



The Coal
Authority

Blaenau Gwent County Borough Council: Mine Water Heat Opportunities

July 2024



Making a **better future** for people
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Version	Produced by	Reviewed by	Approved by	Date
Final	Dan Mallin Martin Katie Watkinson Lee Wyatt	Keith Parker Lee Wyatt	Gareth Farr	24/6/2024

Contents

Contents	iii
List of Figures	iv
List of Tables	iv
Executive summary	1
1 Blaenau Gwent area summary	2
1.1 Geographical summary	2
2 Geological Summary	3
2.1 Solid geology	3
2.2 Structural geology	3
2.3 Superficial drift deposits	3
3 Mining situation	7
4 Mine water regime	9
4.1 Description of mine water blocks	9
4.2 Monitoring data	9
4.2.1 Mine water levels	10
4.2.2 Mine water temperature	10
4.2.3 Mine water chemistry	11
5 Mine water heat opportunities	13
5.1 Borehole schemes	13
5.1.1 Good borehole opportunities	13
5.1.2 Possible borehole opportunities	13
5.1.3 Challenging borehole opportunities	14
5.2 Mine water treatment schemes	14
5.3 Gravity-fed discharge schemes	14
5.3.1 Cwmtillery Level	15
5.3.2 Red Ash Level	15
6 Summary & Recommendations – Blaenau Gwent	18
6.1 Borehole schemes	18
6.1.1 Good Opportunities	18
6.1.2 Possible Opportunities	19
6.2 Mine Water Treatment Schemes	19
6.3 Mine water discharges	19
6.4 Summary and next steps	20
7 References	23

List of Figures

Figure 2.1: Regional geological cross sections for Blaenau Gwent. Top is north-south, bottom is west-east (BGS sheet 232, Abergavenny).	4
Figure 2.2: Bedrock geology and main faults for Blaenau Gwent. Contains British Geological Survey materials © UKRI [2024]	5
Figure 2.3: Summary stratigraphy and geological sequence for the study area	6
Figure 4.1: Mine water blocks for Blaenau Gwent	12
Figure 5.1. Mine water heat opportunities – borehole schemes	16
Figure 5.2. Mine water heat opportunities – treatment schemes and discharges	17
Figure 6.1: Combined mine water heat opportunities map	21
Figure 6.2: Highlighted good opportunities map	22

List of Tables

Table 3.1: List of most recent colliery closures	7
Table 4.1: Coal Authority Mine water monitoring points	9
Table 4.2: Anticipated mine water temperatures for South Wales Area 12 mine water block (from Farr et al. 2020)	10
Table 5.1: Mine water treatment schemes	14
Table 5.2: Summary of selected gravity-fed discharges for mine water heat potential	15
Table 6.1: Mine water heat opportunities within Blaenau Gwent CBC area	18

Executive summary

Coal mining has taken place in the borough since 1880s, with the last colliery to close being Marine Colliery in 1989. Much of the borough is underlain by coal mine workings, with multiple overlapping seams being worked across much of the borough. The topography of the valleys through the Borough has exposed part of the Middle and Upper Coal Measures, where a number were worked from at outcrop. Coal seams and workings become progressively deeper towards the south of the Borough.

The methodology for identifying the mine water heat opportunity areas is described in the overarching report. The northern half of the region has good potential for borehole based mine water heat schemes, avoiding areas of opencast workings and the shallowest workings in the far north of the region.

There are several gravity-fed discharges, where mine water is emitting at surface. This mine water may offer potential for mine water heat without the cost and risk of drilling and pumping. A selection of the larger discharges having a heat potential of over 0.5MW_{th} is listed in table below.

It is recommended that the opportunities listed are considered against surface heat demands to highlight those which may be served by mine water heat technologies. A subsequent, more detailed study of the mining and hydrogeology would add further information to firm up the case to take a number of mine water heat projects forward.

Mine water heat opportunities within Blaenau Gwent CBC area

No./ Area	Opportunity name	Opportunity type	Category	Potential MW _{th}
1	Tredegar	Borehole Scheme	Good	Subject to further testing
2	Ebbw Vale	Borehole Scheme	Good	Subject to further testing
3	Nantyglo	Borehole Scheme	Good	Subject to further testing
4	Blaina	Borehole Scheme	Good	Subject to further testing
5	Abertillery	Borehole Scheme	Good, Possible	Subject to further testing
6	Six Bells MWTS	Mine water treatment scheme	Good	0.8
7	Cwmtillery Level	Gravity Discharge	Possible	0.5
8	Red Ash Level	Gravity Discharge	Possible	0.8

1 Blaenau Gwent area summary

The area covered in this section is the whole of the Blaenau Gwent County Borough Council (CBC) are within which the presence of mine workings combined with knowledge (where available) of recovered mine water levels are used to provide a very high level assessment of the potential for exploring the development of open loop mine water heat projects.

1.1 Geographical summary

Blaenau Gwent covers an area of approximately 108 km², and slightly elongated on a northwest-southeast trend. The district extends from north of the A465 to Hafodyrynys in the southern-most part of Blaenau Gwent. Main urban areas in Blaenau Gwent include: Ebbw Vale; Brynmawr; Tredegar; and Abertillery. Blaenau Gwent includes urban areas along the Ebbw; Sirhowy; and Ebbw Fach valleys. Elevation in Blaenau Gwent ranges from approximately 130 mAOD in the south parts, to >550m above Blaina. Mine workings are present through most of Blaenau Gwent, and are approximately from the A465 and southwards.

2 Geological Summary

The solid and superficial geology, along with seam information has been ascertained by consultation of the available British Geological Survey records including:

- Online GeoIndex viewer;
- Online geological memoirs (Barclay, 1989);
- Online geology maps (Sheet 232 and Sheet 249 for Blaenau Gwent area); and
- Borehole and mine shaft scans across the area of interest.

Links to data used throughout the project are found in the overarching report, References Section.

2.1 Solid geology

The geology of the Blaenau Gwent area comprises of the Pennant Sandstone Formation/ South Wales Upper Coal Measures, and the South Wales Middle and Lower Coal Measures sequences (**Figure 2.1**, **Figure 2.2** and **Figure 2.3**). These are cyclical sequences of hard sandstones, grey mudstones and siltstones and coal seams.

The Coal Measures sequence generally dips towards the south, with the base of the Lower Coal Measures outcropping to the north of the A465. The Coal Measures geology reaches an approximate depth of over 500 m below ground level (**Figure 2.1**) in the south of the district, near Six Bells Colliery. Coal bearing horizons are found in the Middle and Lower Coal Measures, and the Upper Coal Measures/Pennant Sandstone Formation. The Pennant Sandstone formation is host to a number of notably hard quartz sandstones, alongside the shallowest productive coal seams, in the Rhondda Member and Brithdir Member. Middle and Lower Coal Measures are typically a sequence of siltstones, minor sandstones, seatearths and coal seams.

2.2 Structural geology

Major regional faults run through the area and trend roughly northwest-southeast, with a number of smaller observed faults noted across the area. Minor faulting breaks up sections of the Coal Measures.

2.3 Superficial drift deposits

Superficial Geology consists of predominantly glacial deposits (“head”, and till), alongside alluvium, both of which consist of clays, sands and gravels. These deposits are concentrated around the valley floors, including the area around Tredegar, Ebbw Vale, and Abertillery.

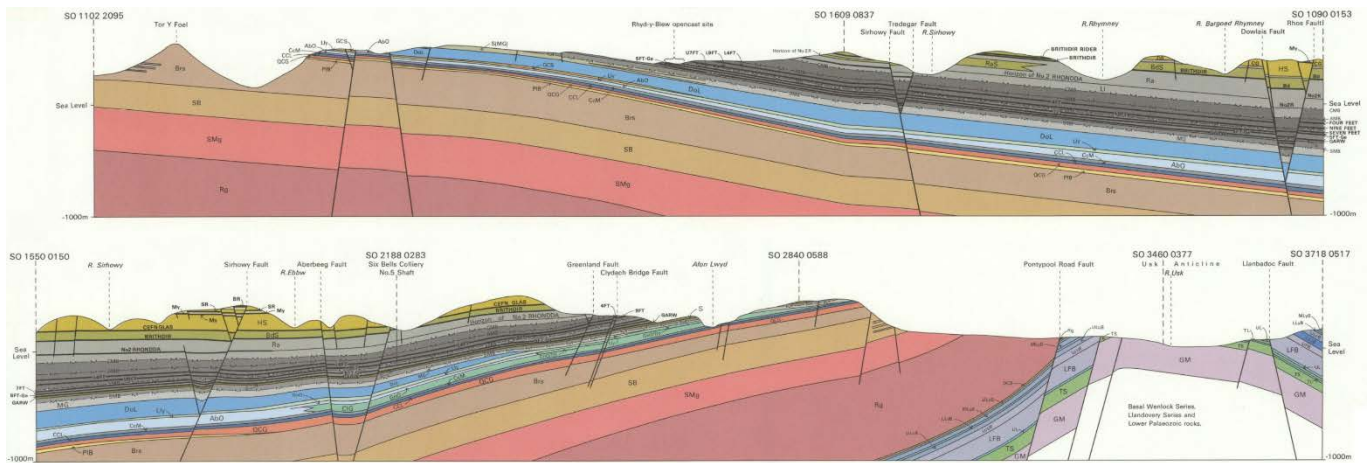


Figure 2.1: Regional geological cross sections for Blaenau Gwent. Top is north-south, bottom is west-east (BGS sheet 232, Abergavenny).

Contains British Geological Survey materials © UKRI 2024.

[Source: British Geological Sheet 232 Abergavenny](#)

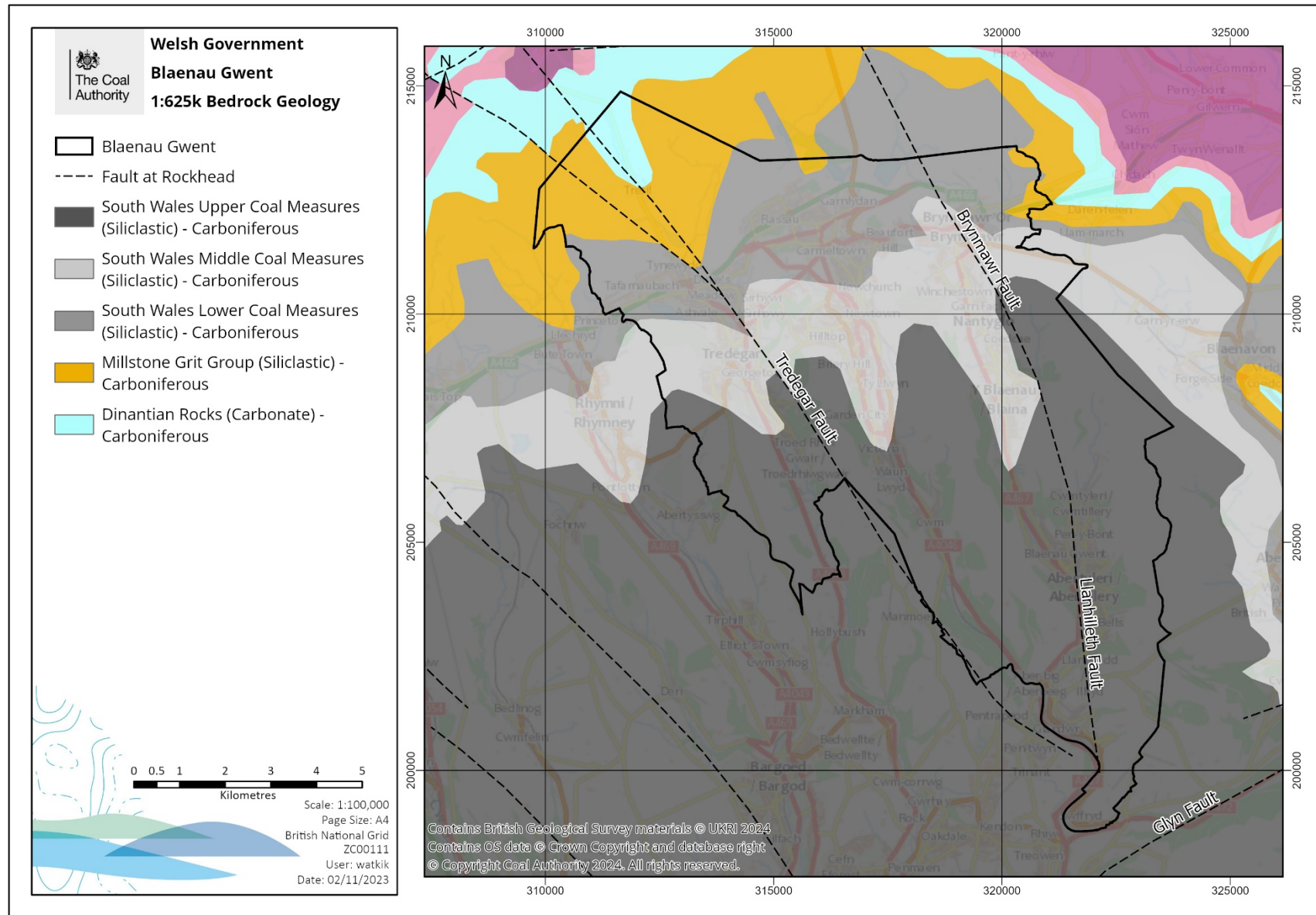
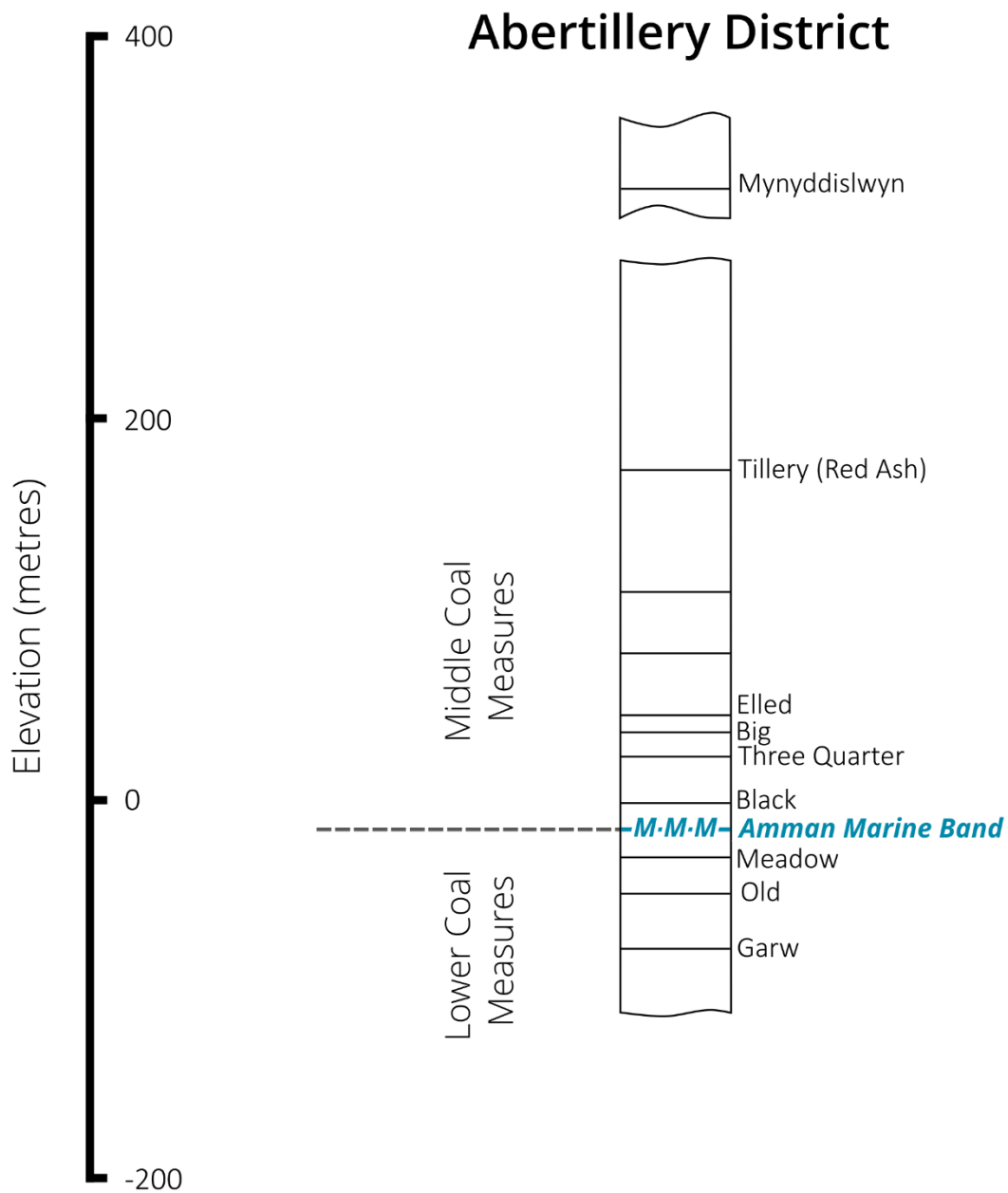


Figure 2.2: Bedrock geology and main faults for Blaenau Gwent. Contains British Geological Survey materials © UKRI [2024]



Adapted from Figure 2 in "Overview of the South Wales Coalfield" report reference A031899-2 by White Young Green 2007

Figure 2.3: Summary stratigraphy and geological sequence for the study area

3 Mining situation

Large scale coal mining took place in Blaenau Gwent from the 1800s (in line with the industrial revolution). The local authority boundary includes the Blaenavon and Tredegar mining areas, where a number of notable collieries had been developed. These included Vivian, Six Bell's, Marine, Roseheymworth, and Cwmtillery among others.

Coal was extracted from the Upper South Wales Coal Measures, and Middle and Lower South Wales Coal Measures, with workings in each isolated from the other in order to minimise inflows of water from the Upper Coal Measures into the deeper Middle and Lower Coal Measures.

There were a number of collieries throughout the Blaenau Gwent area which were opened in the 1880s, and linked in later years (1900s) to improve efficiency and manage both water inflows and production output.

Following colliery closures and end of mines in the 1980/90s, several mines were lost due to flooding. The final collieries (some of which had merged to become complexes) to close are set out in **Table 3.1** below.

Table 3.1: List of most recent colliery closures

Colliery	Closure date	Connected underground to
Six Bells	1986	Vivian; Marine Colliery
Marine Colliery	1989	Six Bells

Note: a detailed assessment of underground mining connections is required to confirm the mining hydrogeological conceptual model(s)

Following these closures all mine water pumping ceased and the mines started to refill.

There are up to 16 named and recorded worked coal seams, and 7 named and recorded worked ironstone seams across the Blaenau Gwent region. The Upper, Middle and Lower South Wales Coal Measures formations outcrop at the north of the region, in the area of the A465 ("Heads of the Valley" road), dipping to the south, where workings become progressively deeper and covered by the Pennant Sandstone formation. Workings tend to be constrained to the topography of the valleys throughout the region, where seams can outcrop and follow the trace of the valley walls.

The uppermost seam worked in the sequence is the Mynyddislwyn seam (**Figure 2.3**). It forms part of the Pennant Sandstone formation, or Upper South Wales Coal Measures. Below this is the more extensively worked Tillery Brithdir (locally Red Ash) seam, dipping to the south. Both were worked from outcrop and into the hillsides.

Below the Pennant Sandstone Formation coal seams, lies the Middle South Wales Coal measures. Seams in the Middle Coal Measures have been extensively worked, being shallowest just south of Camelton and around Tredegar, getting deeper to the south. Depth to the workings is influenced by the shape of the valleys, with workings approaching outcrop and becoming shallowest around the valley walls.

The deepest coal seam in the region is the Gellideg seam, over 500 m below ground level in the south, and sits beneath the Garw seam (NMRS, 2023). This is an expansive and extensively worked seam across the region, worked in the south from Six Bells Colliery, and links to adjacent collieries outside the Local Authority area.

4 Mine water regime

4.1 Description of mine water blocks

Blaenau Gwent is situated in South Wales Area 12, which extends away into the other adjacent local authorities of Torfaen and Caerphilly. The wider mine water block covers an approximate area of 15km by 15km of interconnected workings in the Middle and Lower Coal Measures. There are also some connected shallower workings in the Upper Coal Measures, but these tend to be disconnected from Middle and Lower Coal Measures workings.

Water levels in South Wales Area 12 appear to have recovered on the basis of current monitoring data. Water is pumped from Vivian shaft for treatment at Six Bells/Vivian Mine Water Treatment Scheme in the south of the region. There are a number of recorded discharges across the region.

The mine water blocks in this locality are shown in **Figure 4.1**.

4.2 Monitoring data

There are a total of 5 active monitoring points in the Blaenau Gwent region, with information included in **Table 4.1**.

Table 4.1: Coal Authority Mine water monitoring points

Monitoring point name	Seam monitored	Mine water level (mAOD)	Comments
Drillground (Victoria)	LCM	273.1	<75 mBGL
Vivian (pumping borehole)	LCM/MCM	165.06	<75 mBGL, pumped water level
Vivian (shaft)	LCM/MCM	196.86	<75 mBGL
Six Bells No.5 shaft	LCM/MCM	143.72 (2014)	<75 mBGL, water level managed
St Illtyd	Brithdir (UCM)	276.6 (2023)	>100 mBGL
Llanilleth	Gellideg (LCM)	141 (2014)	<75 mBGL, discharging

Adjacent monitoring for South Wales Block 12 can be found in Caerphilly, which includes Nant Llesg, Bernant (Sirhowy) and Llanover, which are closest to the Blaenau Gwent Local Authority boundary.

4.2.1 Mine water levels

Nearly all monitoring points (except the pumping borehole at Vivian) show a stable and recovered response. Water levels are typically <75 m below ground level or discharging for all sites except St Illtyd, where water levels are >100 m below ground level (**Table 4.1**), but the site is situated on a hill and records indicate some spurious water level measurements. Monitored water levels across the local authority area range between 140 mAOD to 270 mAOD, and may be discharging at surface depending on ground elevation. Water levels in the north (Drillground) are the highest, with levels generally decreasing towards Vivian/Six Bells. There are connections underground of various types, throughout the Middle and Lower Coal Measures, which link the workings in the north of the Local Authority region to those in the South.

Monitoring levels for St Illtyd appear to vary between 200-300 mAOD, and monitor mine water levels in the Upper Coal Measures (Brithdir seam). There is no clear explanation for this range and data may be erroneous. With a surface elevation of over 400 mAOD, this is the only site with a water level >100 mBGL.

There are a number of discharge points (both monitored and unmonitored) across the Local Authority area, some of which are described in detail in **Section 5.3**. These would indicate a typically recovered coalfield extent, and may be a mix of discharges associated with the Upper South Wales Coal Measures, and the Middle and Lower South Wales Coal Measures.

Mine water levels at any location within the region will depend on the surface elevation, and the connectivity to the pumping operations at Vivian/Six Bells.

4.2.2 Mine water temperature

A study into mine water temperatures at various depths around the UK coalfields was published in 2020 (Farr et al, 2020). This study used historic underground water and strata temperatures along with data from mine water pumping where available. Temperature typically increases with depth and data published in the study are shown in **Table 4.2**.

Table 4.2: Anticipated mine water temperatures for South Wales Area 12 mine water block (from Farr et al. 2020)

Depth (m BGL)	Mean(°C)	Max. (°C)	Min. (°C)
100	11.7	12.9	11
200	14.3	16.2	12.9
300	17	19.6	14.9
400	18.9	22.5	16.4
500	22.3	26.3	18.9
600	24.7	29.6	20.8

4.2.3 Mine water chemistry

Mine water chemistry can be highly variable depending on specific location and would not normally form part of any initial high level opportunity scoping considerations guided by this study. The matter would be included in any more detailed, site specific, studies which may be commissioned in future.

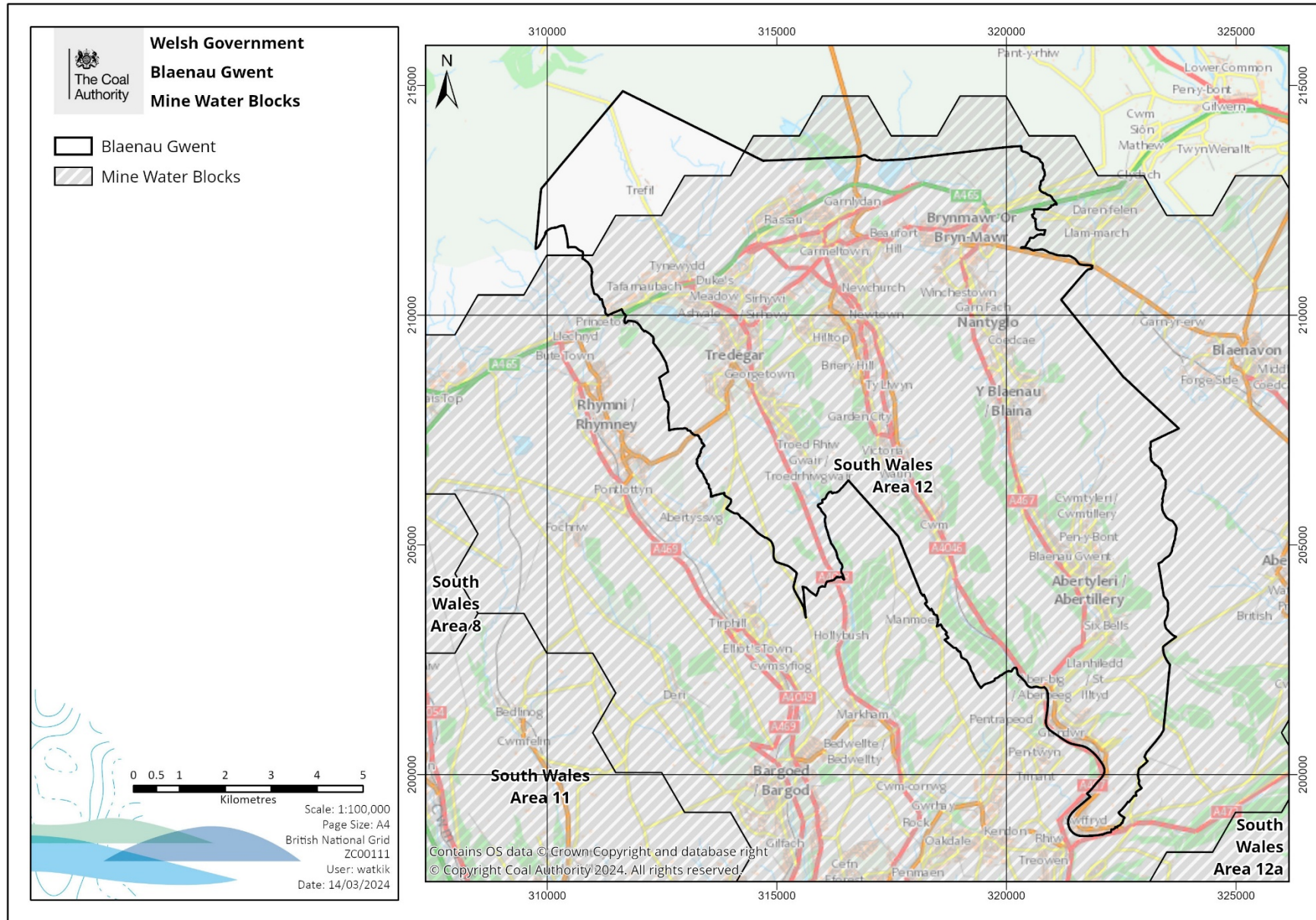


Figure 4.1: Mine water blocks for Blaenau Gwent

5 Mine water heat opportunities

5.1 Borehole schemes

The prospects for progressing a mine water heat scheme based on drilling boreholes to access and return the mine water are assessed on a 'tier' basis.

Three tiers have been adopted for the purposes of this study, the methodology and assessment criteria being set out in the over-arching report for Welsh Government.

The tiers are:

Good opportunities – shown coloured dark orange

Possible opportunities – shown coloured mid orange

Challenging opportunities – shown coloured light orange

Any areas where no opportunity exists, mainly due to absence of mine workings are shown uncoloured.

The broad opportunity areas within the Blaenau Gwent County Borough boundary are outlined below and are illustrated in **Figure 5.1**.

5.1.1 Good borehole opportunities

The north of the Borough is predominantly ranked as "Good" as workings are generally <300 mBGL, and water levels are <75 mBGL. This extends much into the south, although caution must be taken with selecting Upper Coal Measures targets as they also appear at outcrop. Areas with significant development or built up environments include:

- Tredegar, specifically in the south and south west of the town;
- Ebbw Vale, which includes a number of residential areas, and Aneurin Bevan Hospital;
- Nantyglo, covering much of the settlement south of Brynmawr in the direction towards Blaina;
- Blaina, which features a mix of residential development, some community buildings, and an industrial estate;
- Parts of Abertillery in the direction of Cwmtillery, and the eastern part of Six Bells.

5.1.2 Possible borehole opportunities

There are a number of possible opportunities across the region, where workings are deeper (300 – 500 mBGL), opencast workings are recorded and water levels may be deep (St Illyd) but recovering. Possible areas are found in the south, around Swffryd, at the north of the region, to the northwest of Abertillery (around the Blaenau Gwent settlement) and to the west of Waun-Llwyd.

5.1.3 Challenging borehole opportunities

There are only challenging to no opportunities in the north of the region, due to the presence of only shallow (<30 mBGL) workings.

5.2 Mine water treatment schemes

Existing Coal Authority mine water treatment schemes where mine water is already either pumped or flowing may in some circumstances potentially offer a lower risk approach to developing mine water heat projects as new drilling and testing of boreholes would not be required.

Details of the mine water treatment schemes in the Blaenau Gwent area are shown in **Table 5.1** and their location in **Figure 5.2**.

In Blaenau Gwent, there is only one mine water treatment scheme, at Six Bells/Vivian colliery, near Abertillery. Six Bells treats the mine water by aeration and hydrogen peroxide dosing, followed by settlement lagoons and a wetland reed bed (Jarvis et al., 2003). The scheme relies on a borehole driven into the Six Bells workings, in order to pump and manage mine water levels which were previously discharging from the Vivian shaft. The average flow rate pumped from the Six Bells borehole is around 40 L/s, equivalent to 0.8 MWth (with no additional heat pump input).

Table 5.1: Mine water treatment schemes

Name	Flow average (L/s)	Flow range (L/s)	Typical temperature (°C)	Estimated potential heat (MWth)
Six Bells/ Vivian	40.45	34.58 – 49.42	18.5	0.8

5.3 Gravity-fed discharge schemes

Numerous gravity mine water discharges exist in the Blaenau Gwent area. Many are not monitored for flow rate, water quality, or temperature, some of these may offer heat potential not presented in this report. Gravity-fed discharges generally occur when mine workings connect with the surface, typically via mine entries and boreholes.

The nature of gravity-fed discharges (flow, temperature and quality) will be dependent upon a number of factors including mining type and geometry, the hydrogeological system of the mine workings and rainfall.

Some discharges are likely to be more variable in flow rate and temperature than others but as many of the discharges are not currently monitored for flow rate, water quality or temperature and it is difficult to evaluate with any degree of confidence.

Those discharges that do have some monitoring data (albeit in some cases relatively limited) and are likely to have a heat potential of >0.5MW_{th} are described in the sections below supported by data in **Table 5.2** and illustrated on the plans in **Figure 5.2**.

Table 5.2: Summary of selected gravity-fed discharges for mine water heat potential

Name	Flow average (L/s)	Flow range (L/s)	Typical temperature (°C)	Estimated potential heat (MWth)
Cwmtillery Level	18 (further testing required)	1 spot reading	11 (est)	0.3 to 0.5
Red Ash Level	32 (further testing required)	1 spot reading	11 (est)	0.6 to 0.9

Note: Potential heat is based on spot readings and / or average flow rate. Potential heat will vary with flow rate, which varies with rainfall. Potential heat at a site may be above or below the estimated value at different stages of the year

Potential heat is based on average flow rate, ΔT of 5°C and COP of 4

Should a potential heat demand be identified close to one of these discharges (shown in **Table 5.2** and **Figure 5.2**) or any other discharge in the area, then a more detailed study would be required. Additional investigation and data gathering will likely be required to establish its potential.

5.3.1 Cwmtillery Level

The discharge is from Llaneron Padarn Level in to surface drainage at Cwmtillery spoil tip, located >400 m north of Cwmtillery village. Further investigations would need to be undertaken to confirm flow rate, temperature, chemistry. Potential heat users and feasibility of transferring the water will also need to be confirmed by a future study.

5.3.2 Red Ash Level

The discharge is >700 m south of Cwm and in to the west bank of Ebbw River. Further investigations would need to be undertaken to confirm flow rate, temperature, chemistry. Potential heat users and feasibility of transferring the water will also need to be confirmed by a future study.

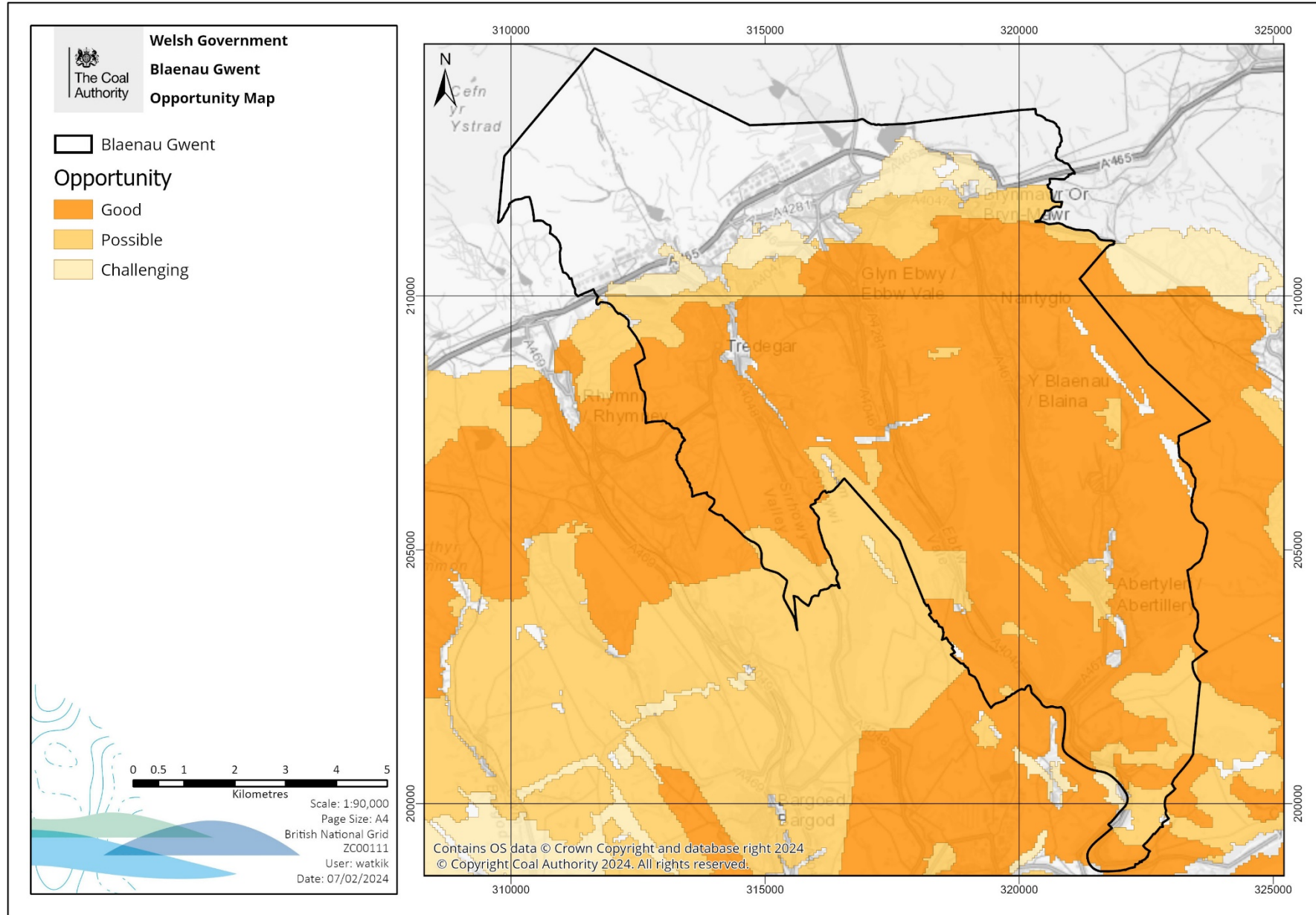


Figure 5.1. Mine water heat opportunities – borehole schemes

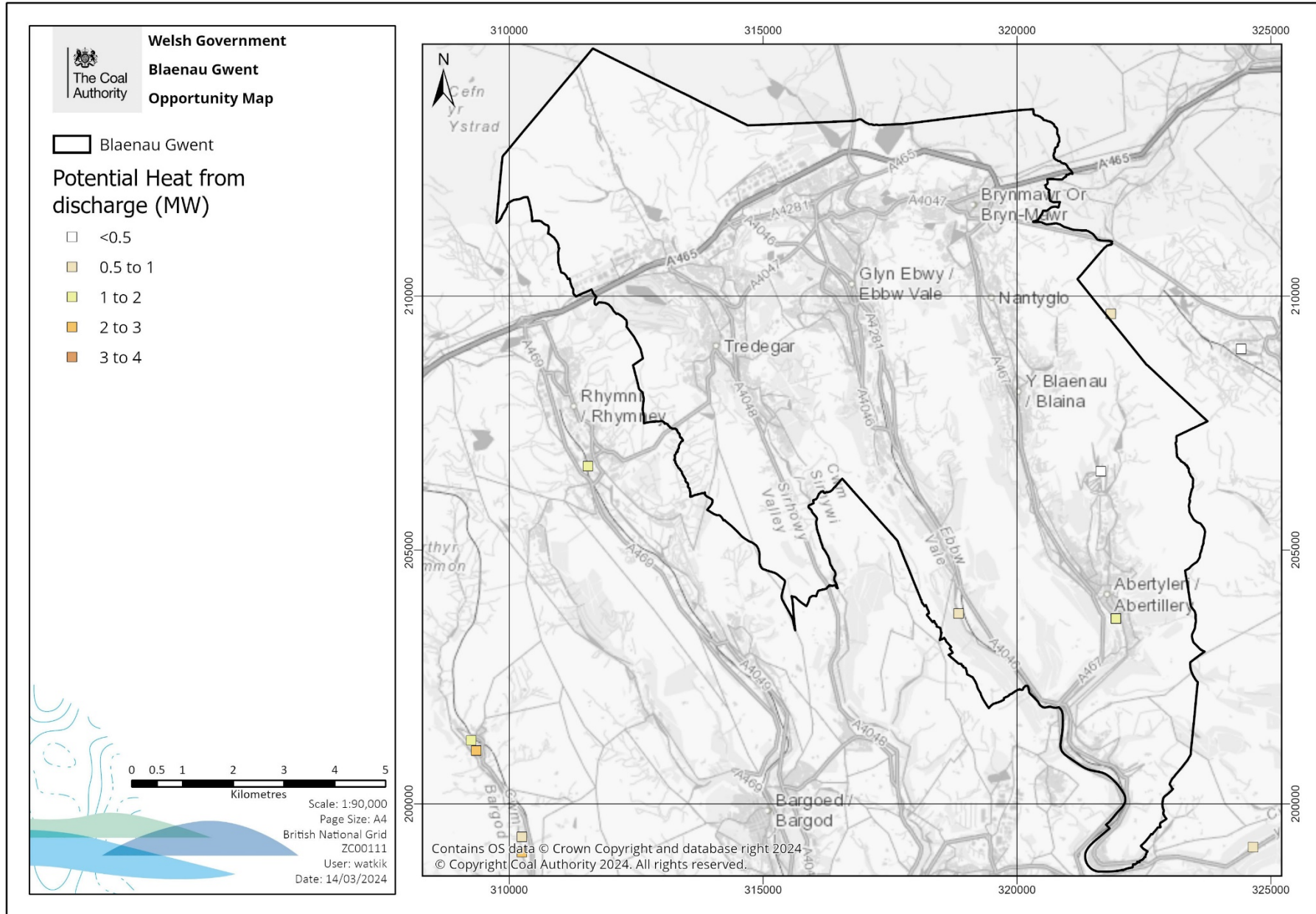


Figure 5.2. Mine water heat opportunities – treatment schemes and discharges

6 Summary & Recommendations – Blaenau Gwent

Blaenau Gwent CBC was an active coal mining region between the 1880s and 1989. Much of the borough is underlain by overlapping seams, with workings between 30 m and 500 m, and water levels <75 mBGL. There are some patches of open cast workings, and some shallow (<30 mBGL) and deep (>500 mBGL) workings also across the region. Mine water temperatures are expected to range between 11.7 and 22.3 °C between 100 mBGL and 500 mBGL.

A summary of opportunity areas are presented in **Table 6.1**, **Figure 6.1** and **Figure 6.2**.

Table 6.1: Mine water heat opportunities within Blaenau Gwent CBC area

No./ Area	Opportunity name	Opportunity type	Category	Potential MW _{th}
1	Tredegar	Borehole Scheme	Good	Subject to further testing
2	Ebbw Vale	Borehole Scheme	Good	Subject to further testing
3	Nantyglo	Borehole Scheme	Good	Subject to further testing
4	Blaina	Borehole Scheme	Good	Subject to further testing
5	Blaenau Gwent	Borehole Scheme	Good	Subject to further testing
6	Abertillery	Borehole Scheme	Good, Possible	Subject to further testing
7	Six Bells MWTS	Mine water treatment scheme	Good	0.8
8	Cwmtillery Level	Gravity Discharge	Possible	0.5
9	Red Ash Level	Gravity Discharge	Possible	0.8

6.1 Borehole schemes

6.1.1 Good Opportunities

There are a number of “Good” opportunity areas for borehole mine water heat schemes across much of Blaenau Gwent, with a number of the main settlements with existing end users underlain by mine workings which may be suitable. These areas are shown on **Figure 6.2, Areas 1 to 6**.

- **Area 1** covers parts of Tredegar, including Georgetown to the south, comprising principally of residential developments and light industry;
- **Area 2** covers Ebbw Vale, and the settlements of Willowtown, Newchurch, Newtown, Pont-y-gof, which is a mix of residential properties, schools, light industry, and the Aneurin Bevan Hospital;

- **Area 3 and Area 4** covers Nantyglo through to Blaina, offering opportunities for mine water heat for principally residential properties, but also industrial estates;
- **Area 5** covers the northwest area of Blaenau Gwent town, which offers good opportunities for a mix of residential properties, light industry (Roseheyworth Business Park) and a school.
- **Area 6** covers parts of Abertillery in the direction of Cwmtillery, and the eastern part of Six Bells, much of which is residential development.

6.1.2 Possible Opportunities

“Possible” opportunities for boreholes schemes are focused in the town of Blaenau Gwent, near to Abertillery, as well as parts of Cwm (**Figure 6.1**). Depending on the heat demand at these locations, they may warrant further investigation, but would be considered lower priority over those marked as “Good” opportunities

6.2 Mine Water Treatment Schemes

Location 7 is the Six Bells mine water treatment scheme, which could provide a possible 0.8 MW_{th} output without the need for frilling boreholes (**Figure 6.2**). The site’s proximity to the Six Bells village may be a possible option for mine water heat, depending on the aggregated demand.

6.3 Mine water discharges

A number of gravity mine water discharges are known to exist in the Blaenau Gwent borough, but only two have any monitoring information. Ratings have been applied to discharges according to the following criteria:

- Good means heat potential over 0.5MW uncomplicated capture and uncomplicated heat transfer.
- Possible means heat potential over 0.5MW complicated capture or complicated heat transfer.
- Challenging heat potential over 0.5MW complicated capture and complicated heat transfer

The two gravity discharges are:

- **Location 8** is the Cwmtillery Level, which sits 400 m north of Cwmtillery village, and is considered “Possible” due to the distance to end users;
- **Location 9** is the Red Ash Level, which sits over 700 m south of Cwm village, and is considered “Possible” due to the distance to end users.

They have been highlighted in **Figure 6.2**.

6.4 Summary and next steps

There are a number of potential mine water heat scheme opportunities across the region. While some of the areas are relatively undeveloped, the opportunity areas have been considered against the major developed areas in the borough to seek to identify places where good or possible heat supply opportunities may coincide with significant heat demand. It is suggested that the opportunities covered in this section and listed in **Table 6.1** and shown in **Figure 6.2** are further considered for more detailed study.

For borehole based mine water heat schemes, there are opportunities across much of the region in the Upper and Middle/Lower Coal Measures. Some areas have been ranked "Possible" on the basis of opencast workings at surface, potentially deep mine water levels (>100 mBGL) and on depth alone (>300 mBGL, or close to shallow workings/outcrop). The heat potential of the borehole schemes cannot be estimated to any degree of certainty until more detailed and localised study is undertaken.

Point source opportunities across the region include Six Bells mine water treatment scheme (potentially 0.8 MWth), Cwmtillery Level discharge, and Red Ash Level discharge.

It is suggested that a survey of the main heat loads, particularly potential large 'anchor' loads such as hospitals or larger public buildings is undertaken in the opportunity areas in **Table 6.1** to establish synergies between potential heat supply and heat demand. Once areas are identified, it is recommended that more focused Phase 1 studies take place at a number of these locations to review the nature of the workings in detail, site specific water levels, potential mine water chemistry, and offer suggestions on possible targets suitable for a mine water heat scheme.

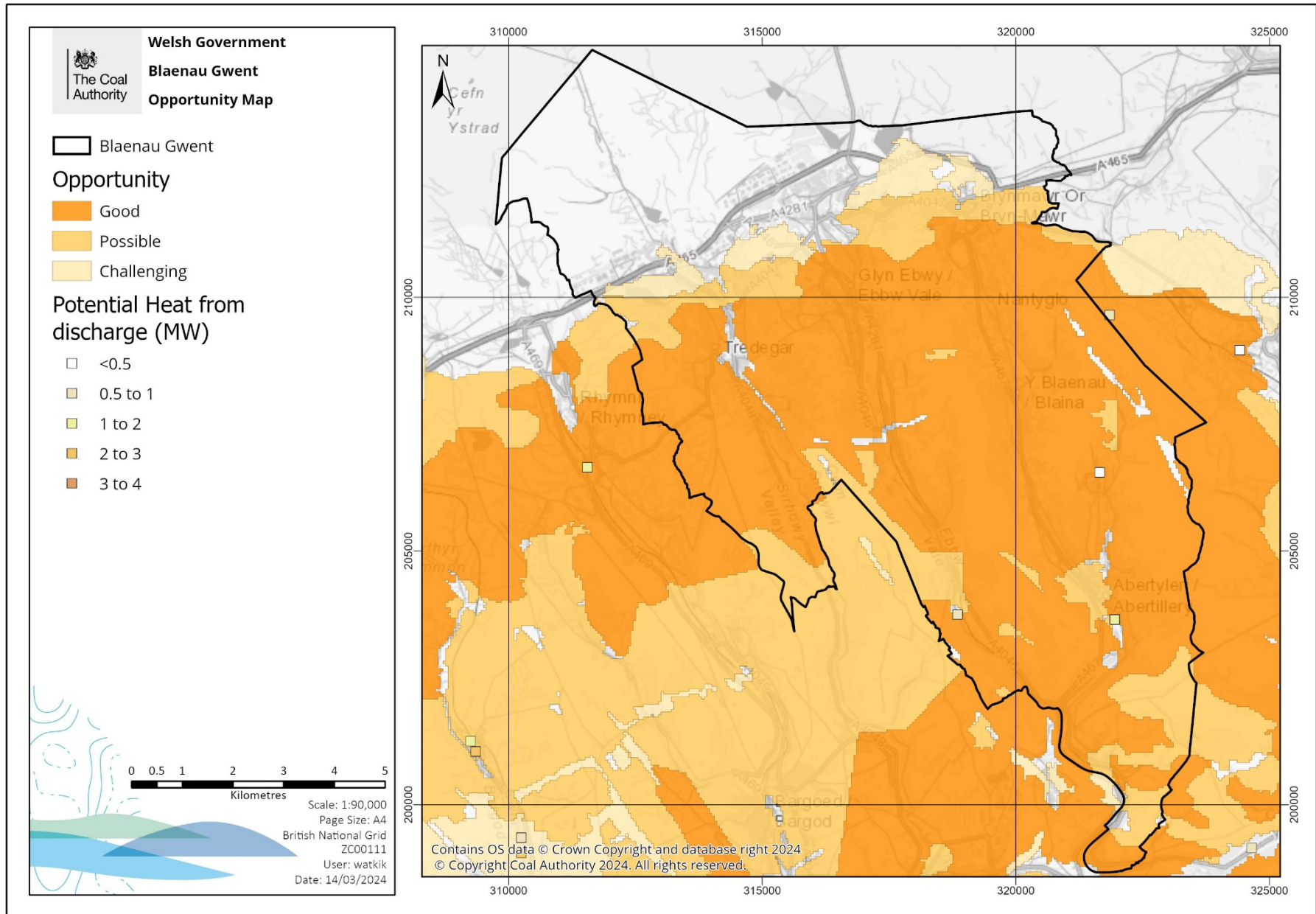


Figure 6.1: Combined mine water heat opportunities map

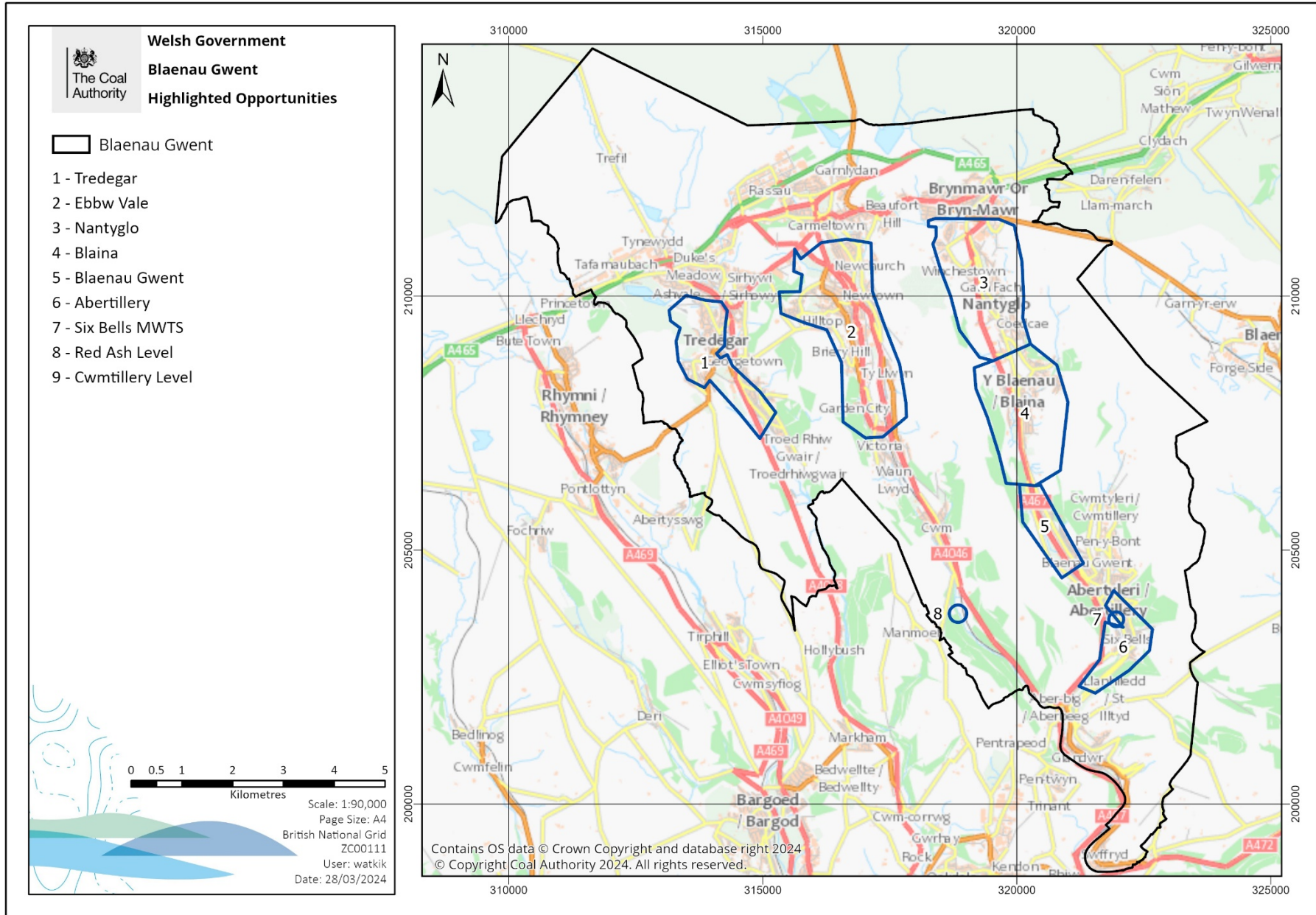


Figure 6.2: Highlighted good opportunities map

7 References

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