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Former Tudor Inn – Cimla, Neath Proposed Residential Development Phase One Coal Mining Risk Assessment

Report Reference: ESP.8398.03.4163

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Former Tudor Inn – Cimla, Neath Proposed Residential Development Phase One Coal Mining Risk Assessment

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Report Reference: **ESP.8398.03.4163**

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Notes:	<ol style="list-style-type: none">1. The status of this report is not final and is issued for comment only; as such, it is subject to change therefore it should not be relied up on. For a checked and authorised version please contact the Earth Science Partnership.2. Once issued this document is Uncontrolled, for the latest version and/or to confirm you have authorisation to use it please contact the Earth Science Partnership at enquiries@earthsciencepartnership.com or by telephone at 029 2081 3385.3. This document has been optimised for double sided printing and therefore may produce some blank pages when printed single sided.				

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Figure 2 – Conceptual Ground Model

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Appendix B Coal Authority Consultants Report (IGWL, 2022)

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Appendix D Boundary Condition Survey (4MDS, 2013)

General Notes

1 Introduction

1.1 Background

Tai Tarian Ltd (hereafter known as the Client) are proposing to redevelop the subject site for residential purposes. The Earth Science Partnership Ltd (ESP) have previously undertaken an intrusive investigation and assessment at the site in 2013 (ESP, 2013), which was updated and reproduced for the Client in January 2023 (ESP, 2023).

The site lies in an area of past coal mining and therefore, the Earth Science Partnership Ltd (ESP), Consulting Engineers, Geologists and Environmental Scientists, have been instructed by the Client to prepare a Phase One (desk study based) coal mining risk assessment (CMRA) to evaluate potential risks posed by past mine workings on the proposed development. The site location is shown on Insert 2 in Section 2.1.

The red line boundary has changed recently and older assessments and reports do not include the boundary of the site that allows for the new access off Beacons View. The reader should therefore be aware that the redline boundary on the appendix information does not match the proposed red line boundary.

The proposed development will comprise conventional two-storey residential dwellings with private gardens, landscaping and estate roads. The proposed development layout is presented as Insert 1 below, and shows a large apartment block in the north-west, with link of three dwellings and six further residential structures around a central north-west to south-east orientated estate road. A new access road for the development will be constructed from Beacons View to the north-east, created by the demolition of existing properties. An infiltration basin (for SuDS) is shown just to the east of the new access.



Insert 1 – Proposed Site Block Plan (Provided by Spring Design)

1.2 Objective and Scope of Works

The scope of works of this preliminary risk assessment is in general accordance with the published Coal Authority guidance on a risk-based approach to development. Specifically:

- to obtain and review relevant desk study data on the site relating to past coal mining; and
- to identify and evaluate the risks (individually and cumulatively) to the proposed development.

The precise scope of works was mutually developed and agreed with the Client by ESP within an agreed budget and comprised a desk study review of available historical Ordnance Survey maps, geological maps, memoirs, and a Coal Authority mining report obtained for the site by ESP, assessment, and reporting. Pertinent information from our previous geo-environmental and geotechnical assessment (ESP, 2023) has been included where relevant throughout this report.

The contract was awarded based on a competitive tender quotation. The terms of reference for the assessment are as laid down in the Earth Science Partnership email proposal of 4th June 2024 (ref: ESP.8398.03 - Tudor Inn, Cimla – Additional Investigation Offer. This assessment was undertaken in August 2024.

1.3 Report Format

This report includes a summary of the desk study information reviewed (Section 2), followed by a summary of the previously identified Ground Model (Section 3) and preliminary assessment of the risks from mining features (Section 4). A summary of the stability assessment undertaken by others is presented in Section 5. Recommendations for further intrusive investigation are provided in Section 6. This report is issued as a digital version only.

1.4 Limitations of Report

This report represents the findings of an assessment of risks associated with possible past shallow coal mining and mine entries on the site. The brief did not require an assessment of the implications for any other end use, nor of other geotechnical or geo-environmental hazards (e.g., contamination, slope stability and gas risks). For all other geo-environmental and geotechnical aspects relating to the site, the reader is advised to refer to our previous assessment

These potential ground hazards may require further assessment prior to development. It should also be appreciated that no site reconnaissance visits, or intrusive investigation has been completed at this stage. The report is not a comprehensive site characterisation and should not be construed as such.

Where preventative, ameliorative or remediation works are required, professional judgement will be used to make recommendations that satisfy the site-specific requirements in accordance with good practice guidance.

Consultation with regulatory authorities will be required with respect to proposed works as there may be overriding regional or policy requirements which demand additional work to be undertaken. It should be noted that both regulations and their interpretation by statutory authorities are continually changing.

This report represents the findings and opinions of experienced geo-environmental and geotechnical specialists. Earth Science Partnership does not provide legal advice, and the advice of lawyers may also be required.

2 Desk Study Review

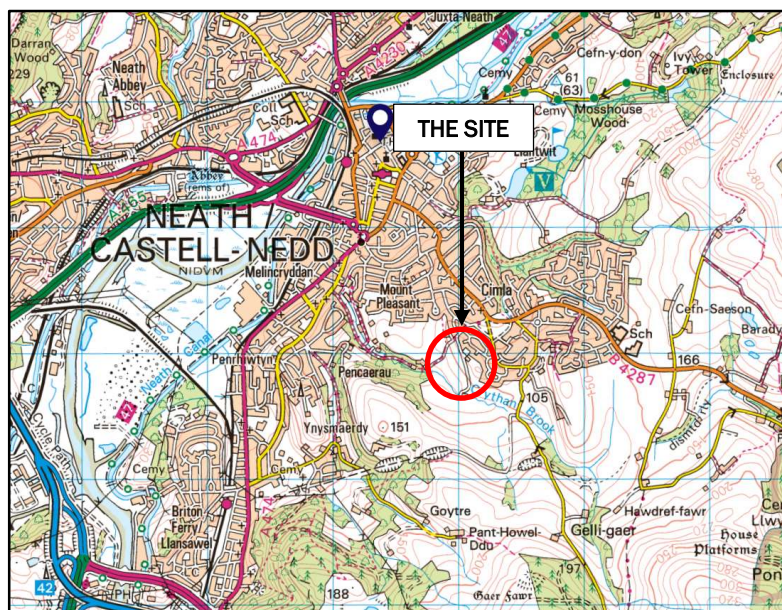
Integral Geotechnique (Wales) Ltd (IGWL) prepared a desk study assessment for the Client in 2022 (IGWL, 2022). The data sources presented in this report are significantly more recent than those in the previous ESP assessment (from 2013), so these more recent sources have been reviewed and are presented as appendices in this assessment.

The information presented in this section was obtained from desk-based research of sources detailed in the text, including historical maps (Appendix A), a mining report obtained from the Coal Authority (Appendix B) and a stability report (Appendix C). Further desk study reports/data/records are included as subsequent appendices as referenced in the text.

Pertinent information from our previous geo-environmental and geotechnical assessment (ESP, 2013) has also been included where relevant throughout this report.

2.1 Site Location and Description

The site comprises the grounds of the former Tudor Inn, located on the south-western side of Cimla, Neath. The National Grid Reference of the centre of the site is (SS) 276060 196010 and the postcode is believed to be SA11 1JA. A Site Location Plan is presented as Insert 2 below.



Insert 2 - Site Location Plan from Ordnance Survey 1:25,000 scale map.
Reproduced with permission (OS License No.: AL100015788).

The site is irregular in shape, consisting in the main of a roughly rectangular area around 100m by 60m in size, with a narrow triangular extension running up to the site entrance on Cae Rhys Ddu Road in the north-western margins. A short access track will be located along the northern edge of the site joining onto Beacons view. In total, the site is approximately 0.8 hectares in area.

It is bounded by:

- to the north-east: residential properties on Beacons View.
- to the south-east: open grassed pasture land behind the houses on Beacons View.
- to the south-west: a farm track and open pasture land; and
- to the south: an old sandstone quarry, and derelict building.

The north-western access comprises a tree-lined former, apparently tarmac surfaced drive to the former Tudor Inn. The former location of the Tudor Inn structure is now occupied by an overgrown ad-hoc stockpile of the remnants of the demolished structure. A former track to the quarry was identified along the south-western margins in 2013, however, this is no longer evident and is apparently covered with vegetation.

Vehicular access to the site is currently gained via the original site entrance off Cae Rhys Ddu Road, which is now blocked by large boulders.

The site lies at the top of a topographical ridge, towards the top of the south-west facing valley sides of the River Neath, with the adjacent land to the south-west sloping away relatively steeply. The land to the north-east also slopes away from the site, albeit at a lower gradient, so that the houses on Brecon View are at a slightly lower elevation than the site.

We are not aware of a topographic survey for the site at this time but, from visual observations, the south-eastern margins of the open grassed area appear to form the topographical high at around 116m OD, with the ground to the north-east sloping gently down towards the houses. The area around the former Tudor Inn and its driveway appears relatively flat and level. The south-western margins of this area comprises a steep downslope to a farm track, of around 3 to 4m height (visually estimated) around the former building. The south-western margins of the open grassed area further to the south-east also appears to comprise a downslope, however this is currently obscured by the dense vegetation – in 2013, this downslope was visually estimated to be around 3m in height. Although obscured by vegetation, the sub-vertical face of the former quarry appears to remain in the southern margins of the site.

2.2 Site History

2.2.1 Published Historical Maps

The site history (with regards to the mining legacy in the area) has been assessed from a review of available historical Ordnance Survey County Series and National Grid maps. The historical maps are presented in Appendix A and the salient features since the First Edition of the County Series maps are summarised in Table 1 below.

Table 1: Review of Historical Maps

Date	On-Site	In Vicinity of Site
1881 - 1970	<p>The southeastern area is indicated to be open land, probably pasture, with a building, Cae-Rhys-ddu, in the central area (possibly a farmhouse). The north-western area is tree-lined.</p> <p>The building had been extended by 1919 with outbuildings to the rear.</p> <p>By 1935, the frontage (north-west) of the site had been redeveloped with a probable driveway, and vehicle turning area.</p> <p>Houses of Beacons View were developed by 1963. Before this the area comprised agricultural fields.</p>	<p>The site is located in a rural setting, with the precursor to Cae Rhys Ddu Road running north-east to Cymmle (Cimla) Common. Two wells are shown to the west of the site, with a 'coal pit' 100m to the west.</p> <p>By 1899/1900, Westernmoor Cottages are shown to the north of the site, and the coal pit to the west is no longer shown. However, a number of old coal pits and levels are shown to the south-east and south.</p> <p>By 1919, an old quarry is shown to the north, adjacent to the Westernmoor Cottages.</p> <p>By 1957 the housing estates to the north had encroached southwards as far as Cae Rhys Ddu Road, and by 1963, the houses on Beacons View to the east had been built.</p>
1971 - present day	<p>The outbuildings of Cae-Rhys-Ddu had been demolished and the building is shown as a 'club'. This building was apparently extended by 1983 and was known as the 'Tudor Inn'.</p>	<p>The area of housing to the north and east underwent marginal changes.</p>
<p>Notes:</p> <ol style="list-style-type: none"> 1. Historical maps presented in Appendix A. 2. Features may have been present on site before or between the dates of the-mapping that may not have been identified. 		

In summary, the site appears to have remained undeveloped until the 1970s when the Tudor Inn was constructed. The Tudor Inn was apparently demolished in 2009 and the site has remained undeveloped since that date.

2.2.2 Other Sources

No further pertinent information on the history of the site has been identified.

2.3 Previous Investigations and Assessments

With the exception of the ESP investigation of 2013 (see Section 1.1) and a boundary condition report and recent desk study (see below), we are not aware of any previous geotechnical or geo-environmental investigations or assessments at the site.

A copy of a Boundary Condition Report, prepared by 4m Development Services Ltd (4MDS) was provided to ESP for our 2013 assessment, and is presented in Appendix D of this report. The site boundary was investigated by 4MDS in eleven separate sections and the following remedial options were recommended:

- Consideration should be given to treating Boundaries G, H, J and K (4MDS designation for south-western margins) by re-grading the embankment to create a stable slope and stabilising with a geo-grid and landscaping.
- An application of netting to Boundary F (southern margins) to the exposed rock face and/or fill against the vertical face.
- The onsite bedrock has a near-horizontal bedding plane and achieving interface with fractures for soakaway drainage may be difficult. On-site percolation tests are recommended; and

- Some plots may require terracing in gardens and others may require re-orientation to increase clearance to the boundary steep slope.

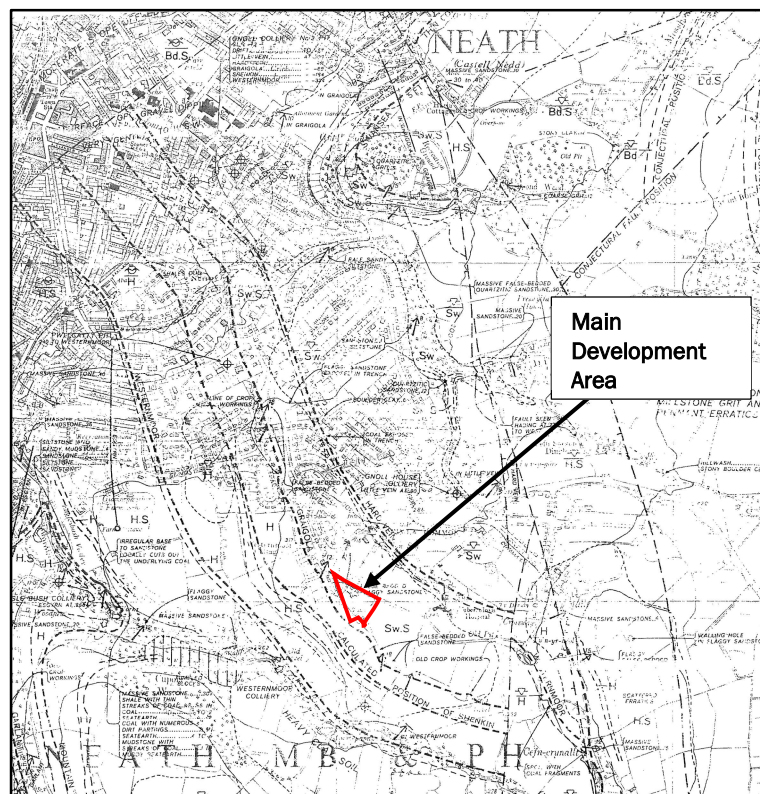
Integral Geotechnique (Wales) Ltd (IGWL) prepared a desk study assessment for the Client in 2022 (IGWL, 2022). The data sources presented in this report are significantly more recent than those in the previous ESP assessment (from 2013), so these more recent sources have been reviewed and are presented as appendices in this assessment.

A recent supplementary soakaway assessment has also been undertaken by ESP (ESP, 2024) and has been reported under separate cover. As this assessment holds no information pertinent to this assessment, we have not included it in this report.

2.4 Geological Setting

2.4.1 Published Geology

The published geological map for the area of the site (1:10,560 scale, Sheet SS 79 NE) indicates the site to be underlain by sandstone bedrock of the Swansea Beds of the Upper Coal Measures. No superficial deposits are shown. An extract of the geological map is presented as Insert 3 below. Reference to the up-to-date mapping available on the website of the British Geological Survey (BGS, 2022) indicates a similar succession. An outcrop of 'false bedded flaggy sandstone' is indicated on the site, probably representing the sandstone exposure on the south-western boundary. The bedrock in the vicinity is shown to dip to the north-north-east at around 12 to 18° to the horizontal.



Insert 3: Extract from BGS Geological Map Sheet SS79NE, original 1:10,560 scale.
Reproduced with permission (BGS licence number: C15/05 CSL)

The Coal Measures bedrock comprises an interbedded succession of sandstone, siltstone and mudstone, with coal seams and associated seat earths. The conjectural outcrop of the Graigola coal

seam is shown to run broadly north-south some 20m to the west (downslope) of the site. Therefore, with a north-north-easterly dip, this seam would be anticipated to underlie the site at shallow depth.

The generalised succession shown on the geological map indicates the Graigola seam to be 5 ft (1.5m) in thickness in the area, and to be underlain by the Swansea Two Feet or Shenkin (a thin seam), and the Westernmoor (2ft or 0.6m thickness) at depths of 45 and 80m beneath the Graigola respectively. These two seams are also anticipated to underlie the site, albeit at greater depth.

2.4.2 Available BGS Borehole Records

Reference to the website of the British Geological Survey (BGS, 2024) indicates no available records of boreholes in the vicinity of the site. The findings of the ESP investigation of 2013 are discussed later in this report.

2.5 Coal Authority Records

2.5.1 Coal Authority Website

- The outcrop of a coal seam is shown just to the west of the site. Reference to the published geology (Section 2.4.1) suggests that this is the Graigola seam.
- No past surface hazard or surface mining is identified in the vicinity of the site.
- No recorded past shallow coal mining is indicated in the immediate vicinity of the site.
- ‘Probable’ past shallow coal mining is indicated associated within the outcrop of the Graigola seam to the north of the site.
- No mine entries are shown within the site boundary.
- The site lies immediately to the north-east of a ‘Development High Risk Area’, apparently associated with the outcrop of the Graigola coal seam.

2.5.2 Coal Authority Mining Report

A CON29 mining report was obtained from the Coal Authority for the site by IGWL as part of the 2022 assessment and this is reproduced in Appendix B of this report. The red line boundary for this assessment is the main development area, and not the new red line boundary onto Beacons View, when the site investigation is carried out, a new updated Coal Authority Consultants report should be obtained and included into the assessment.

This indicates that, based on the available Coal Authority records, there are ‘*known or potential coal mining risks*’ at the site, and:

- The property is in a surface area that could be affected by underground mining in 2 seams of coal at 80m to 280m depth, and last worked in 1903. Any movement in the ground due to coal mining activity associated with these workings should have stopped by now.
- The property is in an area where the Coal Authority believes there is coal at or close to the surface. This coal may have been worked at some time in the past. The potential presence of coal workings at or close to the surface should be considered, particularly prior to any site works or future development activity, as ground movement could still be a risk.
- 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, nor is it in an area where a licence has been granted to remove or otherwise work coal using underground methods. 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.
- There are no recorded coal mine entries known to the Coal Authority within, or within 20 metres, of the boundary of the property. There may be unrecorded mine entries in the local area that do not appear on Coal Authority records.
- 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.
- The property is not within the boundary of an opencast site from which coal has been removed by opencast methods, or within 800m of licensed future opencast sites.
- 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.
- The Coal Authority has no record of a mine gas emission requiring action.
- 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.

The stability report (Appendix D) identifies former 'opencast' sites some 20m to the north-west of the site (Westernmoor Cottages), and 150m to the south-east (Cae Rhys Ddu). Both these sites reportedly worked sandstone and likely to be former quarries rather than traditional opencast sites. The old quarry on the southern boundary of the site is also identified.

The stability report references workings beneath the site in the Esgyrn (or Erskine, Hughes or Garland) seam which ceased in 1903, the Rotten (or Bodwr) seam which ceased in 1859, the Western Moor and Western Moor Two Feet seam which ceased in 1888. The Garland, Esgyrn and Bodwr seams all lie well beneath Westernmoor in the succession, i.e. in excess of 50m depth beneath the site.

Although there are no records of past mine workings at shallow depth beneath the site, the Graigola seam (which crops out to the west and is anticipated to underlie the site at shallow depth) is indicated to be 1.5m in thickness in the area. Given this reported thickness, the recorded position of the outcrop just to the west of the site, the identified presence of an old 'coal pit' close to the outcrop around 100m to the south-west of the site (see Figure 2), and the fact that the seam was mined extensively across the Swansea and Neath area (Arup, 1994), we consider it to be almost inconceivable that the seam has not been worked beneath the site. The seam outcrop to the west would have allowed relatively easy access to the coal via adits (tunnels into the bedrock to work the coal – as shown on historical maps).

Further mine shafts are indicated north-east of the outcrop, some 450m east of the site – these are likely to have intercepted the Graigola seam at shallow depth, and probably accessed workings within the seam. Such potential workings are indicated by the Coal Authority within the Graigola seam to the north of the site.

2.6 Other Sources of Mining Information

We are not aware of any other sources of information at this stage.

3 Development of the Conceptual Model

3.1 Conceptual Ground Model – Geology

The following summarises the findings of the previous investigation at the site (ESP, 2013) and should be reviewed/ revised following any future, supplementary works. For reference, the previous investigation point records are presented in Appendix C and the investigation point plan is presented as Figure 1.

The previous exploratory holes have identified the site to be generally underlain by a thin veneer of Made Ground or Topsoil, overlying weathered Coal Measures bedrock at very shallow depth (less than 1m) On the south-western margins, a greater thickness of Made Ground (in excess of 3m) was identified. These strata are discussed in more detail below. The geological succession identified in the exploratory holes is presented on a Conceptual Ground Model in Figure 2. At this stage no investigation has been carried out in the Beacons View properties and investigation will be carried out in these areas in due course and the Conceptual Ground Model will be updated.

Made Ground: encountered beneath the hard surfaced areas around the former Tudor Inn building as a tarmacadam surface underlain by a probable gravel sub-base, with occasional fragments of tile, to a depth of 0.15 to 0.3m.

On the south-western boundary, a trial pit identified a substantially greater thickness of Made Ground to depths in excess of 3.2m (the base of the pit), comprising black/brown, slightly clayey, sandy gravel with many fragments of brick, concrete, plastic, tiles, ceramics, glass, metal, rope and carpet. The pit sides were very unstable in these soils. This pit lies on the margins of the site, where the ground falls away to the south-west, and we consider that the Made Ground is likely to represent fill materials end-tipped over the previous site margins, possibly to create additional space on site. A chocolate bar wrapper found at around 1.1m showed a 'best before' date of June 1990, suggesting that the date of the tipping is likely to be around that time.

Topsoil: encountered at the surface in the south-east of the site (away from the Tudor Inn hard surfacing), and comprising the comprises dark brown, slightly sandy clay of soft consistency, with common rootlets.

Glacial Diamicton: not encountered in the trial pits, but possibly present in the form of clay and boulders in the area of Borehole RO1, in the north-western margins of the site.

Weathered Coal Measures Bedrock: encountered identified at a very shallow depth, less than 0.5m below the site surface in all the trial pits across the main part of the site (except the south-western margins), as a weak to medium strong, light brown grey, very thinly to thinly laminated, highly to moderately weathered, sandstone, which was recovered as a slightly sandy, angular, medium coarse gravel with many cobble and boulder sized fragments of sandstone. The trial pits commonly failed to penetrate more than 100 or 150mm depth into this bedrock without the use of a hydraulic breaker.

The rotary boreholes indicated the initial weathered sandstone to be underlain by a coal seam and then mudstone, with a band of mudstone also above the coal in Borehole RO1. The coal seam was at depths of between 4.0m (in RO1 in the north-western margins) and 12.5m (in RO3, in the eastern margins). The seam was around 2.8m in thickness in Borehole RO1, 1.6m in Borehole RO2, and 1.0m in Borehole RO3, and is considered to be the Graigola coal which crops out to the west of the site.

3.2 Conceptual Ground Model - Hydrogeology

No shallow groundwater was recorded in the trial pits. The investigation did not identify any groundwater to a depth of 30m within the rotary drillholes. However, the drillholes were completed with air mist flush which could have masked groundwater strikes.

3.3 Site Instability

No evidence was identified of potential landslides or unstable ground in the Preliminary Geotechnical Risk Register (ESP, 2023). The only evidence of possible instability was recorded in the south-western margins where the original site surface appears to have been filled (in TP9) – this area is not clearly visible at present due to the presence of dense vegetation.

As discussed in Section 3.1, the investigation has identified the Graigola coal seam to be present at depths of between 4.0 and 12.5m across the site. See Section 4 for further discussion.

An assessment of the boundary conditions was undertaken by others (see Section 2.3).

4 Assessment of Coal Mining Risks

4.1 Summary of Mining Hazard

The potential coal mining risks identified at the site are summarised in Table 2 below:

Table 2: Identified Coal Mining Risks

Coal Mining Aspect	Identified Hazard	Risk Assessment
Underground Coal Mining (recorded at shallow depth ¹)	No	None identified.
Underground Coal Mining (unrecorded shallow ¹)	Possible	See Section 4.2
Recorded Mine Entries (shafts and adits)	No	None identified.
Unrecorded Mine Entries (shafts and adits)	Possible	See Section 4.3
Recorded Coal Mining Geology (fissures)	No	None identified.
Recorded Past Mine Gas Emissions or Potential	Possible	See Section 4.4
Recorded Surface Coal Mining Hazard	No	None identified.
Recorded Surface Mining (opencast workings)	No	None identified.
Notes:		
1. The Coal Authority defines shallow depth as within 30m of the ground surface.		
2. Identified risks are discussed further in the following sections.		

4.2 Unrecorded Shallow Coal Mine Workings

The previous investigation (ESP, 2013) identified the presence of the probable Graigola coal seam at depths of between 4.0 and 8.8m depth on the south-western margins, and at a depth of 12.5m beneath the north-eastern area. This suggests a dip to the north-east, as indicated on the geological mapping. The seam was recorded as solid coal in all three boreholes, and of between 1.0 and 2.8m thickness, the latter thickness being greater than indicated as typical for the area.

The Graigola seam was mined extensively across the Swansea and Neath area and, given its proven thickness beneath the site, and the apparent ease of access from mine entries along the outcrop, we consider it to be almost inconceivable that the seam was not worked beneath the site. Therefore, the coal encountered within the three drillholes constructed to date is likely to represent solid pillars of coal left to support the roof of adjacent mine workings.

The workings, if present, would be present at depths of between 4.0 and 8.8m beneath the south-western margins of the site, and 12.5m beneath the north-eastern area (see Figure 2). The seam/workings are overlain by an apparently competent sandstone roof rock, which could have supported the ground above any voids since the workings were completed. However, the competency of this sandstone is not known and evidence from the trial pits and exposures suggests that near the surface, the stratum is highly fractured. Therefore, we cannot discount that, at some unknown time in the future, the sandstone roof rock could collapse and result in subsidence features on the site surface. Any such collapses could undermine foundations and other infrastructure of any development on site. Given this, we consider that the subsidence risk at the site is **High**.

At present the three rotary boreholes previously completed have identified a possible hazard but are not sufficient to define the extent of the hazard to any degree of certainty. We consider that any workings present beneath the proposed apartment block and dwellings to the south-west of the access road are likely to require stabilisation by drilling and grouting. The seam is at greater depth, with a greater rock cover beneath the north-east of the site. The rock cover looks to thin toward the northeastern portion of the site formed by the existing Beacon View road and the additional assessment should consider existing risks to this road as part of the investigation.

Using the well-established 'rule of thumb' whereby a bedrock thickness above the workings of ten times the working height being sufficient to mitigate risks, where the sandstone cover is 12.1m (as identified in Borehole RO3), this is likely to be sufficient to mitigate risks above workings up to 1.2m in height – the seam in RO3 was recorded as 1.0m in thickness. Therefore, the risks to the dwellings to the north of the access road in the east of the site may be lower. However, if the workings were in excess of 1.2m height in this area, unacceptable subsidence risks may be present. Further investigation is required to further define the risk in this area (see Section 6).

As the seam was identified at only 4.0m depth below the surface in the north-west of the site, any workings beneath this area would also pose an unacceptable subsidence risk to the new access road and vehicle parking areas and would also need to be stabilised to mitigate the risk of a subsidence feature. Further east, the workings are likely to be 10 to 12m depth below the site surface and, hence, the subsidence risk is likely to be reduced, but still potentially significant. The use of geo-grids within the road construction, rather than stabilising the workings, may be sufficient to mitigate the possible subsidence risks in this area.

With the limited information available at this stage, it is difficult to assess the length of the road which could require stabilisation by drilling and grouting. To clarify this, we recommend that further rotary drilling be undertaken across the site to provide additional information on the depth and thickness of the coal seam and the presence and height of any workings – at this stage we recommend a further eight rotary boreholes, taken to maximum depths of around 15m (shallower borehole depths will be appropriate in the south-western and north-western margins, where the seam is shallower). Gas wells should also be installed and monitored within these drillholes to allow a detailed gas risk assessment.

4.3 Unrecorded Mine Entries

No mine entries are recorded in the immediate vicinity of the site. However, it should be appreciated that in any area of past mining activity, particularly where the seam is present at as shallow a depth as identified beneath this site, the possibility of the existence of unrecorded mine entries cannot be discounted. The hard sandstone band overlying the coal seam may have encouraged any entries to be adits located on the lower-lying ground outside the western site boundary rather than as shafts from the site surface.

During site clearance operations and all excavation, a careful watch should be maintained for any isolated pockets of loose fill, brickwork or other anomalous features which may be indicative of past mining operations. Any such features should be subject to further investigation.

We have identified no direct evidence of old mine entries on the site during this desk study assessment however, given the above, we cannot discount that old mine entries, probably dating from before the First Edition of the historical mapping, could be present on site.

Based on the information to date, we consider that the risk of mine entries beneath the site is **Moderate** to **High**.

4.4 Mine Gas Emissions

As discussed in Section 2.5.2, the Coal Authority has no record of a mine gas emission requiring action in the vicinity of the site. Notwithstanding this, given the probability of shallow mine workings and mine entries along the outcrop, there is a potential risk from mine gas and a mine gas risk assessment based on the guidelines (CL:AIRE Good Practice for Risk Assessment for Coal Mine Gas Emissions (October 2021)) would be required. This will need to be assessed through intrusive investigation works.

4.5 Potential Combustibility

Although outside the brief, the developer should be aware of the potential for a combustibility risk where any coal seam crops out on site or is close to the surface. The risks of combustion will be controlled by the carbon content of the outcropping coal and the nature of development immediately above the outcrop. Further guidance on the risk of potential combustibility can be provided, if required.

5 Site Stability

5.1 Site Stability – Filled South-western Margins

The south-western margins of the site appear to have been filled by loose end-tipped materials, as identified by a trial pit in this area, which are prone to instability. The extent of the filled ground is not clear as the area is currently completely overgrown with dense vegetation, but it may comprise the wider area extending out from the remainder of the south-western boundary.

From Insert 1, this area appears to lie to the south-west of the garden area to the rear of Plots 8 to 13, so we do not anticipate that it will impact on the proposed development. However, we recommend further investigation by trial pitting in the area (and particularly to the rear of Plots 8 to 13) to establish the lateral extent and depth of the fill materials and, hence, the risk to the development.

5.2 Site Stability - Former Quarry

A former quarry forms part of the southern boundary, and is believed to be a small, historical sandstone quarry. As discussed in Section 2.3, 4M Development Services (4MDS) undertook an inspection of the quarry face and recommended netting or and/or placement of fill against the rock exposures to maintain stability. However, at present, the quarry face is inaccessible due to dense vegetation, so a full assessment of the stability of the face cannot be made.

This quarry face lies to the rear of Plots 6 and 7 and its stability could impact on the rear garden areas of these dwellings. We recommend that the vegetation be cleared to provide an access to the quarry face so that a full geotechnical inspection can be made of the exposure, and suitable support measures (if required) designed. At this stage, from the available information, we can make the following preliminary comments:

- The available information suggests that the bedding planes of the bedrock are dipping into the face at an angle of 12 to 18°. Hence, large-scale planar or wedge failures are considered unlikely.
- The near-surface bedrock is fractured so toppling failures or unravelling of the rock slope could occur.
- No mudstone bands have been identified at shallow depth, therefore wide scale bearing capacity failure, where the softer mudstone bands have been eroded, are unlikely.
- Bedrock excavated as part of the development works (e.g. for soakaways, foundations or drainage) could be used to construct dentition or other rock support measures.
- Soakaways constructed above quarry face could have a detrimental impact on its stability.

A suitable stand-off distance will be required between development structures and the top of the rock face – this would be determined after the rock face inspection.

6 Recommended Investigation

Further intrusive investigation will be required to confirm the Conceptual Ground Model and the likely mining risks to the proposed development. In particular, the investigation would need to (as a minimum):

- Obtain up to date Coal Mining Report for whole site (including Beacons View) and assess as part of the below investigation.
- Confirm the depth and thickness of the Graigola seam across the site.
- Confirm the absence of any further coal seams within 30m of the site surface.
- Install gas monitoring wells and undertake coal mining gas risk assessment.
- Allow an assessment of the quarry face to the southeast of the site.

We consider that the appropriate further investigation would comprise rotary boreholes as detailed in our proposal offer of 4th June 2024 (re: ESP.8398.03 – Tudor Inn, Cimla – Additional Investigation) and a quarry face inspection and analysis.

Further borehole may be required, with their location's dependant on emerging findings. These drillholes should be taken to a minimum of 15m depth as required. We consider that a minimum of eight drillholes would be required, but the emerging conditions will be constantly reviewed and if there is scope to reduce this number down, we will action this to provide savings if possible.

7 References

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