

FOEL TRAWSNANT WINDFARM PROPOSAL

AN ASSESSMENT OF PREVIOUS UNDERGROUND MINEWORKING ACTIVITY AND ITS POTENTIAL IMPACT UPON THE PROPOSED FOEL TRAWSNANT WINDFARM SITE

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DRAWINGS

Drawing No. JA-146-001-002	Geological Sheet Extract.
Drawing No. JA-146-001-003	Site Location.
Drawing No. JA-146-001-004	Windfarm Turbine and Coal Mine Drift Locations.
Drawing No. JA-146-001-005	Old Workings Location Plan.
Drawing No. JA-146-001-006	Shaft and Adit Location Plan.
Drawing No. JA-146-001-007	Conditional Underground Licences Plan.

APPENDIX

Coal Authority - Non-residential Coal Authority Mining Report (ref: 71000500709001)
dated 24 September 2013.

Coal Authority Abandoned Mines Records listing.

1. INTRODUCTION

It is proposed to establish the Foel Trawsnant windfarm comprising x 13 No. wind turbines which will be located on high ground located approximately 3 kilometres to the north of Maesteg. The area has historically been one of intense underground coal mining activity which has long since ceased (last recorded workings were in 1980).

As a part of the initial investigatory works associated with the development, a Coal Authority Mining Report has been commissioned which highlighted the presence of abandoned coal mineworkings in 20 seams at shallow to 790 metres depth plus workings in one fireclay horizon at a level of between "shallow" and 140 metres deep beneath the site area.

The report also indicated the presence of x 10 No. adits within or in close proximity to the application area.

The latest date at which any of the identified mining operations were active was 1980, and it is anticipated that any significant settlement associated with these workings will have long since ceased. Usually, when support is removed, any collapse into extraction areas occurs almost immediately, with minor residual movements possibly occurring within a few months thereafter. Nevertheless, some of the identified mineworkings have been undertaken at very shallow depths and as a consequence can, even although abandoned many years ago, still produce stability problems for some types of structures if constructed on ground above them.

The problem can be addressed by suitable engineering works which may involve the following:

- Very shallow depth workings can be excavated out and replaced by engineered fill.
- Ground can be partially grouted to improve the bearing capacity of the ground and reduce the potential for further void migration / collapse.
- Full grouting-up of the workings.

This report identifies the locations of recorded mineworkings, both their plan position and the depth at which they occur within the application area, and makes comment on the likelihood or not of turbines and associated infrastructural developments potentially being affected by them.

It should be noted that although shallow workings may occur, ground stabilisation works can be undertaken which will remove the potential problem.

2. INFORMATION REFERRED TO

- Published Geological Sheets Glamorgan XXV and XXVI
- The Geology of the South Wales Coalfield Part IV - The Country around Pontypridd and Maesteg. Memoir of the Geological Survey of Great Britain.

- Coal Authority - Non-residential Coal Authority Mining Report (ref: 71000500709001) dated 24 September 2013.
- CIRA Report 'Construction over Abandoned Mineworkings - P R Healy, J M Head, 2002
- Coal Authority Abandoned Mines Records (listing contained in Appendix).

3. SITE LOCATION

The site is approximately 130 hectares in area and located approximately 10 kilometres to the north east of Port Talbot and 3 kilometres north of Maesteg - see Drawing No. JA-146-001-003.

4. TOPOGRAPHY AND LAND USE

The site occupies high ground which rises to a maximum height of approximately 370 metres AOD on Foel Trawsnant Hill and is located between the Llynfi river valley on the eastern side and Afan river valley on the northern.

The ground falls steeply to the adjacent river valleys and is cut by a number of minor watercourses which are contained in steeply sided incised valleys.

The land use is rough grazing.

5. GEOLOGY

(Reference should be made to Drawing No. JA-146-001-002 - Geological Sheet Extract, which comprises the published Glamorgan Geological Sheets XXV and XXVI.)

The entire site area is underlain by Upper Coal Measures strata which crop out at surface or are, in a very limited area, concealed beneath a thin veneer of Glacial Drift deposits. The only location within the application area in which Glacial Drift deposits are indicated to occur is in the valley of the north westerly flowing Nant-yr-Hwyald watercourse which occurs in the northern half of the site.

Beneath the site the Upper Coal Measures pass downwards into the Middle and then Lower Coal Measures, the latter two within which the main production coal seams occur. The strata can be observed to be inclined towards the north at a gradient of 1 in 8 increasing to approximately 1 in 5 as followed northwards.

Structural continuity is disrupted by north north west / south south east trending normal faults which generally displace the strata to the west. Further structural disturbance occurs in association with north west / south east trending, low angle thrust faulting; the Jubilee Slide being an example of which can be observed to cut across the southern parts of the site.

Several coal seams contained within the Lower Pennant Series can be observed to crop out at surface at the eastern end of the site, namely seams extending from the Wernpistyll up to the Wernddu (No. 2 Rhondda) then Field vein and small un-named seams above this level.

5.1 Geological Succession

The upper part of the stratigraphic sequence extending from surface level to a depth of between 150 and 300 metres is dominated by thick, competent sandstone units contained within the Rhondda and Llynfi Beds. The two units comprise the Lower Pennant Series (see Drawing No. JA-146-001-002).

The sequence of rocks exposed at surface within the application area extends from approximately the level of the Wernddu (No. 2 Rhondda) seam up to a short distance below to No. 1 Rhondda seam.

Within the site area named coal seams which crop out at surface include (from bottom to top) the Wernpistyll, Wernddu (No. 2 Rhondda) and Field Vein along with a number of thinner, unnamed and laterally impersistent seams - see Drawing No. JA-146-001-002 for the Generalised Vertical Section.

6. PREVIOUS MINeworkINGS

The area has been subject to an extended period of minerals extraction of coal, fireclay and ironstone, with records extending back to the 1800s. Unrecorded workings which pre-date this period may well have occurred.

6.1 Coal

6.1.1 Surface Opencast Mineworkings - Coal and Other Minerals

No surface opencast mineworkings for coal or any other minerals are recorded to have been undertaken in the application area.

6.1.2 Underground Mineworkings - Coal

A Coal Authority Abandoned Mines and Shafts Records search for coal and other minerals has been undertaken (search reference no. 71000500709001) which identified the site to lie in the likely zone of influence associated with abandoned workings in 20 seams of coal and one seam of fireclay.

The workings are indicated to have been undertaken from shallow (near surface level) to a depth of approximately 790 metres below ground level with records dating back to the early 1800s.

A total number of 10 recorded mine entries have been identified, for which all (but one) have no details with respect to whether the structures have been made safe. It should be noted that additional shafts or (more likely) adits may occur within the site for which there are no location or sealing details available.

As a part of this assessment a detailed search of the Coal Authority Abandoned Mines Records and an assessment of relevant plans have been undertaken.

6.2 Shafts and Adits

The locations of known adits within the site area are shown in Drawing No. JA-146-001-004 and can be seen to be concentrated in the southern one third or so of the site area. The adits access the Wernpistyll, Wernddu (No. 2 Rhondda) and possibly the Field Vein seams. Workings at the lower seam horizons were accessed via entrances located outside of the site area.

Additional adits may be present within the site area and, if so, it is highly likely that they will occur at various locations around the site where the above coals seams are indicated to crop out at surface (see Drawing No. JA-146-001-002).

6.2.1 Sealing Details

283193-002	No treatment details
283193-003	No treatment details
284193-052	No treatment details
283193-001	No treatment details
283193-008	No treatment details
284193-036	Adit sealed with compacted brick rubble and backfilled with soil. 4.3m square fence erected (CCD/92/34).
285193-011	No treatment details
283194-018	No treatment details
284193-035	No treatment details
283193-007	No treatment details

All locations should be treated as suspect with respect to their structural integrity.

6.3 Recorded Mineworkings

The principal working horizons which have possible significance with respect to the stability of the ground in the proximity of the proposed wind turbines are the seams contained within the Rhondda / Llynfi Beds, Upper Coal Measures section of the stratigraphic sequence.

The seams contained within this section of the sequence tend to be of limited thickness when compared with the economically more important (and thicker) seams which are located several hundreds of metres below in the Middle and Lower Coal Measures.

The lower seams have been extensively worked from beneath the site area but are at such a depth and age that they will have no impact upon the structural integrity of the ground beneath the proposed turbines.

Details of the seams for which abandonment records exist are shown in Table No. 1 - Summary of Abandoned Mineworkings. The table provides details of seams present, intervals between seams, date of abandonment, seam section and approximate depths to the base of the seams below specific turbine locations.

The outline of the colliery 'takes' within the upper seams, i.e. Wernpistyll and Wernddu (Rhondda No. 2), are shown in Drawing No. JA-146-001-005 - Old Workings Location Plan. Details of workings in the lower seam horizons are not included as they are considered to be of no direct relevance.

6.4 Character of Workings

6.4.1 Upper Seams

The upper seams of relevance extend from the Wernpistyll up to the Field vein and include the Wernpistyll Rider and Wernddu (No. 2 Rhonda).

The seams, which are generally thin with extractive thicknesses of less than 1 metre, were worked by pillar and stall method which involves the extraction of 'stalls' of coal between which 'pillars' of solid coal are left in place. The extent of coal extraction would have been dependent upon a number of factors, namely the nature of the roof and floor strata which surround the seam in addition to seam thickness, section quality consideration plus the depth of workings: the greater the depth the larger the support pillars required. Records of 'actual' extraction percentage and extraction geometry are not necessarily accurate. Due to the payment of royalties for coal being due to minerals owners there has always been the temptation to conceal accurate information with respect to areas worked / tonnes extracted.

Whilst most collapse occurs soon after the removal of any timber support which may have been used, residual movements can occur for some time afterwards being associated with the degradation of pillars, rises in groundwater and secondary disruption due to the effects of workings at lower levels.

Given the age of the workings (latest recorded being in the Wernddu from the Nant Glas Colliery which was abandoned in 1988) in the upper seams it is likely that all significant movements will have long since ceased; generally occurring immediately after extraction with residual movements usually being completed within a year or so. It should be noted though that, where abandoned workings are present at shallow levels, surface loading and vibratory movements associated with structures such as wind turbines could reactivate collapse. This potential problem can be removed by undertaking appropriate ground stabilisation works.

Turbine locations which could be affected by abandoned mineworkings are highlighted in 'red' in Table No. 1 and include Turbines T1, T2, T3, T4, T8, T9 and T10.

6.4.2 Lower Seams

The Tormynydd seam occurs at a minimum estimated distance of 135 metres below any of the proposed turbines (the seam is at its shallowest below T1).

The extraction thickness of the Tormynydd is indicated to be approximately 1 metre, with the most recent workings being abandoned in 1957. These workings were undertaken by pillar and stall technique and as such will have created little or no subsidence at surface other than in locations close to the seam's surface outcrop position.

Workings in additional seams below the Tormynydd extend to depths in excess of 790 metres. Subsidence associated with these lower level workings, which were undertaken up until the late 1970s, will have long since ceased, with all movements being completed within a year or so of the removal of support.

6.5 Other Minerals

6.5.1 Fireclay

The Coal Authority search indicated the presence of abandoned underground workings in fireclay within the site area at a level of shallow to 140 metres below ground level.

The Geological Memoir indicates that historically extensive underground workings of good quality seatearths from beneath the Rhondda 1, 2 (Wernddu) and 3 seams occurred in the general area.

The workings, if present beneath the site, will have been associated with the fireclays located beneath the Wernddu (No. 2 Rhondda) and the clay (Hafod) seam horizon which occurs approximately 155 metres below the Wernddu.

No information on the extraction thickness is available though it should be assumed* that the fireclay will have been extracted in association with the Rhondda No. 2 seam giving a total extracted thickness of potentially 1.5 to 2 metres.

(* Abandonment Plans indicate a fireclay thickness of approximately 0.76m beneath the Wernddu seam.)

6.5.2 Ironstone

Ironstones of commercial value occur in the lower parts of the stratigraphic sequence at around the Gellideg / Garw seam horizons (Lower Coal Measures).

The level of these horizons beneath the site is in excess of 700 metres and therefore any workings within them are of no significance with respect to turbine stability.

6.6 Active Mines

The Coal Authority search indicates the recent existence of three licences to remove or otherwise work coal by underground method are located in the immediate vicinity of the application area,. The locations of the licences are shown in drawing number JA-146-001-007 'Conditional Underground Licences'. The licences are

i) Nant Glas Newydd Mine

Small mine licence

Status: Expired.

ii) Cefn Parc Arlais No.4 Mine

Small mine licence

Status: Expired

ii) Bryn Troedgarn Farm

Small mine conditional licence located to the south of N194350 and west of E284660

Status: Conditional licence which expired in June 2014, and there has been no subsequent application to re-new this licence.

7. POTENTIAL RANGE OF IMPACT ASSOCIATED WITH ABANDONED MINeworkINGS

7.1 Lower Level - Tormynydd and Underlying Seams

The deeper level workings are at such a depth and age that there will be no further impacts associated with them. All subsidence associated with the removal of support, rising ground water and effects of any later stage sub-jacent mining operations will have long since ceased.

7.2 Shallow Level - Wernpistyll to Field Vein

The search of the Coal Authority's Abandoned Mines Records provided information relating to 'recorded' abandoned mineworkings only and it should be noted that unrecorded mineworkings in addition to those identified may be present. In addition, the outline details showing mined-out blocks are not necessarily accurate and have often been found to be significantly inaccurate.

It is not likely that any workings of significance will be present in seams other than those identified below:

Field Vein, Wernddu (No. 2 Rhondda), Wernpistyll Rider and Wernpistyll seams

The No. 1 Rhondda seam, which occurs at a higher level than the No. 2 Rhondda, crops out at surface beyond the northern limit of the site (see Drawing No. JA-146-001-004), dips towards the north and is, therefore, not present beneath the site area.

The stratigraphic generalised vertical section for the sequence indicates the worked seam horizons to be generally contained between sandstone units, though it should be noted that above the Wernddu (No. 2 Rhondda) mudstones are, in places, present.

7.3 Geological Features of Note and Potential Impact

A significant geological feature in the area is the Jubilee Slide, the approximate surface position of which is shown in Drawing No. JA-146-001-004.

The structure is part of a system of arcuate normal faults which extend in a broadly east / west direction and are traceable over a distance in excess of 12 miles. The displacement direction of the faulting is generally towards the south.

The hade (i.e. angle between fault plane and vertical) of the faults can be highly variable from 45° to much lower inclination. Within the site area the fault is shown to lie within close proximity to Turbines T3 and T7.

Potential Impacts

Commonly, subsidence movements associated with underground mineworkings can focus onto fault planes when present.

It is conceivable that loading associated with a wind turbine could re-activate fault movements along fault planes such as the Jubilee Slide.

Recommendations

It is recommended that the surface position of the Jubilee Slide is established, along with the presence of underground mineworkings cavitation.

7.4 Impact on Turbines

Drawing No. JA-146-001-005 shows the location of recorded mineworkings and proposed turbine locations from which it can be seen that the following turbines lie within zones of potential impact associated with the abandoned workings.

- T1, T2** Nant Glas Colliery. Wernddu Seam. (At depths between 10 and 35 metres bgl)
- T9, T8** Duffryn Rhondda and Foel-y-Duffryn Collieries - Wernddu seam (At depths between 20 and 35 metres bgl).
- T3** No workings but seams close to surface (At between 10 and 30 metres bgl).
- T4** Argoed Colliery - Wernpistyl seam (At between 30 and 40 metres)

(Whilst Abandonment Plans indicate the worked area to lie marginally outside of the proposed T10 turbine location, it is in close proximity to workings and therefore should be considered as being potentially within the zone of impact.)

Recommendations

It is recommended that a programme of site investigation work should be undertaken around each of the proposed turbine locations noted above where abandoned mineworkings are known to occur or lie in close proximity.

The site investigation works should include field mapping (to identify, if possible, the location of the Jubilee Slide) and exploratory borehole drilling (to identify the nature of the ground conditions beneath the proposed turbine sites).

CIRIA guidance suggests that drilling to a depth of ten times the extraction thickness is undertaken which, in the case of the Wernddu (where there is potential for seatearth extraction to have occurred), would represent a depth of 20-25 metres. Littlejohn (Consolidation of Old Coal Workings - Ground Engineering May 1979 12 (c)15-21) suggests where substantial structures are being constructed the depth should be 60 metres.

It is recommended that drilling in the locations of the proposed turbines should be undertaken to a level where the position of the identified seam horizon of concern is confirmed - reference to Table No. 1 provides guidance to likely depths.

Depending upon the findings of the site investigation it may be necessary to stabilise the disturbed over-lying strata by either partial grouting to improve the bearing capacity of specific zones or to undertake full grouting of the workings and overlying strata.

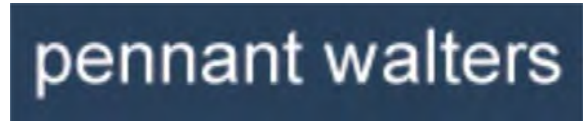
In conclusion, whilst the potential for shallow level abandoned underground mineworkings exist in the vicinity of several of the turbine locations, the problem can be readily engineered-out by adopting standard ground stabilisation works.

The presence of shallow level abandoned mineworkings does not preclude the locating of wind turbines above them provided that the appropriate level of ground stabilisation works are undertaken prior to erection.

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June 2014

TABLES

TABLE NO. 1 - SUMMARY OF ABANDONED MINEWORKINGS



FOEL TRAWSNANT

TABLE NO. 1 - SUMMARY OF ABANDONED MINEWORKINGS
(Reference should be made to Drawing No. JA-146-001-005 for location details)

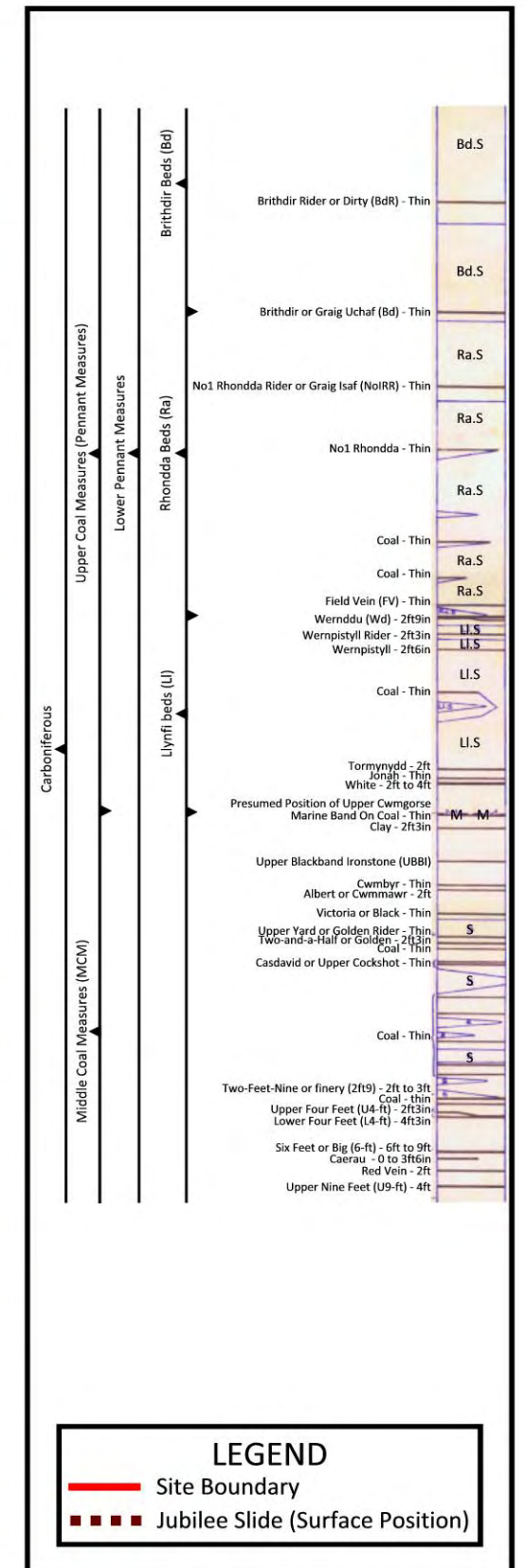
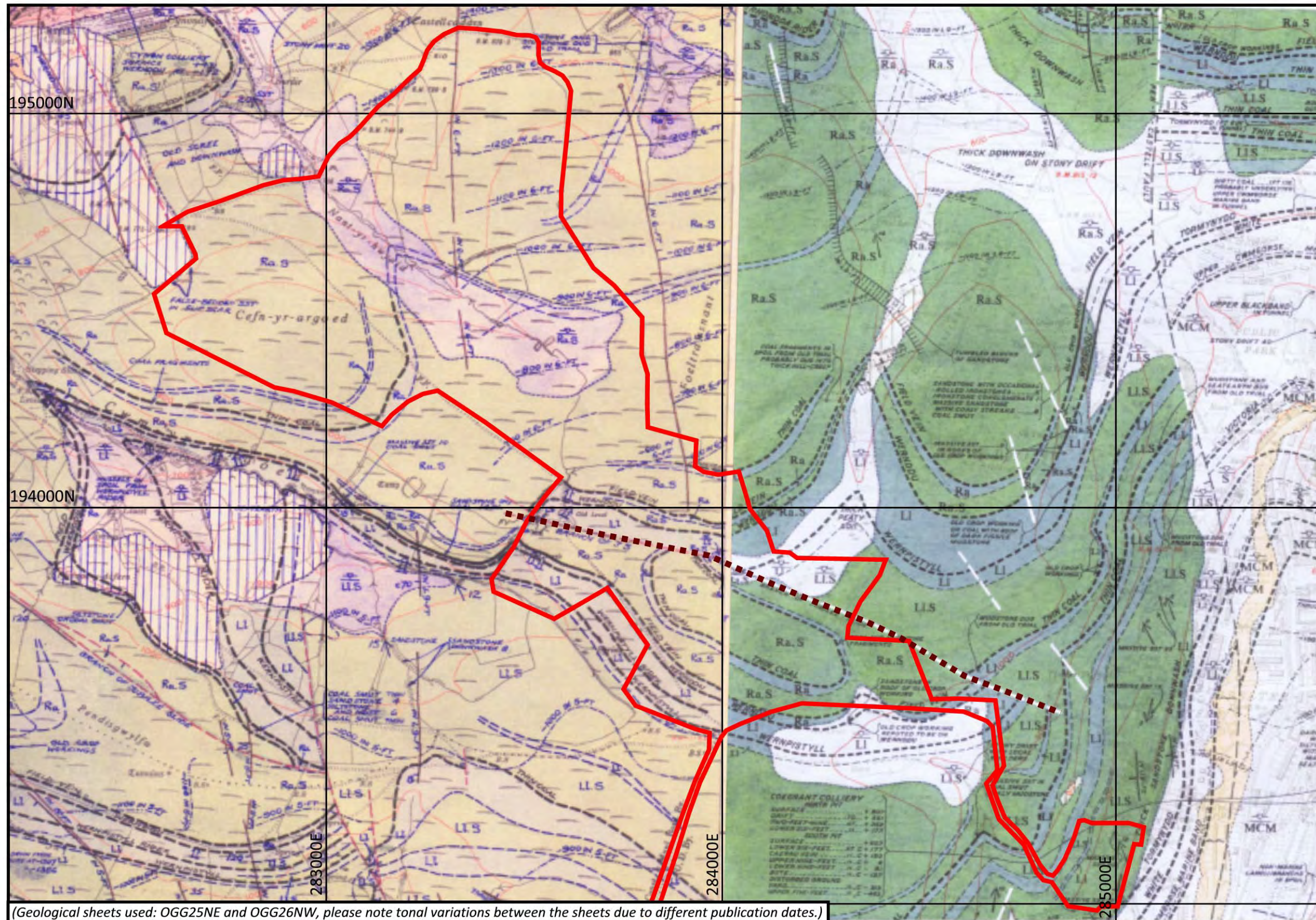
SEAM	INTERVAL BETWEEN SEAMS (M)	WORKED BENEATH SITE AREA	DATE OF WORKING	APPROXIMATE EXTRACTION THICKNESS (M)	APPROXIMATE DISTANCE TO SEAM BELOW TURBINE LOCATION (METRES)												
					T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13
No. 1 Rhondda	148	NO	N/W	N/A	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
Field Vein		YES	1872-1967	25(5)10(25)22	0* ¹	20-25	10-20	10-20	60-70	70+	NP	20-25	15-20	10-20	60-70	70-80	80+
No. 2 Rhondda (Wernddu)	11	YES	1872-1967	71* ²	0-10	30-35	20-30	20-30	70-80	70+	NP	30-35	25-30	20-30	70-80	80-90	
Wernpistyll Rider	11	YES	1925-1959	50	10-20	40-45	30-40	30-40	80-90	80+	5-10	40-45	35-40	30-40	80-90	90-100	
Wernpistyll	<10	YES	1925-1959	55(5)40	20-30	50-60	40-50	40-50	90-100	90+	15-20	50-55	45-50	40-50	90-100	100-110	
Tormynydd	114	NO	1872-1957		135-145	165-175	155-165	155-165	205-215	205+	130-135	165-170	160-165	155-165	205-215	215-220	
Jonah	11	YES			145-155	175-185	165-175	165-175	215-225	215+	140-145	175-180	170-175	165-175	215-225	220-225	
White	5	YES	1912-1927		150-160	185-190	175-180	175-180	215-220	220+	145-150	180-195	175-180	175-180	225-230	225-230	
Clay	40	YES	1911	66	190-200	220-230	210-220	210-220	255-265	255+	185-190	220-225	215-220	210-220	255-265	265-270	
Black	80	YES	1872		270-280												
Golden	275	YES	1872-1931		IN EXCESS OF 200 METRES BELOW TURBINE LEVEL												
Cockshot		YES	1872														
Two Feet		YES															
Four Feet		YES	1966														
Six Feet		YES	1950-1977														
Upper Nine Feet		YES	1970														
Lower Nine Feet		YES	1977														
Five Feet		YES															

*¹ = At Surface
*² = Plus possibly 0.76m seatearth extraction
NP = Not Present N/A = Not applicable N/W = Not Worked
53(10)50 = Coal (Dirt) Coal
T3 - Turbines located within the potential zone of effect associated with shallow level abandoned mineworkings

DRAWINGS

DRAWING NO. JA-146-001-002	GEOLOGICAL SHEET EXTRACT
DRAWING NO. JA-146-001-003	SITE LOCATION
DRAWING NO. JA-146-001-004	WINDFARM TURBINE AND COAL MINE DRIFT LOCATIONS
DRAWING NO. JA-146-001-005	OLD WORKINGS LOCATION PLAN
DRAWING NO. JA-146-001-006	SHAFT AND ADIT LOCATION PLAN

FOEL TRAWSNANT
GEOLOGICAL SURVEY SHEET EXTRACT AND GENERALISED VERTICAL SECTION



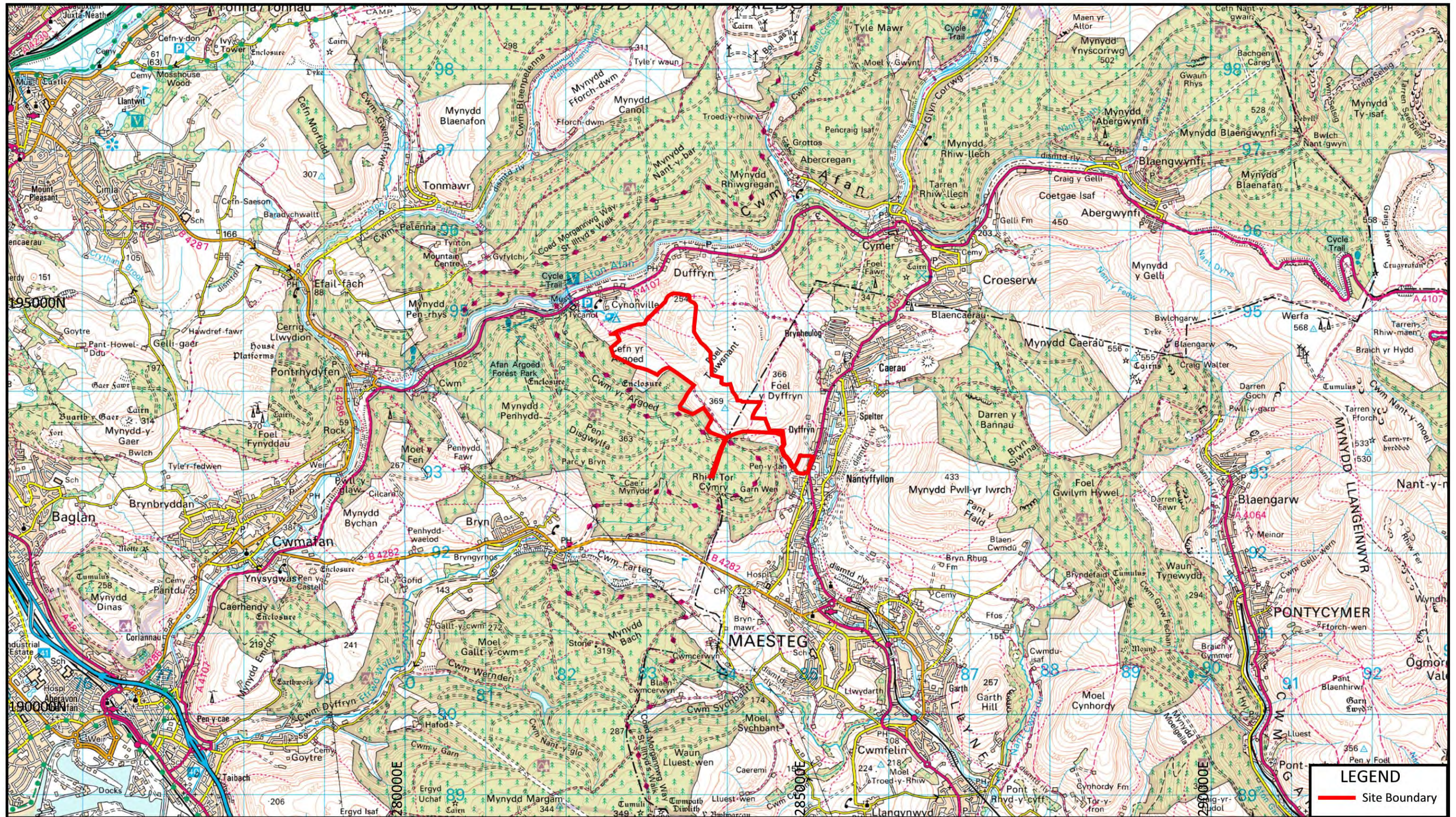
Drawing No. JA-146-001-002

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FOEL TRAWSNANT SITE LOCATION PLAN



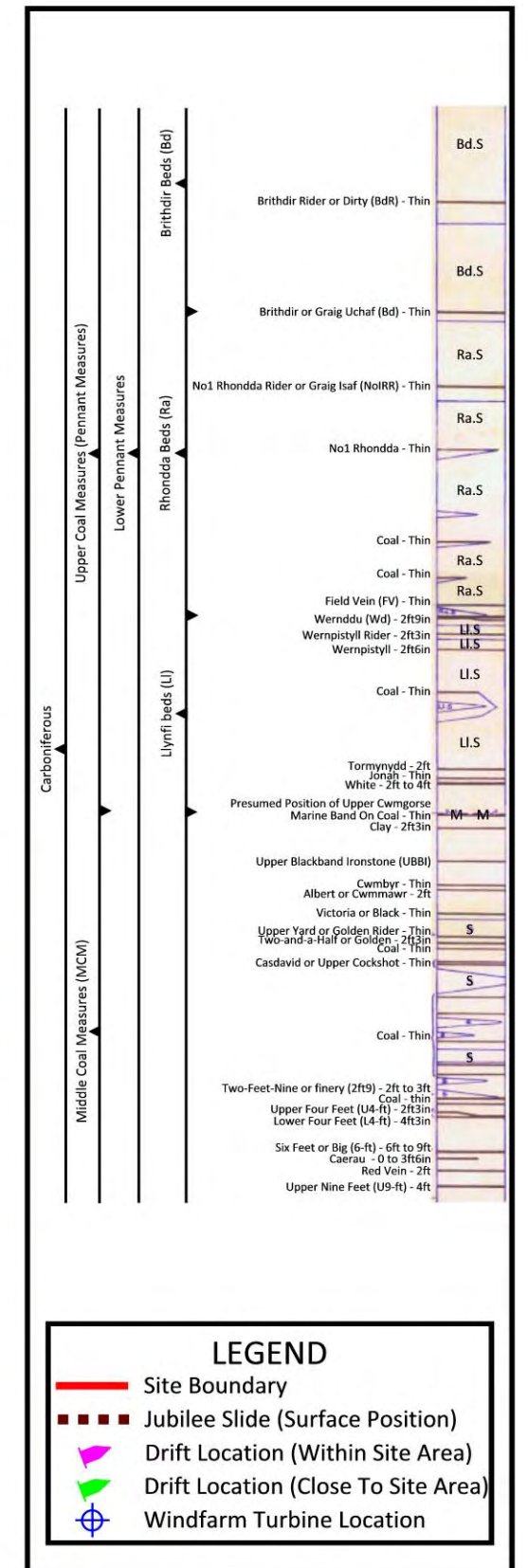
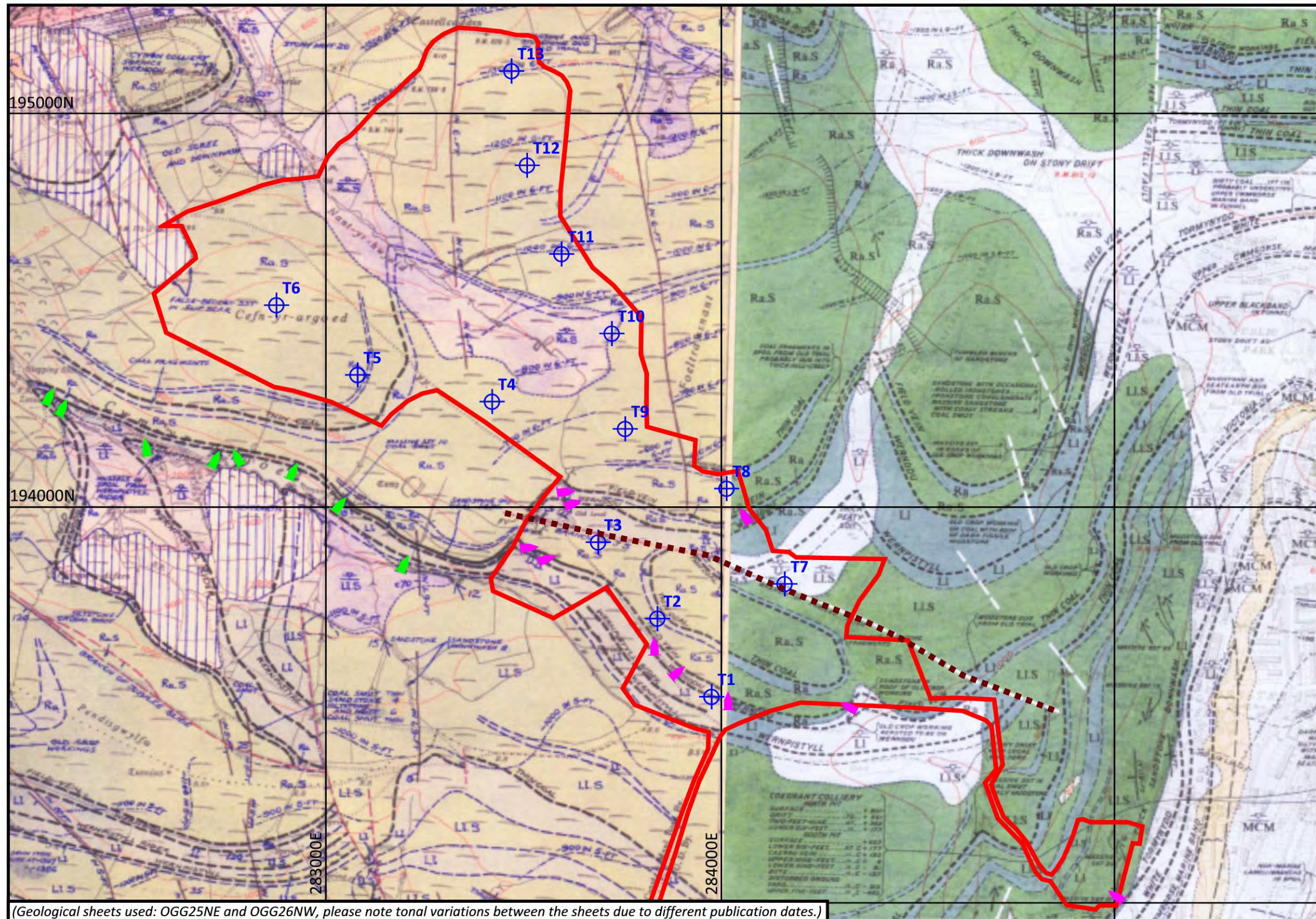
Drawing No. JA-146-001-003

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FOEL TRAWSNANT
WINDFARM TURBINE AND COAL MINE DRIFT LOCATIONS



Drawing No. JA-146-001-004

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