

# **BLAENAU GWENT LANDMAP STUDY GEOLOGICAL LANDSCAPE LAYER**



## **Original LANDMAP Study**

N. Noonan (2001)

## **Upgrading and Updating Technical Report**

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## Crynodeb Gweithredol

Mae ardal LANDMAP Blaenau Gwent (BG) yn gorwedd o fewn rhan ogledd-orllewinol plyg Farisgaidd rhanbarthol maes glo de Cymru, adeiledd y gellir ei olrhain o'r dwyrain i'r gorllewin. Tua'r gorllewin y mae Bwrdeistref Sirol (BS) Caerffili, ac i'r dwyrain BS Torfaen. Tua'r gogledd mae BS Brycheiniog a Bannau Brycheiniog. Arwynebedd yr ardal yw 109km<sup>2</sup> sy'n golygu mai hon yw un o'r bwrdeistrefi sirol lleiaf. Dylanwadir yn drwm ar dirwedd/geomorffoleg ardal Blaenau Gwent gan greigiau Palaeosöig Uchaf, Carbonifferaidd Uchaf y Ffuriant Glo Cynhyrchiol (Cystradau Glo Isaf-Canol) a ffurfiannau gorchuddiol Pennant a Grovesend de Cymru (Cystradau Pennant/Cystradau Glo Uchaf). Mae'r ddaearog a'r geomorffoleg i'w gweld yn glir ar fapiau tirwedd a mapiau tir digidol. Synffurf yw'r maes glo sydd â thywodfeini Pennant gwydn – y creigiau mwyaf diweddar – yn ei chanol ac mae'r rhain yn sail i lwyfandir uchel sy'n gogwyddo'n raddol tua'r de-ddwyrain. Yn gyffredinol, mae'r haenau'n goleddu tua chraidd y plyg. O amgylch y craidd hwn mae olyniaeth o gerrig llaid meddal, yn bennaf, sy'n rhan o'r Ffuriant Glo Cynhyrchiol, yn brigo ar ffurf gwregysau gogleddol a deheuol – y Brig Gogleddol a'r Brig Deheuol. Mae'r haenau hyn sy'n cynnwys glo hefyd yn brigo ar lechweddau a lloriau dyffrynnoedd culrych dyfnion y maes glo. Ym Mlaenau Gwent mae'r ucheldir, sy'n rhan o lwyfandir tywodfaen Pennant canolog y maes glo, ar ei uchaf ar Fynydd Coety (578m uwchlaw DO) yn nwyrain yr ardal. Ymhellach tua'r gogledd, gorchuddir y golethrau sy'n wynebu'r de, llethrau y mae cerrig llaid y Cystradau Glo yn sail iddynt yn bennaf, gan glog-glai. O amgylch rhimyn gogleddol y maes glo mae creigiau hŷn Grŵp y Grut Melinfaen a'r Calchfaen Carbonifferaidd, sy'n goleddu tua'r de, yn ffurfio'r llechweddau uwch dan darren Hen Dywodfaen Coch Bannau Brycheiniog. Nodweddir y calchfaen a'r Grut Gwaelodol gan dirwedd garstig. Mae'r dyffrynnoedd afonol culrych mawr y gellir eu holrhain o'r gogledd-orllewin i'r de-ddwyrain/gogledd-ogledd-orllewin i'r de-dde-ddwyrain, sydd hefyd yn cynrychioli sianeli draeniad rhewlifol hynafol, yn dyrannu llwyfandir y tywodfaen Pennant, ac yn orserth eu gwedd o ganlyniad i erydiad rhewlifol. Ym Mlaenau Gwent ceir dyffrynnoedd ffurf V-U rhan uchaf afon Sirhywi ac afonydd Ebwy Fach ac Ebwy Fawr, a rhan uchaf afon Llwyd yn yr ardal fwyaf dwyreiniol. Lluniwyd tirwedd ardal Blaenau Gwent yn fwyaf diweddar gan y rhewlifant Defensaidd diweddar, diwethaf a adawodd drwch o glog-glai dros bobman ac eithrio'r tir uchaf. Mae gwaddodion priddlif ffinrewlifol (wynebynnau) yn gorchuddio rhannau helaeth o lechweddau'r dyffrynnoedd ac mae tirlithriadau – hen a mwy diweddar – yn gyffredin ar gerrig llaid llechweddau gorserth y dyffrynnoedd, islaw'r tywodfeini Pennant. Roedd cloddio glo yn ddiwydiant o bwys ac erys tystiolaeth o weithgaredd gwaith cloddio'r gorffennol yn rhan o'r dirwedd ar ffurf tomennydd rwbwl, tipiau, siaffftiau pyllau a thir diffaith. Ar lethrau dyffrynnoedd ac arnynt hen dirlithriadau, sbardunwyd ansefydlogrwydd pellach drwy gloddio am lo a haearnfaen.

Mae'r data o'r astudiaeth LANDMAP wreiddiol wedi'i ddiweddarau a'i uwchraddio. Adolygir methodoleg y Tirweddau Daearegol, gan gynnwys agweddau o'r defnydd o'r dosbarthiad hierarchaidd diwygiedig a'r gronfa ddata Collector (gweler Methodoleg). Darperir Arolwg o'r ddaearog a'r

geomorffoleg. Rhestrir ffynonellau allweddol y mapiau a'r llenyddiaeth yn y Llyfryddiaeth.

Nodwyd y berthynas glòs rhwng daeareg/geomorffoleg a thirwedd, sy'n amlwg wrth gymharu mapiau topograffig a daearegol, wrth ddynodi Ardaloedd Agwedd yr astudiaeth LANDMAP wreiddiol. Mae'r dyffrynnoedd rhewlifol yn ffurfio nodweddion tirwedd sylfaenol ac mae creigiau ac adeileddau tectonig yn ddylanwadau pwysig pellach arnynt. Disgrifiwyd a chofnodwyd 23 o Ardaloedd Agwedd yn Collector LANDMAP. Seilir yr arfarniadau ar y potensial ar gyfer ymchwil ac addysg, yn ôl yr amlinelliad a luniwyd ar gyfer yr Arolwg Cadwraeth Ddaearegol (ACDd), a chyfyngir arfarniadau Eithriadol i ardaloedd ac ynddynt safleoedd geocadwraeth pwysig. Ar hyn o bryd, ni restrir unrhyw Safleoedd Ddaearegol/Geomorffolegol o Bwysigrwydd Rhanbarthol (RIGS), sydd fel rheol yn cynnwys safleoedd addysgol pwysig nad ydynt wedi'u dynodi'n SoDdGA. O blith y 23 Ardal Agwedd, mae 26% ohonynt wedi'u dynodi'n Eithriadol neu Uchel, 61% o werth Canolig (y dynodiad diodyn), ac 13% yn Isel. Mae'r dirwedd ddaearegol yn gymharol sad; ar lwyfandiroedd uchel mae'r Cyflwr, at ei gilydd, yn Dda. Ystyrir bod y Duedd yn y manau lle y mae'r tir dan ddylanwad hindreuliad a diraddiant naturiol – megis ar draws y llwyfandiroedd uchel – yn gymharol Gyson. Yn y manau glofaol, mae cloddio am lo wedi dod i ben, i raddau helaeth, ac mae tir adferedig neu dir diffaith wedi'i ailddatblygu. Gweddol, at ei gilydd, yw cyflwr y fath ardaloedd ond ers y duedd yn Gyson. Mae'r blaenoriaethau rheoli yn rhai hirdymor, fel sy'n briodol ar gyfer astudiaeth Lefel 3.

## Executive Summary

The Blaenau Gwent (BG) LANDMAP area occupies the northeastern segment of the regional E-W Variscan fold structure of the South Wales Coalfield. It is bounded to the west by Caerphilly, and to the east by Torfaen county boroughs (CB). Brecknock CB and the Brecon Beacons lie to the north. The area covers 109km<sup>2</sup>, which makes it one of the smaller county boroughs. The landscape/geomorphology of the Blaenau Gwent area is controlled by Upper Palaeozoic, Upper Carboniferous rocks of the Productive Coal Formation (Lower-Middle Coal Measures) and overlying South Wales Pennant and Grovesend formations (Pennant Measures/Upper Coal Measures). The geology and geomorphology are well displayed on landscape and digital terrain maps. The Coalfield is a synform (downfold) which has resistant Pennant sandstones as the youngest rocks, in its core, and these form a high level upland plateau, gently tilted towards the SE. The beds dip generally towards the core of the fold. Around this core, a softer, dominantly mudstone succession of the Productive Coal Formation crops out in northern and southern belts – the North and South Crops. These coal-bearing beds are also exposed in the sides and floors of the deeply dissected valleys of the Coalfield. In Blaenau Gwent, the upland terrain formed by the central Pennant sandstone plateau of the Coalfield reaches its highest point at Coety Mountain in the E of the area (578 m above OD). The mudstone dominated Coal Measures further north form boulder clay covered, S-facing dip slopes. Around the north rim of the Coalfield, older rocks of the S-dipping Millstone Grit Group and Carboniferous Limestone form higher hill slopes below the escarpment of the Old Red Sandstone Brecon Beacons. The Limestone and Basal Grit have characteristically karstic topography. Major NW-SE to NNW-SSE trending river valleys that also represent ancient glacial drainage channels are deeply dissected through the Pennant sandstone plateau of the Coalfield, and glacially oversteepened. In Blaenau Gwent, there are the V-U shaped valleys of the upper Sirhowy, Ebbw Fach and Ebbw Fawr rivers, with the upper Afon Lwyd in the easternmost part. The topography of the Blaenau Gwent area was shaped most recently by the last, late Devensian glaciation, which left widespread deposits of boulder clay, now preserved over all but the highest ground. Periglacial solifluction deposits (head) are widespread along valley slopes, and large landslips –both ancient and more recent - are common along the oversteepened valley sides beneath the Pennant sandstones onto the mudstones below. Coal mining was an important industry, and evidence of previous mining activity remains in the landscape in the form of spoil heaps, tips, mine shafts and areas of made ground. On valley slopes with ancient landslips, renewed instability has resulted from extraction of coal and ironstone.

The data from the original LANDMAP study are updated and upgraded. The Geological Landscapes methodology is reviewed, including aspects of the application of the revised hierarchical classification and using the Collector database (see Methodology). An Overview of the geology and geomorphology is given. Key sources of maps and literature are listed in the Bibliography.

The intimate relationship between geology/geomorphology and landscape, which is evident from comparing geology and terrain maps, was recognised in

designation of the Aspect Areas in the original LANDMAP study. The glaciated valleys form primary landscape features, within which bedrock and tectonic structures are further important controls. 23 Aspect Areas have been described and recorded in LANDMAP Collector. Evaluations are based on the potential for research and education as outlined for the Geological Conservation Review (GCR), where Outstanding evaluations are restricted to areas with prime geoconservation sites. Currently there are no RIGS sites listed, which typically include prime educational sites not covered by an SSSI designation. Of the 23 Aspect Areas, 26% are rated as Outstanding or High, 61% as Moderate (which is the default), and 13% low. The geological landscape is relatively robust; in upland plateau areas where the Condition is generally Good. The Trend, where subject mainly to natural weathering and degradation – as across wide areas of the upland plateau - is considered relatively Constant. In coal mining areas, extraction has largely ceased, and reclaimed or made ground in the valleys has been developed. The condition in such areas is more generally Fair, but the trend remains Constant. Management priorities are long-term, as is appropriate to a Level 3 study.

## CONTENTS

	Page	
Crynodeb Gweithredol	2	
Executive Summary	4	
Introduction	7	
Personnel	7	
Methodology	7	
Collector Database for Geological Landscape	8	
Geological Landscapes Aspect Areas	10	
Overview	11	
Bibliography	14	
Figures and Tables		
Figure 1	Geology of the South Wales Coalfield	16
Figure 2	Shaded Landsat Image of South Wales Coalfield	16
Figure 3	Geology of South Wales Coalfield on Shaded Landsat Image	17
Figure 4	Geological Landscape Aspect Areas and SSSIs	17
Figure 5	Aspect Area numbering	18
Figure 6	Isopach maps of the South Wales Coalfield (from Woodland and Evans 1964)	19
Figure 7	Upper Carboniferous, Westphalian Stratigraphy of the Coalfield	20
Figure 8	Major tectonic structures of the Coalfield	21
Table 1	Evaluations of Geological Landscapes Aspect Areas	11
Table 2	Summary of Area ID codes, descriptions, evaluations and SSSI/GCR sites	22

## **INTRODUCTION**

Blaenau Gwent County Borough (BG) lies within the dissected upland plateau area formed geologically by the South Wales Coalfield. The area is covered by 2 geological (BGS) map sheets at 1:50 000 (see Bibliography). To complement the geological map coverage, digital terrain models compiled from OS panorama digital terrain data (50m resolution), hydrogeological and Quaternary maps were used, as well as the Ordnance Survey 1:25 000 Explorer Series maps. Geological memoirs to accompany the map sheets formed the major literature sources. Geological Conservation Review volumes represent key sources for geoconservation sites.

### **LANDMAP study personnel**

The initial LANDMAP survey by Noretta Noonan (MSc Applied Environmental Geology - School of Earth, Ocean and Planetary Sciences, Cardiff University) has been updated to Geological Landscapes specification by:

Dr Lesley Cherns – Senior Lecturer  
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Mr Alun Rogers – GIS Technician

Previous LANDMAP studies carried out by this team include Brecknock, Snowdonia and Gwynnedd, Merthyr, Rhondda Cynon Taf - Caerphilly - Bridgend, Torfaen, Cardiff, the Vale of Glamorgan, Neath-Port Talbot and Swansea.

## **METHODOLOGY**

This LANDMAP upgrading and updating exercise followed the introduction of the new LANDMAP methodology and Collector software in 2003. Designation of Aspect Areas is based on geology and geomorphology, where bedrock and the processes, both past and present, that have acted on it are integral. The hierarchical classification of this new methodology differs from that originally employed, but the basis on which Aspect Areas are selected, i.e. geological and geomorphological expression within a landscape, remains essentially the same. Application of the new terrain classification is discussed further below and software amendments resolved most of the constraints on data transfer into the Survey part of the new LANDMAP Collector form. Survey data in LANDMAP are not compromised by the changed Classification.

The Level 1 terrain topography of Mountain and upland valley (Level 1) applies throughout BG. This is the main category where glaciated terrain can be classified, although other key features such as the dissected upland plateau that characterises the valley geomorphology may also be of primary significance. For glaciated areas such as the Coalfield, the Level 2 option is

effectively restricted to a single category (Glaciated mountain terrain), and also at Level 3 (Glacial mountain valley). Tectonic control of valleys and valley sides is common, however, but selection of that Level 1 option removes the classification of topographic terrain type. For BG, where glacial geomorphology represents the primary landscape control, the terrain record rather than the tectonic has therefore been selected in most cases. Similarly, important landscape features, such as the landslips that characterise many valley sides in the Coalfield, have been registered under Mass movement as an additional Level 3 character (rather than at levels 1 and 2) and as Landslips at Level 4. Although the detailed survey of Level 4 features lies beyond the scope of a Level 3 study, many have been recorded.

The close relationship of geology and landscape (Figures 1-3) was recognised in delimiting areas in the original LANDMAP study. Geological boundaries, major geological structures (faults, folds), and geomorphology were used to determine area boundaries. BG comprises upland/mountain terrain, capped by the high Pennant sandstone plateau (South Wales Pennant Formation-Grovesend Formation) of the Coalfield, and dissected by river valleys. The area has been glaciated, and glacial geomorphology provides a key control on landscape. Oversteepened glacial valleys that dissect the upland areas have accentuated prominent fault lineaments. The broad valley floors include deposits of glacial and fluvio-glacial material, as well as the deposits of active rivers, such as channel deposits and alluvium. Glacial boulder clay forms a widespread blanket over valley slopes and floors, and across the dip slopes of the North Crop. Mining activity was formerly widespread, and there are areas of worked out and reclaimed land, coal spoil tips, mine shafts and levels. Landslips have developed on the oversteepened valley sides, a consequence of both natural, ancient slope instability and more recent mining activity.

## **COLLECTOR DATABASE FOR GEOLOGICAL LANDSCAPE**

**Classification** - Although the selected Level 1 category, and hence Level 2, also controls the choice of Level 3 factors in the initial classification, the Collector form also allows for the recording of additional characteristic Level 3 categories, to more fully describe the delineated Aspect Area. In addition, selecting 'Other' in the initial classification also allows for flexibility.

Level 4 characters – which are commonly important component features of aspect areas – have been input in most cases. A number of additional Level 4 features not included in Collector field 8, are recorded in field 37 ('Additional comments'), including: Stream, Disused quarry.

**Survey** data include important stratigraphical, drift and structural data, and also hydrological and soil characteristics. Geological characters of named rock units (e.g. sedimentary, igneous, or metamorphic – and rock types, e.g. sandstones, mudstones, etc.) are recorded in the Technical Report, except where mentioned separately in the Description. That Description is the main section where the relative importance of bedrock type, drift characteristics,

structures and processes is assessed. Details are given of hydrology, industrial activity, and SSSIs/GCRs. Under Pedology, 1:100 000 Groundwater Vulnerability maps (see Bibliography) provide broad soil permeability categories that relate to bedrock units.

**Evaluation and Evaluation Matrix** - Evaluation relies on a matrix for geoconservation assessment where outstanding research value is assigned to the prime SSSI/GCR sites, and outstanding educational value would apply to RIGS sites. As no data was available for RIGS sites, outstanding educational evaluations have not generally been made, except where known through personal experience or from excursion guidebooks. At Level 3, without field visits and further research, evaluations of educational importance are generally uncertain, as the suitability for educational group visits cannot be fully ascertained. Nevertheless, as educational value is typically linked to scientific value, the presence of notable SSSIs may justify a high educational evaluation.

Evaluations of historical importance, rarity/uniqueness and classic examples, which are characters used in determining geoconservation sites, may therefore reflect the presence of a geological SSSI in the Aspect Area, but should be viewed with caution from a Level 3, desktop study. In general, well exposed areas displaying features of research value (e.g. landslips, Lower or Upper Carboniferous stratigraphy, Variscan structures, etc.) are rated as High. Moderate value is the default position for typical representation, applied to areas of more limited exposure, widely distributed stratigraphical units or landscape features. Low evaluations are applied only to areas relatively unimportant for geoconservation, where the natural landscape has been significantly degraded by industrial and urban development. These evaluations should all be regarded as relative. Justifications for the ratings are shown under the Overall Evaluation (Q34). Note, where SSSI/GCR sites are given Outstanding research evaluations, this is applied to the Aspect Area as a whole as there are no objective grounds in the methodology adopted here for listing any different evaluation. For example, one area evaluated as Outstanding includes a SSSI for Upper Carboniferous stratigraphy, in outcrop along sections of a major trunk road.

**Condition** – Upland areas of the geological landscape are fairly well exposed, and subject to natural change. Industrial development is extensive across the coal and ironstone mining areas of the North Crop and in valley sides cut through the Pennant sandstones. Condition has been assessed as Good or Fair, depending on the degree of development and industrial degradation.

**Trend** – Although the initial survey included field visits, this Level 3 revision does not include any further field evaluation. In general, geological landscape is considered to be robust, and the default trend as Constant. An assessment of Declining is appropriate, for example, for areas of active slope instability as a consequence of human activity (e.g. mining).

**Recommendation** – Covers aspects of management regime, and general suggestions have been made, as are appropriate for a Level 3 study. Where

the natural Geological Landscape is reasonably robust and not subject to rapid change, the default for the existing regime is neutral, and the strategy is to conserve as existing. Priorities and potential issues or threats are entered as appropriate; in general, it is desirable to preserve the geological and geomorphological integrity of the landscape and ensure that no significant features of geological or geomorphological significance are lost or damaged and that any SSSIs present are maintained in favourable condition by the implementation of CCW's management plan process.

Although RIGS sites have not been formally proposed for this area, where regionally significant non-SSSI sites are noted within an Aspect Area, assessment of such a status may be proposed (including where a high scientific evaluation has been made although no geological SSSIs are currently notified).

**Tolerance to Change** – Potential threats are entered in this field, although it should be noted that these may not be *actual* threats. Recommendations regarding development/industrial activity are included.

**Aspect Area Boundary** – Data sources for Geological Landscape are primarily 1:50 000 BGS geological map sheets. These represent the most up to date sources for the geological (solid and drift geology) succession and structural data, so that the older 1:10 000 map series are mostly less relevant. In addition, digital terrain data models have been superimposed to display landscape in relation to geology. The digital terrain data is accurate to 50m resolution. The OS maps used for plotting areas are 1:25 000. Thus the overall accuracy of the GL data is less than 1:10 000.

Justification is given for positioning boundaries that define landscape entities. They are consistently placed to coincide with geological boundaries, tectonic structures or to bound geomorphological features. They therefore attempt to define controls on Geological Landscape.

**Bibliography** – BGS Maps and Memoirs, and other key map and literature sources are listed.

## **GEOLOGICAL LANDSCAPES ASPECT AREAS**

Geological Landscapes in this Level 3 LANDMAP study were divided into 23 Aspect Areas (Table 2, Figure 5) on the basis of geology and geomorphology. Evaluations (Table 1) were based on criteria assessing research and education potential for geoconservation. One Aspect Area has a geological SSSI/GCR site of international research status and has therefore been evaluated as Outstanding. It represents key reference sections for Upper Carboniferous stratigraphy. No RIGS sites, which typically include prime non-SSSI educational sites, have been formally listed in the area, and thus no Aspect Area is rated Outstanding on this criterion. High evaluations have been given where there are significant non-SSSI geological or geomorphological features, however, some of which may be of regional

importance and could therefore be considered as potential RIGS sites (as noted on the Collector forms).

Outstanding and High evaluations represent 26% of the total. Moderate evaluations, which represent the default setting, include 61% of the Aspect Areas. Low evaluations for research/educational geoconservation potential were given to 13% of Aspect Areas.

Table 1. Evaluations for Geological Landscapes Aspect Areas

<b>Evaluation</b>	<b>No. of Aspect Areas</b>
Outstanding	1
High	5
Moderate	14
Low	3

## **OVERVIEW - THE GEOLOGY AND GEOMORPHOLOGY OF BLAENAU GWENT**

### **General stratigraphy (Figs. 1, 6-8)**

The bedrock geology of the Blaenau Gwent area is entirely Upper Palaeozoic, of Lower-Upper Carboniferous age.

### **Lower Carboniferous (Dinantian)**

***Carboniferous Limestone Supergroup – Visean Series:*** A small outcrop of Dowlais Limestone forms a ridge across the top of the Sirhowy valley. The limestone has been quarried extensively around the rim of the Coalfield, e.g. at Trefil Quarry. Karstic topography in the Limestone is exposed on Trefil Moor.

### **Upper Carboniferous**

***Millstone Grit Group - Namurian Series:*** The Millstone Grit Group comprises a sequence of intercalated marine and fluvial deposits of quartz rich sandstones, conglomerates and mudstones. In the North Crop of the Coalfield; the Millstone Grit succession is generally split into the Basal Grit Formation overlain by the Middle Shales Formation, and sequences are much thinner (e.g. 30m in Clydach) than in the South Crop. The lower sandstones, which are massive and quartzitic, form bands of prominent crags or scarps. Marine bands with bivalves and goniatites which are used for correlation across the Coalfield represent periodic marine incursions. The Namurian

becomes increasingly unconformable and thinner from west to east (280-80m) as it oversteps the (Dinantian) Carboniferous Limestone. The Millstone Grit represents an influx of northerly derived quartz-rich sediment into the basin that fines southwards; maximum subsidence was in the southwest (Figure 6). The Middle Shales Formation represents more distal, delta plain environments.

**Coal Measures Group – Farewell Rock, Productive Coal, South Wales Pennant, Grovesend formations (Lower and Middle Coal Measures, Pennant Measures/Upper Coal Measures) - Westphalian Series (Figure 7):** The Coal Measures Group comprises mudstones, siltstones and sandstones and economic coals arranged in cyclothems. The classification of the Coal Measures into Lower, Middle and Upper units was based on fossiliferous (goniatite-bearing) marine bands (Woodland and Evans 1964). The Lower and Middle Coal Measures (Upper Carboniferous) are dominated by mudstones, whereas the Pennant Measures (Upper Coal Measures) are dominated by more resistant sandstones. Cleal and Thomas (1996) revised this classification into the Farewell Rock Formation (basal Lower Coal Measures), Productive Coal Formation (Lower-Middle Coal Measures), and South Wales Pennant Formation (Pennant Measures). The formations all thicken towards the southwest. Of current opencast workings in the Coal Measures, the largest is in the North Crop at Selar (also Nant Helen). The Coal Measures Group thicken east to west across the Coalfield.

The *Farewell Rock Formation* (Langsettian; Westphalian A) outcrop is around the margins of the productive coal basin. This Formation consists of a series of coarsening upwards cycles with marine bands at their bases and thick fluvial sandstones above. The sandstones are collectively known as the 'Farewell Rock'. This quartzitic sandstone unit has the *Gastrioceras subcrenatum* marine band at its base. On the North Crop that marine band in mudstones is thin (<2m), beneath a well developed sandstone (<45m thick at Glynneath), but in the South Crop the marine mudstones are considerably thicker (<24m) and the sandstones (33m in the Margam Park borehole) thin and die out eastwards. The sandstones form low strike ridges and scarps between the shales of the Namurian and the Productive Coal Formation of the Coalfield. On the South Crop, mudstones of the Productive Coal Formation form an E-W topographic hollow between the Farewell Rock sandstones and the central high Pennant plateau of the Coalfield plateau. On the North Crop, the Productive Coal Formation is thinner (<570m), and forms boulder clay covered, gentle dip slopes across lower ground to the north of the Pennant plateau.

The *Productive Coal Formation* (Langsettian – Bolsovian; Westphalian A-C) mudstones with coals show reduced marine influence above the Garw coal seam. The Gellideg to Two Foot Nine seams (Lower-Middle Coal Measures) were referred to as the Main Productive Measures, in which the Amman (*Vanderbeckei*) marine band represents the only recognised marine influence (at the base of the Middle Coal Measures). Shales, siltstones and coals form cyclothems 6-30m thick. Extensive developments of ironstone nodules and bands were previously worked commercially. The formation is exposed

around the margins of the coalfield, in the sides of the deeply incised valleys through the Pennant plateau outcrop area. Above the Main Productive Measures the shales and siltstones have several marine bands, including the Cefn Coed (Aegiranum) band which marks the base of the Bolsovian (Westphalian C). The Productive Coal Formation (310-535m) thickens westwards across the Coalfield. Numerous disused mine shafts, adits and colliery tips are situated along the slopes of valleys, and opencasts with reclaimed land are found across the main outcrop belt in both North and South Crop.

The *South Wales Pennant Formation* (Pennant Measures/Upper Coal Measures; Bolsovian - Westphalian D; Westphalian C-D) are dominated by sandstones. These resistant, thick sandstones form the upland areas and the high ground between valleys the high ground of the central plateau. The base of the formation is the Upper Cwmgorse (Cambriense) marine band, but it is then divided into members based by coal seams: the Llynfi, Rhondda and Brithdir (Lower Pennant Measures), Hughes, Swansea and Grovesend (Upper Pennant Measures) Beds. The Hughes Vein or equivalent - locally the Cefn Glas coal seam - is a prominent horizon across the Coalfield. Coals are widespread but poorer in the Pennant than the Productive Coal Formation, occurring in cyclothem 20-150m thick. The onset and spread of sandstone deposition in the Coalfield was diachronous, appearing earlier in the southwest (Llynfi Beds) and later in the northeast (Brithdir Beds). Sandstones dominate, in the Llynfi Beds (Llynfi Rock), slightly earlier in the South Crop, than the North Crop. The change to sandstone dominated sedimentation corresponds to a basin-wide change in sediment supply in response to the rising, advancing Variscan landmass to the south; northerly derived, quartz-rich sandstones are replaced by largely southerly derived, lithic (=rock fragments) sandstones. The younger, 'Upper Pennant Measures' cap the deeply dissected plateaus. The Pennant succession thickness varies from c.1200m in the southwest to 670m in the North Crop (Figure 6).

### **Structural geology (Figure 8)**

Blaenau Gwent forms part of the broad, E-W Variscan syncline of the South Wales Coalfield. The main structure was established through crustal shortening that led to Variscan mountain building. The E-W fold structure of the coalfield demonstrates associated strike-thrust and normal faults that are also E-W. Cross- or dip faults cut the main axes of folding. There are numerous later N-S to NNW-SSE faults of Tertiary age, e.g. the Tredegar Fault.

### **Superficial drift and glacial geomorphology**

South Wales was glaciated several times during the Pleistocene, but most glacial deposits are attributed to the last, late Devensian episode. Ice gathered on the high ground of the Brecon Beacons and spread southwards towards the Coalfield, and moved down the Valleys. The last, late Devensian

glaciation left widespread deposits of boulder clay, which form an extensive and generally featureless cover over the bedrock on valley slopes and floors. The main ice movement was through the Pennant plateau southwards, across the South Crop. Periglacial solifluction deposits (head) are common on the valley slopes and along the base of the Pennant scarp. Landslips are common on the glacially oversteepened sides of the valleys, usually where the thick open jointed sandstones of the Pennant overlie impermeable mudstones of the Productive Coal Formation (Conway et al. 1980, Conway 1985). Some of these ancient landslips have been reactivated more recently following coal mining activity.

Alluvium covers the U- and V-shaped river valley floors, and river terraces are intermittent. Alluvial fans are common where tributaries join more major valleys or floodplains. Hill peat is fairly widespread on the Pennant plateau.

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Figure 1. Geology of the South Wales Coalfield

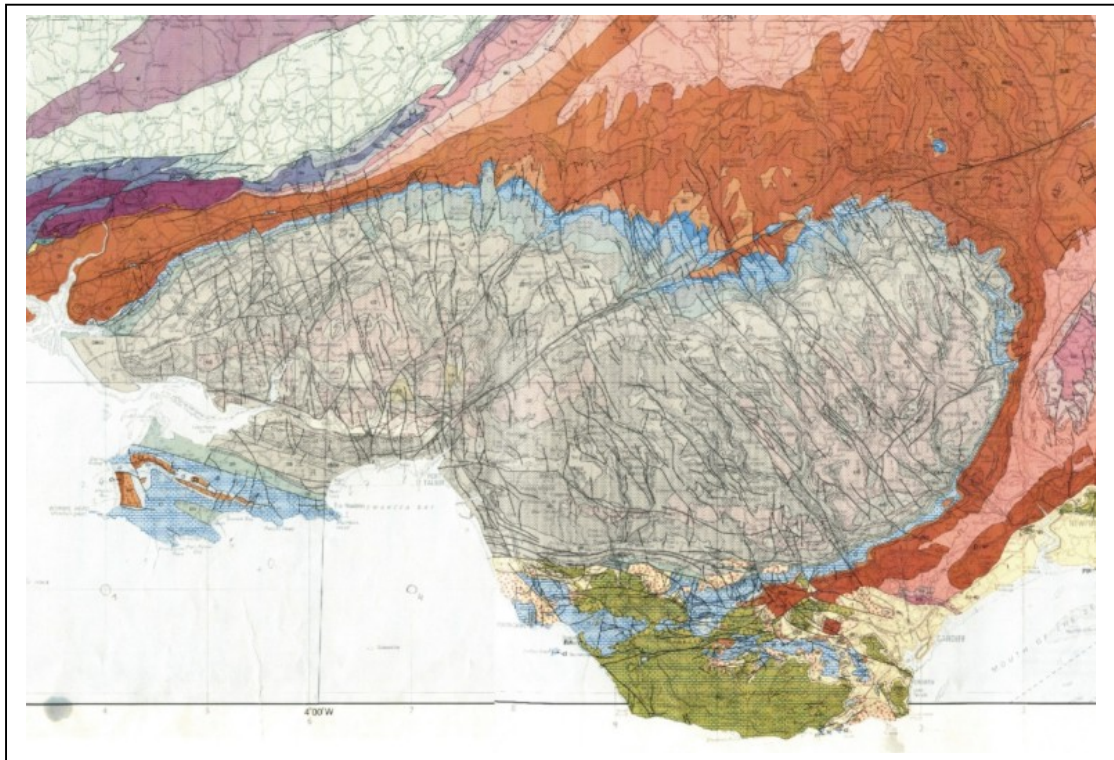


Figure 2. Shaded Landsat Image of South Wales Coalfield



Figure 3. Geology of South Wales Coalfield on Shaded Landsat Image



Figure 4. Geological Landscape Aspect Areas and SSSIs (N.B. Aspect Area numbering on this figure differs from finalised survey)

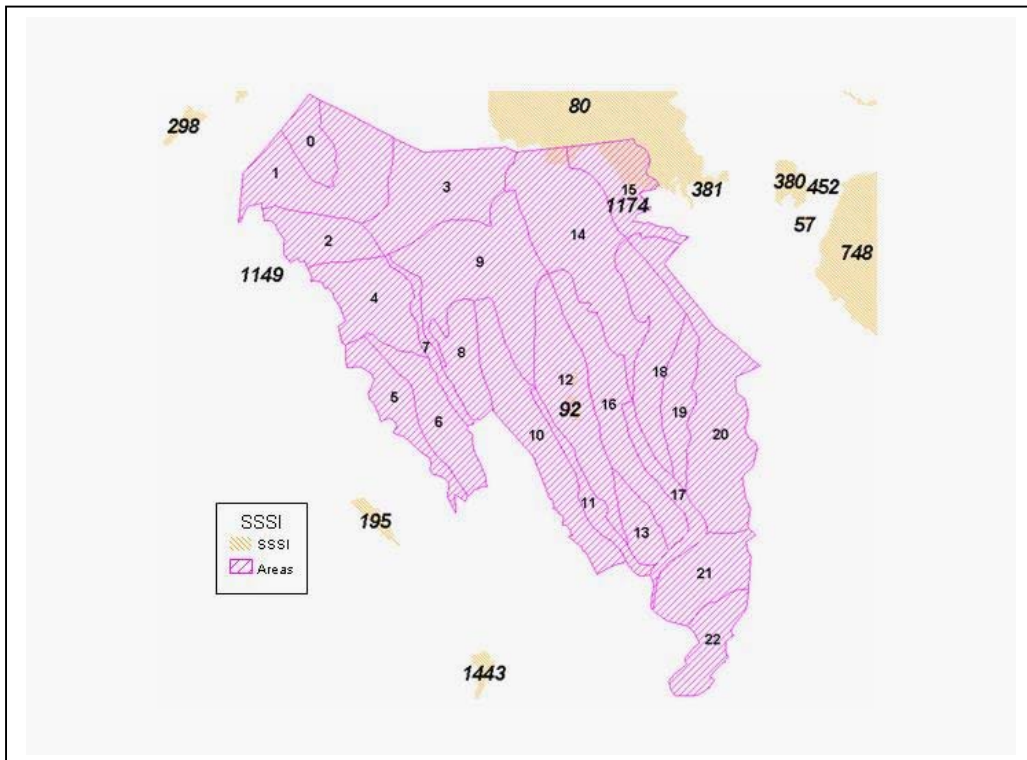


Figure 5. Aspect Area numbering.

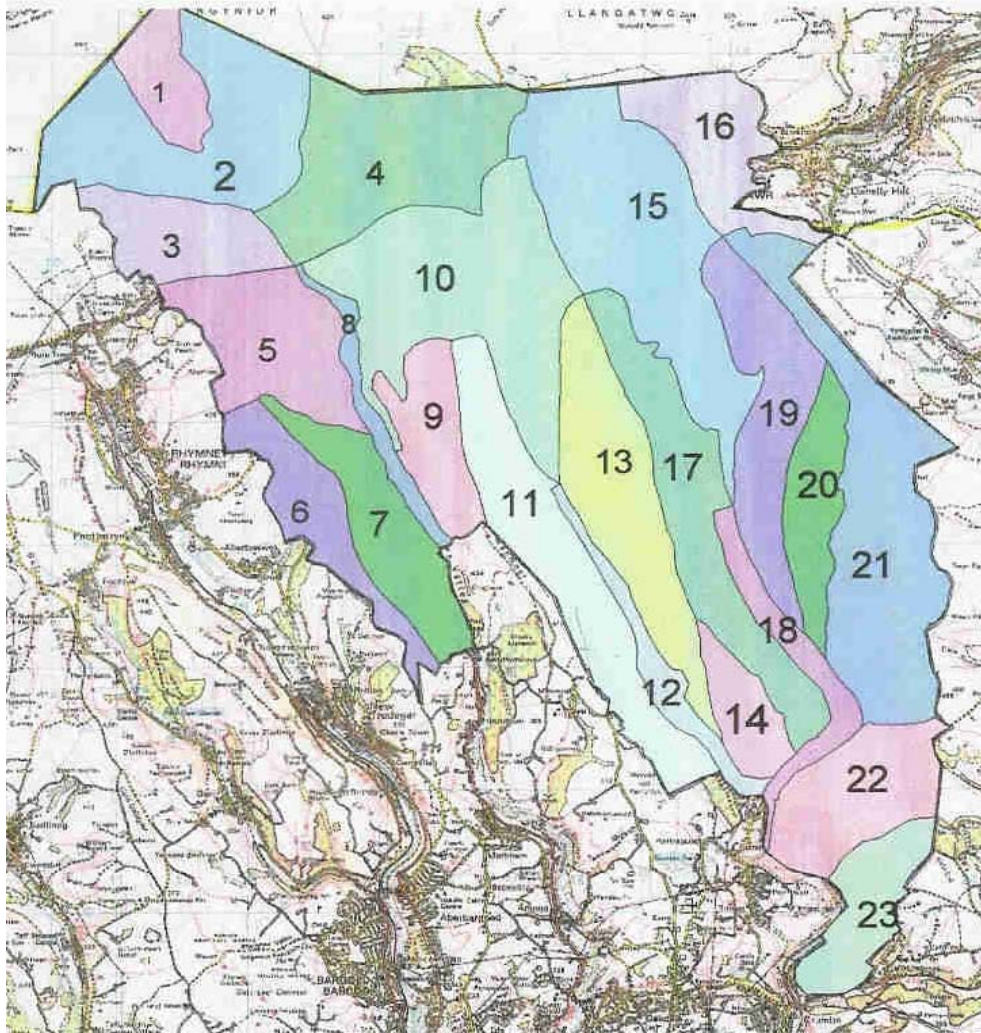


Figure 6. Isopach maps of the South Wales Coalfield (from Woodland and Evans 1964)

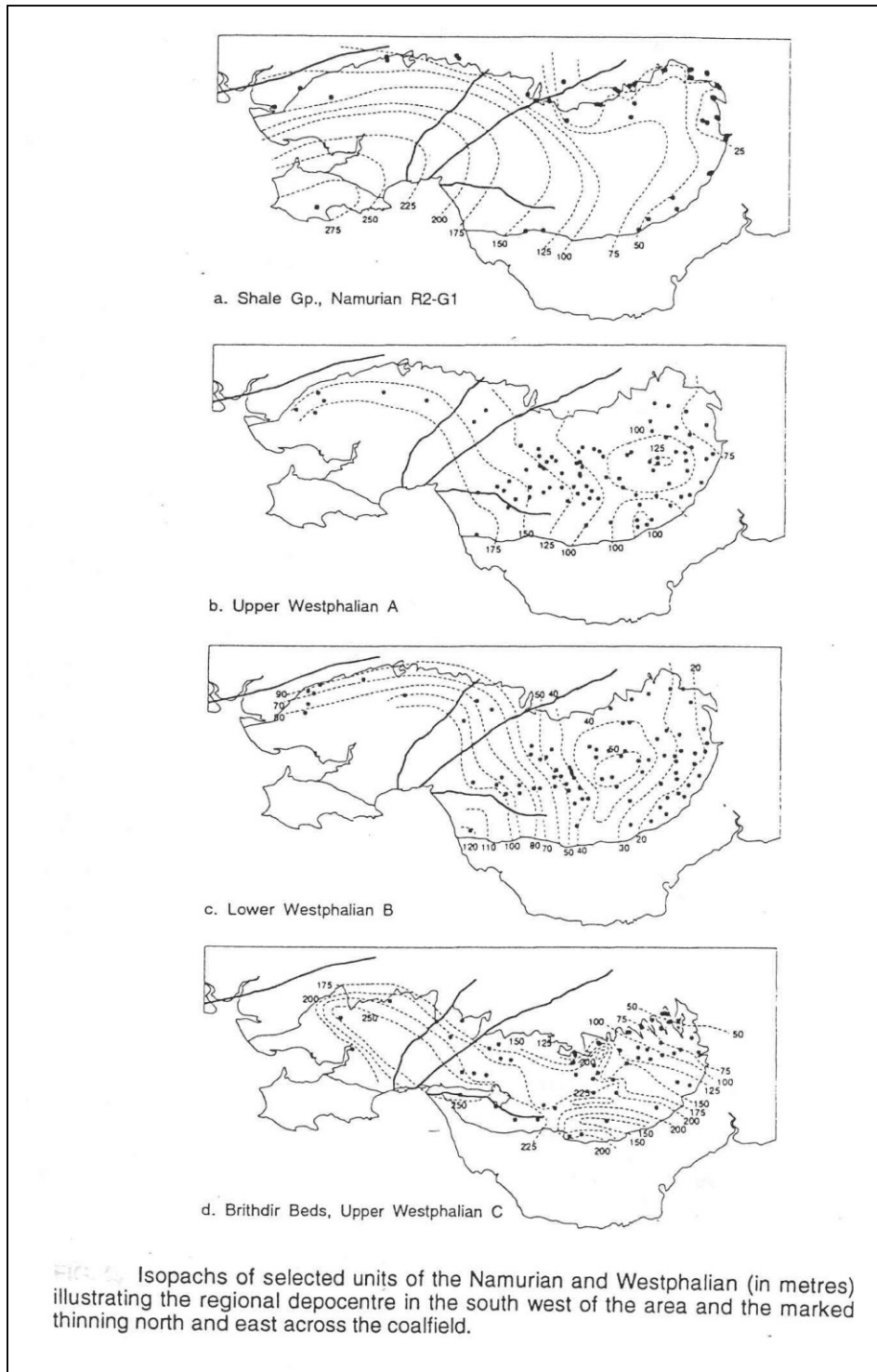


Figure 7. Upper Carboniferous, Westphalian Stratigraphy of the Coalfield

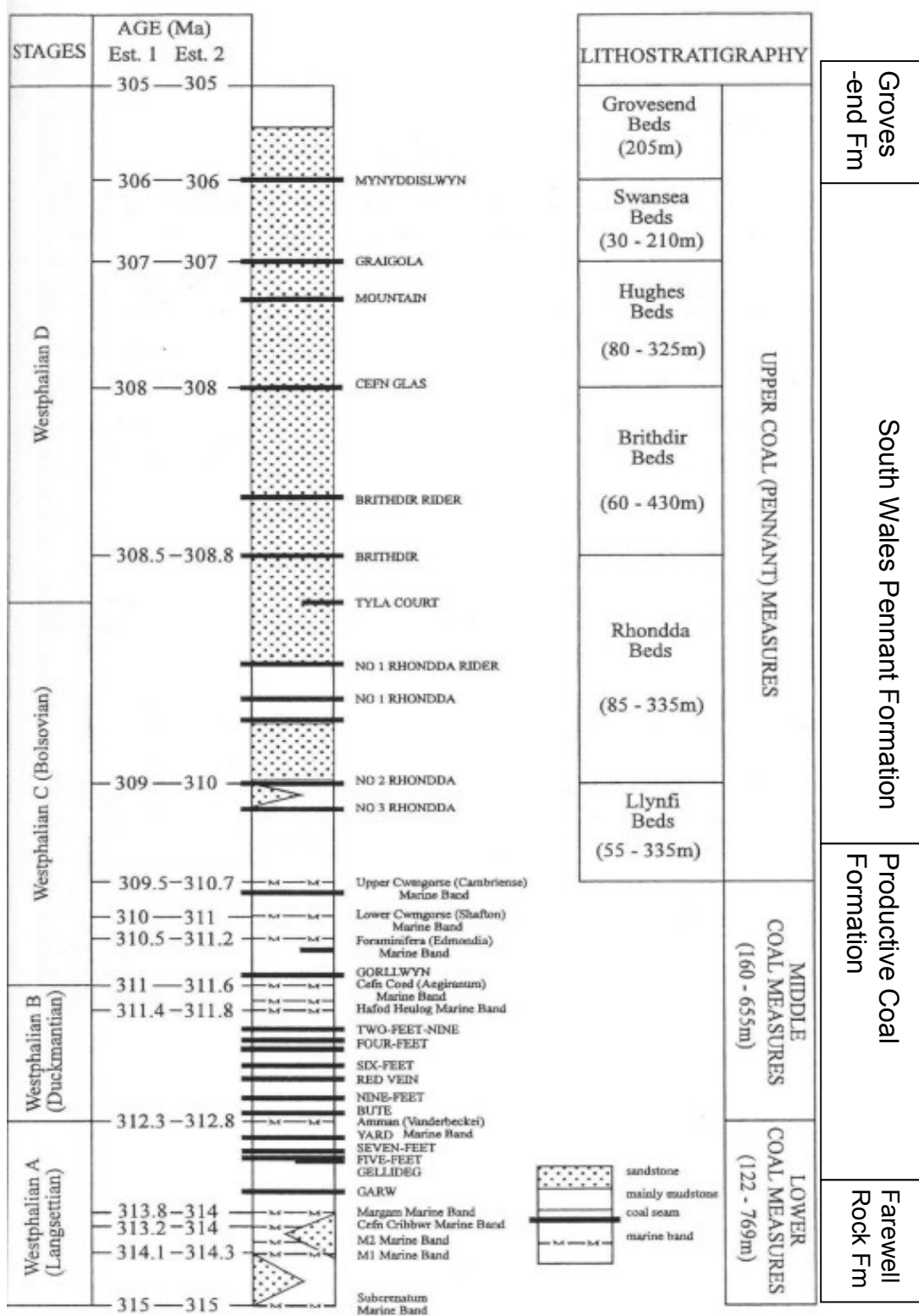
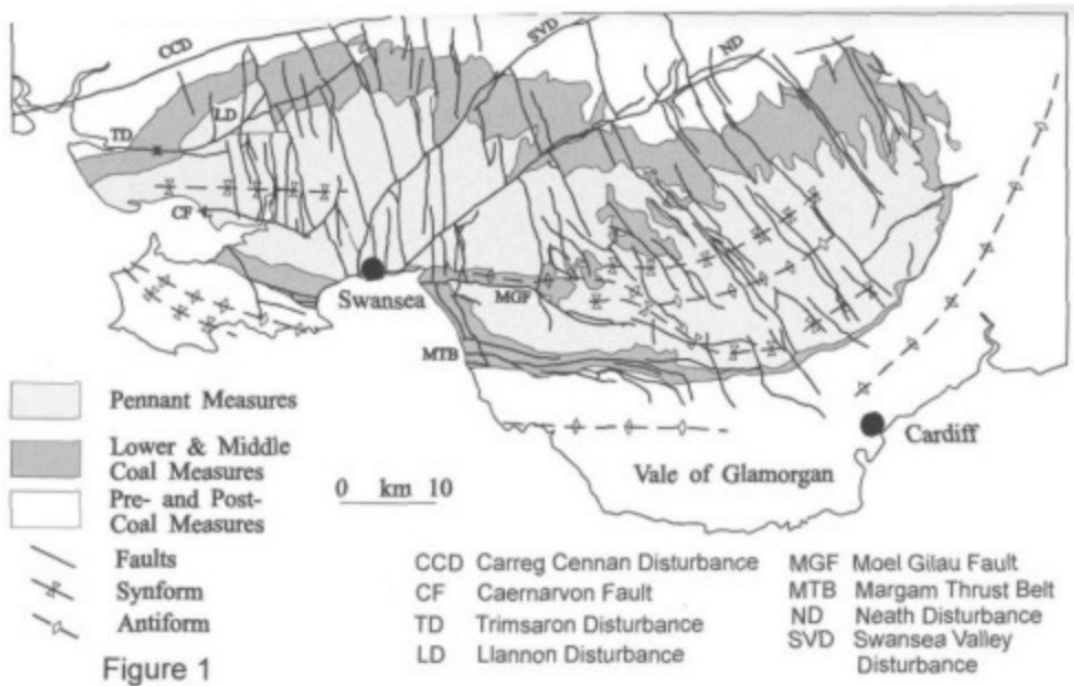


Figure 8. Major tectonic structures of the Coalfield



**Table 2. GEOLOGICAL LANDSCAPES ASPECT AREAS AND EVALUATIONS, BLAENAU GWENT**

Area code BLNGWGL-	Name	Description	Evaluation	SSSI/GCR
001	Trefil	NE-SW upland, rounded ridge and scarp slope of SE-dipping Dinantian Dowlais Limestone. Cut by NW-SE Sirhowy Fault and upper Sirhowy valley. Valley slopes drained by tributaries. Cover of boulder clay on lower valley sides, also head, peat; alluvium in valley floor. Large quarries on E side of Trefil. Karstic cave systems in Limestone to N on Trefil Moor.	High	Potential RIGS of Trefil Quarries
002	Dros y Llyn	SE-facing dip slope in Namurian Millstone Grit conglomerates, sandstones and siltstones, with shake holes and clutter on upper slopes, unconformable on the Dowlais Limestone (BLNGWGL001). Cut by NW-SE Sirhowy and Tredegar Faults, which control Sirhowy valley. Widespread cover on slopes of boulder clay, and patches of peat, head. Disused sandstone quarries.	High	Potential RIGS of karstic Basal Grit
003	Tynewyd	SE-facing broad, gentle dip slope in mudstones and Garw sandstones of lower part of Productive Coal Fm, with widespread cover of boulder clay, on W slopes of upper Sirhowy valley. Small areas of head on slopes, alluvium in valley floor. NW-SE and WNW-ESE faults.	Moderate	
004	Rassau	Broad dip slopes across upper, E. Sirhowy and Ebbw, NW-SE river valleys in SE-dipping mudstones and Garw Sandstone of lower Productive Coal Fm. Widespread cover of boulder clay, and peat. Alluvium in Sirhowy valley floor and floodplain. Reservoirs in E.	Moderate	
005	Nant y Bwch	W slopes of Sirhowy valley in SE-dipping mudstone-dominated Productive Coal Fm, with widespread cover of boulder clay. Many disused opencast coal mines, mines and waste tips, large areas of worked out opencast, reclaimed and	Moderate	

		made ground. NW-SE Tredegar Fault runs along hillside, and Sirhowy fault in valley floor.		
006	Bedwellte	E steep slopes of U-shaped Rhymney valley, dissected into upland plateau of S-dipping Pennant sandstones. Plateau of Mynydd Bedwellte in Hughes Beds sandstones, slopes in Rhondda-Brithdir sandstones and siltstones with coals. Disused mine adits, quarries and waste tips along upper valley sides. Boulder clay on slopes, patches of glacial sand/gravel in lower valley.	Moderate	
007	Cefn Golau	W steep slopes of NW-SE, U-shaped Sirhowy valley dissected into S-dipping Pennant sandstones of upland plateau. Large landslips on valley slopes beneath sandstones, onto mudstone dominated Productive Coal Fm exposed on lower slopes and valley floor. Disused coal mine adits, waste tips along valley sides. Boulder clay on lower slopes, and glacial sand/gravel in floor. NW-SE faults along high Pennant slopes.	Moderate	
008	Sirhowy Valley	Narrow alluvial floor of the Sirhowy valley, controlled by NW-SE faults along parts of its course. Reclaimed land forming lower valley slopes through outcrop of Productive Coal Fm. Areas of glacial sand/gravel floodplain.	Low	
009	Coed y Rhyd	E steep slopes of asymmetrical U-shaped, NE-SW to N-S Sirhowy valley, dissected into SE-dipping Pennant sandstones of upland plateau. NW-SE Tredegar and Sirhowy faults control plateau. Landslips on slopes beneath Pennant, onto mudstone dominated Productive Coal Fm exposed in lower valley slopes. Mine workings, adits, waste tips. Boulder clay, and glacial sand and gravel on lower valley slopes.	Moderate	
010	Ebbw Vale	Broad gentle dip slopes of E Sirhowy and upper Ebbw valleys,	Moderate	

		in SE-dipping, mudstone-dominated Productive Coal Fm, exposed in main NE-SW outcrop belt and exposed along valley sides below Pennant. Widely exploited for coal, and large areas of worked out opencasts, reclaimed land, as well as mine adits and waste tips. Large landslips on oversteepened valley sides below Pennant. Boulder clay on lower valley slopes, and across wide areas of main coal plateau. Reservoir, and lakes across workings.		
011	Cefn Manmoel	W steep slopes of U-shaped Ebbw Fawr valley, dissected into upland plateau of SW-dipping Pennant sandstones. Hughes Beds form the main plateau, with valley slope in Rhondda-Brithdir Beds. Large landslips beneath Pennant forming scarps on oversteepened valley sides in mudstones of the Productive Coal Fm. Head and boulder clay on lower valley slopes. NW-SW faults controlling Pennant plateau. Coal adits along slopes, waste tips and areas of reclaimed land.	Moderate	
012	Ebbw Fawr	Narrow alluvial floodplain of NW-SE Ebbw Fawr, flanked by glacial sand/gravel through the Pennant outcrop. Mines in valley floor into Productive Coal mudstones, and areas of reclaimed ground in valley floor.	Low	
013	Mynydd Carn y Cefn	E upland plateau and less steep slopes of asymmetrical NW-SE, U-shaped Ebbw Fawr valley, dissected into SE-dipping Pennant Rhondda-Hughes Beds sandstones, with mudstones of Productive Coal Fm exposed in the valley slopes of N-S Cwm Marddog. Rounded hills of plateau in Hughes Beds. Landslips on oversteepened valley sides beneath Pennant sandstones. Boulder clay on lower valley slopes, head flanking slopes of Cwm Marddog. Coal mines in Cwm Marddog, areas of made ground there and on plateau.	High	

014	Aberdeeg	Fault controlled N-S, steep-sided V-shaped Cwm Big valley dissected in SE-dipping Pennant (Hughes Beds) sandstones of upland plateau of E. Ebbw Fawr valley above confluence with Ebbw Fach. Alluvium in valley floor. Coal workings and tips on upper E slopes.	Moderate	
015	Nantyglo	S-facing, moderate dip slopes of broad plateau of S- to SW-dipping, mudstone-dominated Productive Coal Fm at head of Ebbw Fach valley, with siltstones/sandstones forming narrow strike ridges of higher ground. Extensive cover of boulder clay. Widespread areas of coal mining, with shafts, adits, worked out and reclaimed land. Dissected by river valley, and exposed along lower valley slopes below Pennant sandstones, with many disused mines. Landslips on oversteepened valley sides below sandstones, on both sides of valley (BLNGWGL017, -019). NW-SE faults; E side of upper valley partly fault controlled. Reservoirs on plateau.	Moderate	
016	Clydach	S-facing moderate dip slopes of plateau of SE-dipping mudstone-dominated Productive Coal Fm, with siltstones/sandstones forming strike ridges and sandstones in rounded low hills, at head of Ebbw Fach. NW-SE faults and NNW-SSE Blaenavon Faults crossing plateau, and partly controlling upper Llwd valley. Upper Clydach valley (Clydach Dingle) forms NE boundary of area, swinging to ENE-WSW into main Clydach valley. Coal workings, tips, and reclaimed, mage ground. Boulder clay as extensive cover. Head along valley slopes.	Outstanding	SSSI Brynmawr road sections - Upper Carboniferous stratigraphy
017	Cefn yr Arail	W steep slopes of NW-SE U-shaped Ebbw Fach valley, dissected into upland plateau of SE-dipping Pennant sandstones. Hughes Beds sandstones form the rounded	High	

		plateau, with weaker Rhondda-Brithdir beds in the valley slopes. Large landslips (e.g. Westside) on oversteepened valley sides beneath sandstones onto the Productive Coal mudstones of lower slopes. Numerous mine adits into sandstones. Head along lower valley slopes, and boulder clay. Areas of reclaimed land on plateau. N-S faults affecting southern part of plateau.		
018	Ebbw Fach	Alluvial floor and floodplain of U-shaped Ebbw Fach valley, cut into S-dipping mudstone-dominated Productive Coal Fm. NW-SE valley turns NE-SW to S of Abertillery through steep sided valley in Pennant sandstones, to confluence with Ebbw Fawr valley. Closed mineshafts along valley floor, and made ground across much of valley.	Low	
019	Blaina	E upland plateau and less steep slopes of asymmetrical U-shaped, NW-SE Ebbw Fach valley, in S- to SW-dipping Pennant sandstones, cut by N-S steep sided Cwm Celyn tributary valley. Resistant Hughes Beds sandstones form the higher rounded plateau of Mynydd James, with Rhondda-Brithdir sandstones in valley slopes, forming the W slopes of Cwm Celyn and Mulfran. Extensive areas of landslips affecting the Rhondda and Brithdir Beds, onto lower, oversteepened, mudstone slopes, e.g. E Pentwyn, Bourneville, which have W-facing scarps. Coal adits, tips and shafts along valley slopes. Head flanking lower, W-facing valley slopes, and some boulder clay. NW-SE faults across Pennant plateau.	High	
020	W Cwmtillery	W steep side of N-S U-shaped tributary Cwm Tyleri valley to Ebbw Fach in S- to SW-dipping Pennant sandstones forming upland plateau and steep slope, with moderate to gentle lower	Moderate	

		valley slope and floor in underlying mudstone dominated Productive Coal Fm. Major N-S fault controlling side of valley along narrow Pennant plateau of Hughes Beds separating tributary from main valley. Valley floor broadens to south, with alluvial channel and reservoirs. Coal mines and shafts along slopes. Large landslips in Rhonda-Brithdir sandstones onto mudstones along valley sides. Boulder clay along lower valley slopes.		
021	E Cwmtillery-Coety Mountain	E steep side of Cwm Tyleri tributary valley to Ebbw Fach, and upland plateau of Coety Mountain, in S- to SW-dipping Pennant sandstones forming upland plateau and steep slope, with moderate to gentle lower valley slope and floor in underlying mudstone dominated Productive Coal Fm. Major NW-SE Clydach Bridge Fault controlling top of valley and Pennant ridge through Cefn Coch, bringing Brithdir sandstones with hills of Hughes Beds to NE against high ground of Hughes sandstones to SW. NW-SE faults affect steep sided tributary cwms of E slopes of valley. Valley floor broadens to south, with alluvial channel and reservoirs. Coal mines and shafts along slopes. Large landslips in Rhonda-Brithdir sandstones onto mudstones along valley sides. Head along lower valley slope, and boulder clay.	Moderate	
022	Mynydd Llanilleth	E-W ridge of S- to SW-dipping Pennant sandstones of Hughes Beds and Grovesend Fm, forming E side of NW-SE Ebbw valley and dissected by steep sided tributary valleys WNW-ESE to NW-SE. Sandstone plateau cut by major N-S fault with downthrow to W. Mine adits into Grovesend coals, and extensive areas of made ground and worked out opencast. Boulder clay on northern slopes of ridge.	Moderate	

023	Swyffryd	Upland plateau of S- to SE-dipping Pennant sandstones and Grovesend Fm, forming moderately steep E side of NW-SE Ebbw valley, dissected by steep NE-SW tributary valleys. Glacial sand/gravel in lower Cwm y Glyn valley floor. NE-SW Glyn fault controls Nant Gawn valley to Newbridge. N-S fault partly controlling main Ebbw valley. Disused quarries in sandstone.	Moderate	
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