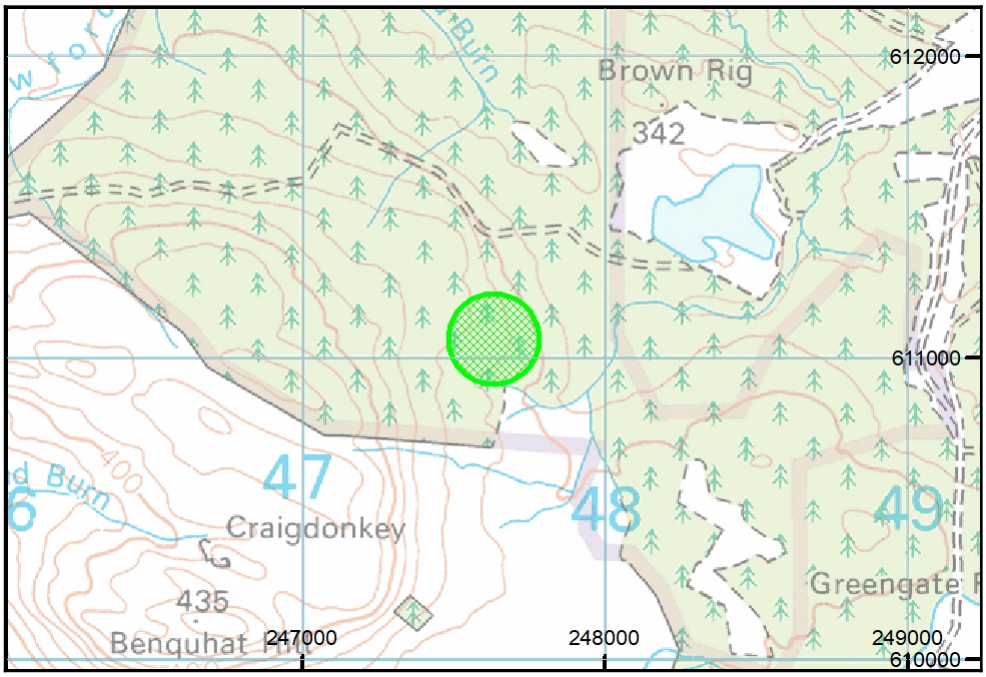
Shaft/adit:	Adit
Reference:	247610-003
Source:	Ab plan S3523
Colliery name:	Unknown
Entry name:	Rankinston Old Mine
Date abandoned:	Unknown
Depth of superficial deposits (m):	Unknown
Depth of shaft (m):	Unknown
Diameter of shaft (m):	Unknown
Probable adit azimuth:	286
Treatment details:	Unknown
Conveyance:	Not Applicable
Easting:	247702
Northing:	610881
Other information:	None

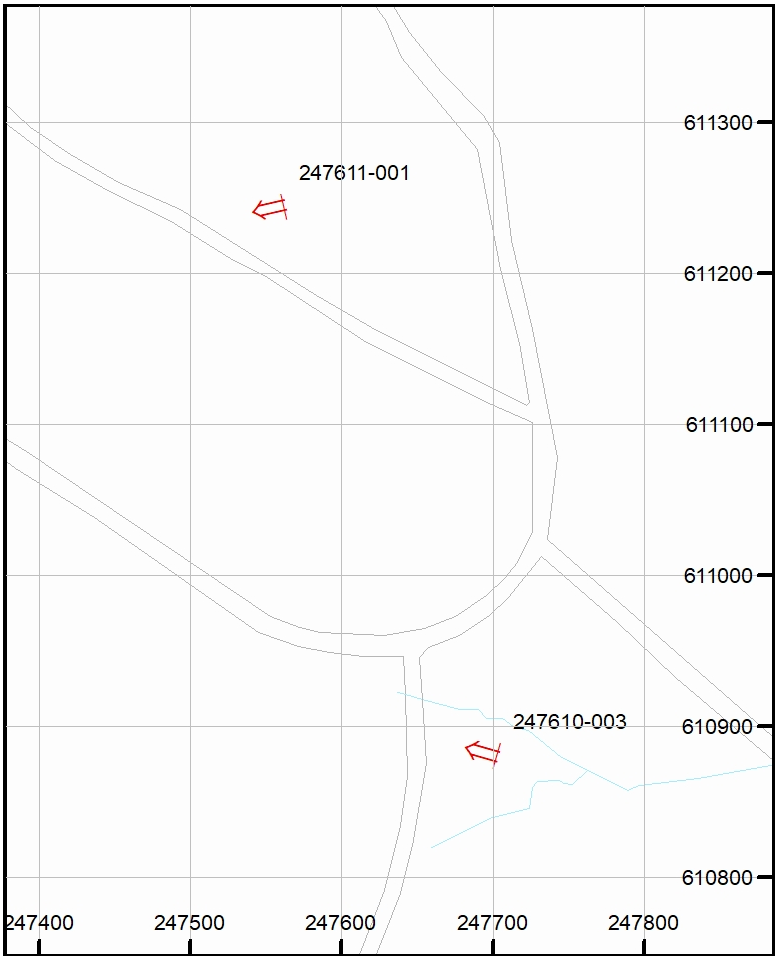
Mine Entry Data (continued)

Shaft/adit:	Adit
Reference:	247611-001
Source:	Abandonment Plan No S3523
Colliery name:	Unknown
Entry name:	Rankinston- Old Adit.
Date abandoned:	Unknown
Depth of superficial deposits (m):	Unknown
Depth of shaft (m):	Unknown
Diameter of shaft (m):	Unknown
Probable adit azimuth:	257
Treatment details:	Unknown
Conveyance:	Not Applicable
Easting:	247561
Northing:	611245
Other information:	None

Location map

Approximate position of enquiry





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

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

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

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

Our emergency telephone number is 0800 288 4242.

Key

Disused Adit or Mineshaft

Mapping sourced from Ordnance Survey

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