The Coal Authority

Merthyr Tydfil County Borough Council: Mine Water Heat Opportunities

July 2024

Making a **better future** for people and the environment **in mining areas**

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Executive summary

Coal mining has taken place in the Merthyr Tydfil County Borough Council (CBC) area between the 1800s and 1990s, with coal being worked across the Upper, Middle and Lower South Wales Coal Measures. Coal Measures outcrop in the north of the region, near Merthyr Tydfil, progressively becoming deeper around Trelewis. There are a number of large open cast coal mines recorded across the north of the region which may have removed a number of shallower workings.

The methodology for identifying the mine water heat opportunity areas is described in the overarching report. There are a range of borehole mine water heat opportunities, ranging from good to challenging across the region, alongside gravity discharge point sources and a single mine water treatment scheme.

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 0.5MWth 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 Merthyr Tydfil County Borough Council area

No./ Area	Opportunity name	Opportunity type	Opportunity Category	Estimated Heat Potential (MW_{th})
1	Abercanaid	Borehole scheme	Good	Subject to further testing
2	Pentrebach	Borehole scheme	Good	Subject to further testing
3	Glyn Dirus Pit	Gravity Discharge	Good	1.8
4	Castle shaft	Gravity Discharge	Good	2.6
5	Bargoed Taff No.6 and No.7 levels	Gravity Discharge	Good	4.3
6	Taff Merthyr/Trelewis	Mine Water Treatment Scheme	Possible	2.7

1 Introduction

The area covered in this section is the whole of the Merthyr Tydfil CBC administrative boundary 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 in the borough.

1.1 Geographic summary

Merthyr Tydfil CBC covers an area of approximately 112 km^2, and runs roughly north-south, from Nant Wern-ddu to Treharris. Urban areas within the district include: Merthyr Tydfil, Aberfan, and Treharris, with urban areas along the Taff and Bargoed Taf valleys. Coal Measures and associated mine workings are present from the outskirts of Merthyr Tydfil town and southwards. Elevation in Merthyr Tydfil area ranges from approximately 90 mAOD in the south to >500m in the north.

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 et al., 1988);
- Online geology maps (Sheets 231, 232, 248 and 249 for Merthyr Tydfil area); and
- Borehole and mine shaft scans across the area of interest.

2.1 Solid geology

The geology of Merthyr Tydfil CBC area consists of the South Wales Coal Measures group, and some older Carboniferous and Devonian rocks in the far north of the borough (**Figure 2.1**). The focus of this section will be on the geology of the South Wales Coal Measures group.

The South Wales Coal Measures consist of the Pennant Sandstone Formation/Upper Coal Measures, the Middle Coal Measures, and Lower Coal Measures. All three sets of measures outcrop at surface in the borough, and dip towards the south and southeast. The Pennant Sandstone Formation is principally a sequence of hard sandstones, with some minor mudstones and worked coal seams, and forms much of the valleys throughout the borough.

These overlie the Middle and Lower Coal Measures, which host many of the economical coal seams in the borough that have been worked in the past. The sequence consists of siltstones, mudstones, some sandstones, alongside coals and seatearths. The limit of the Lower Measures (at outcrop) is just north of Merthyr Tydfil town.

The Lower Coal Measures extend down to in excess of 500 m below ground level (mBGL) in the south of the borough (BGS Sheet 249), with the total sequence of Coal Measures geology estimated to be up to 1100 m thick (Barclay et al., 1988).

The stratigraphic sequence and approximate depths are shown in **Figure 2.2**.

2.2 Structural geology

Structurally, the Merthyr Tydfil borough is host to a number of regional scale northwest-southeast faults (**Figure 2.1**), which offset the coal seams and geology moving east to west.

2.3 Superficial geology

Superficial geology consist of glacial deposits, including clay-dominated tills, and sands and gravels. Superficial deposits are constrained to in and around the valley floors.

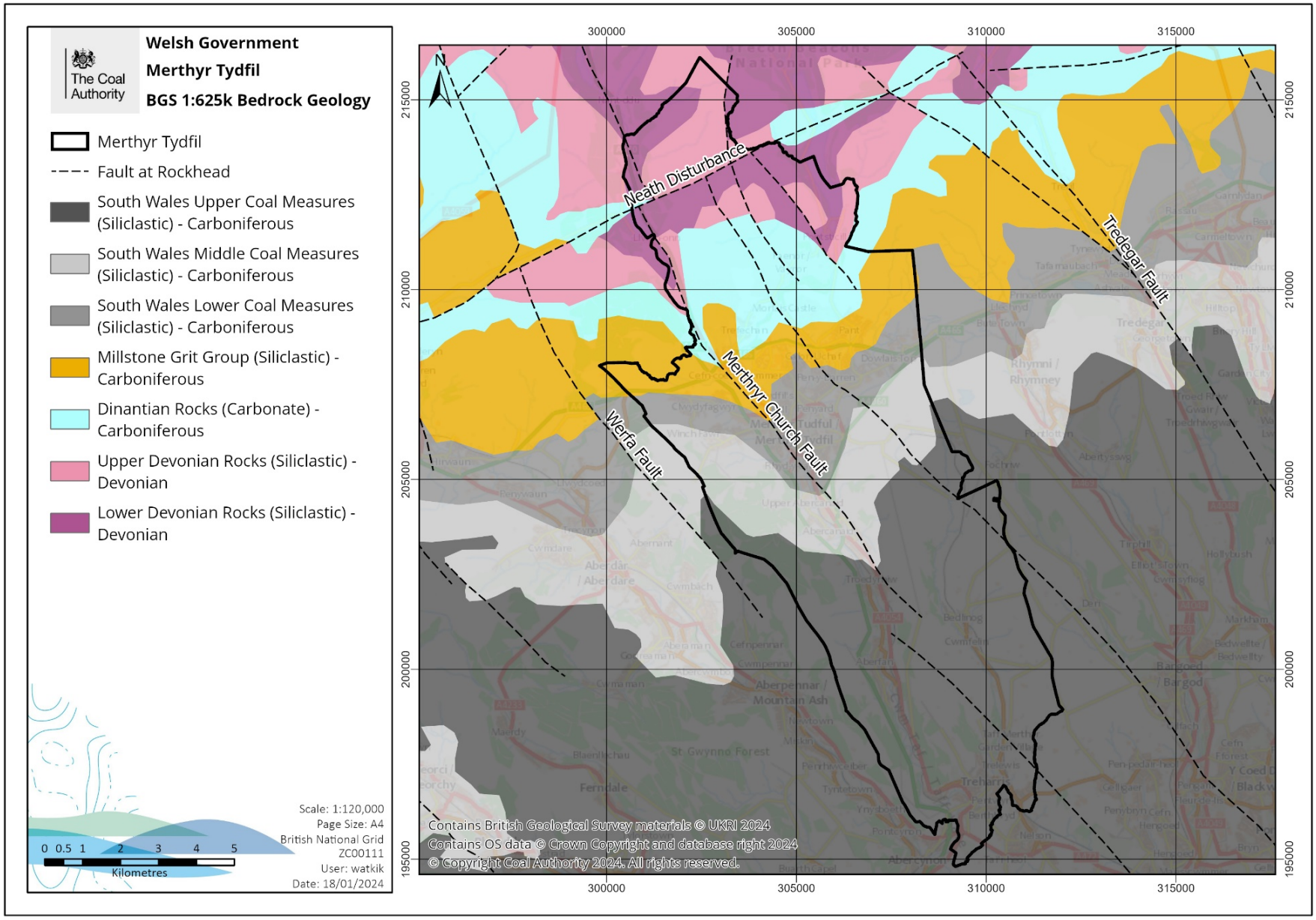
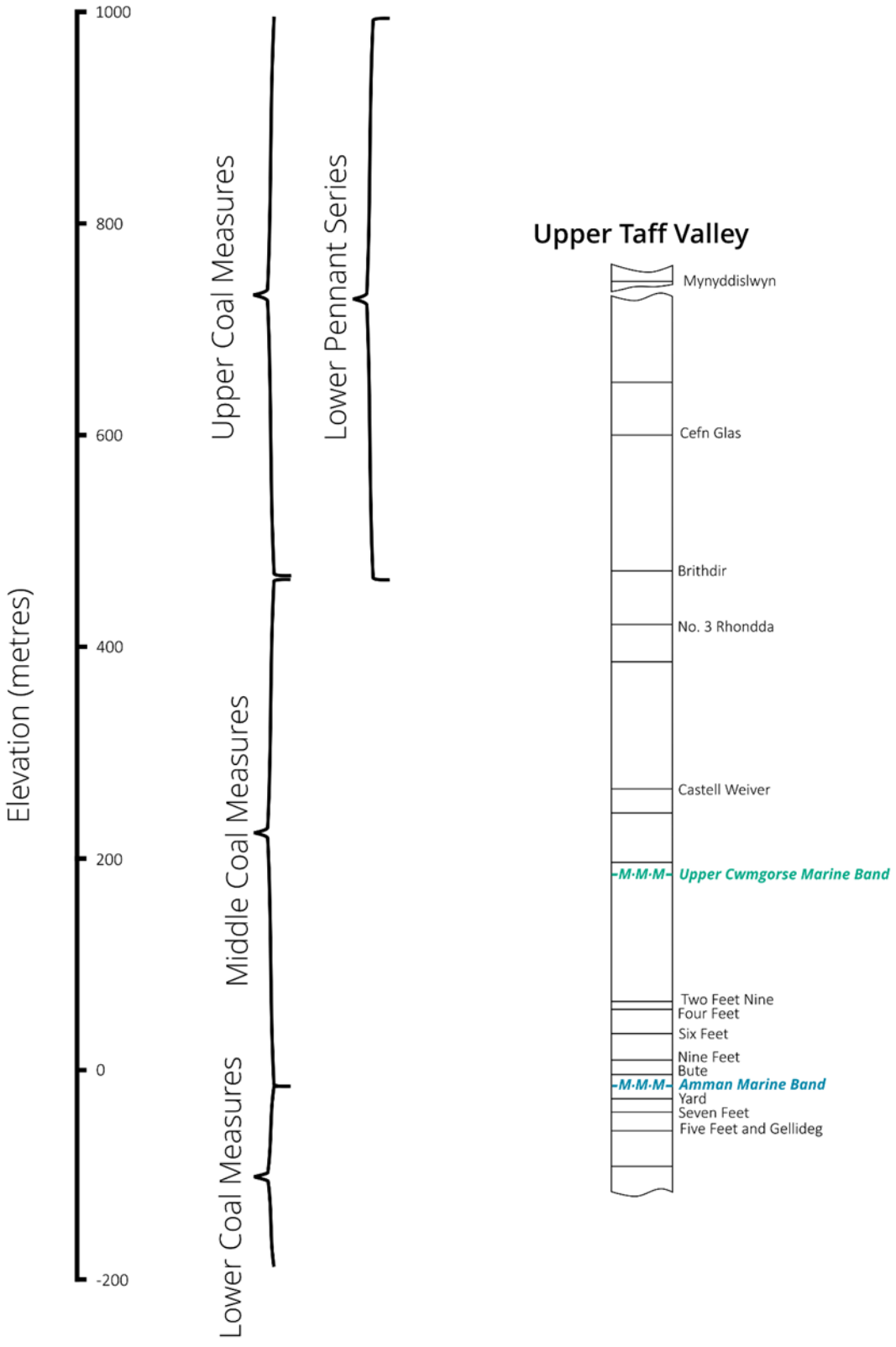


Figure 2.1. Bedrock geology in the Merthyr Tydfil district (Contains British Geological Survey materials © UKRI 2024)



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

Figure 2.2: Summary stratigraphy and geological sequence for the study area

3 Mining situation

Coal has been mined across Merthyr Tydfil since the 1800s, with the last mine closing in the 1990s. The local authority boundary includes the Abercynon and Abercanaid mining districts, with notable colliers including Taf Merthyr, Deep Navigation, and Merthyr Vale.

Coal has been worked both at surface by opencasting, and at depth underground. Coal seams across the whole sequence of coal measures have been worked, with workings between the upper, and middle and lower measures being isolated to minimise water inflows from shallower workings into deeper sets. Workings are typically bounded by NW-SE trending faults, and deepen to the west and south.

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 (NMRS, 2023)

Colliery	Closure date	Connected underground to
Merthyr Vale	1989	Deep Navigation, Navigation (Deep Duffryn)
Trelewis drift	1989	Taff Merthyr
Taff Merthyr	1992	Trelewis Drift, Bedlinog
Deep Navigation	1991	Methyr Vale, Abercynon

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

There are up to 21 named and recorded coal seams, and 6 named and recorded ironstone seams worked across the Merthyr Tydfil region. The Upper, Middle and Lower South Wales Coal Measures formations outcrop at the north of the region, just south 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, part of the Pennant Sandstone Formation/Upper Measures. The most extensively worked shallow seam in the Pennant Sandstone is the (Tillery) Brithdir, seam.

Below the Pennant Sandstone Formation/Upper Measures, lies the Middle South Wales Coal Measures, including seams between the Two Foot Nine and Bute/Yard seams. The deepest worked seam in the area is the Five Foot Gellideg.

4 Mine water regime

4.1 Description of mine water blocks

The Merthyr Tydfil region intersects three of the south wales mine water blocks – Area 8, Area 11 and Area 12. They are extensive mine water blocks, crossing over into the neighbouring local authorities of Rhondda Cynon Taf, Blaenau Gwent, and Caerphilly. Further detailed studies are required to confirm the boundaries of the mine water blocks, and hydraulic connections internally within the blocks and externally between blocks.

- Area 8 covers much of the region around Merthyr Tydfil,
- Area 11 extending from Treharris north to Bedlinog and Aberfan,
- Area 12 is found to the east of Merthyr Tydfil, where it borders with Blaenau Gwent.

There is limited knowledge of the interconnectivity in Area 8, whilst Area 11 and 12 are better characterised, with known links between major collieries recorded.

Mine water levels are thought to be recovered throughout the borough, with limited connectivity between the shallower Upper Measures, and deeper Middle and Lower Measures, although there may be some connectivity between all seams where shafts and drifts have not been plugged or dammed appropriately.

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

4.2 Monitoring data

There are a total of 3 monitoring points in the Merthyr Tydfil region, with information included in **Table 4.1**. There is no monitoring data past 2015 for the region. Additional monitoring points adjacent to the local authority include Abercwmboi (west), Nant Llesg (east), and Britannia and Glanavron (to the south east).

Table 4.1: Mine water monitoring points

Monitoring point name	Monitoring	Mine water level (mAOD)	Comments
Ellis Pit	Unknown	157.13 (2015)	<75 mBGL, recovered
Gethin Shaft	Unknown	165.88 (2014)	<75 mBGL, recovered
Trelewis Drift Borehole	UCM	165.65 (2014)	<75 mBGL, recovered

4.2.1 Mine water levels

Mine water levels across the region are considered recovered, with all monitoring points indicating a mine water level less than 75 m below ground. There is a lack of recent monitoring data for the area, with the last recorded measurements taken in 2014/2015. There are also a number of monitored and unmonitored discharges across the borough, where mine water exits at the surface.

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 suggests the following may be anticipated for the Merthyr Tydfil area:

Table 4.2: Anticipated mine water temperatures block 8

Depth (m BGL)	Mean(°C)	Max. (°C)	Min. (°C)
100	12.3	12.8	11.8
200	15	15.7	14.4
300	17.7	18.9	16.5
400	18.4	22.5	15.1
500	23.1	26.1	20.9
600	25.1	29.6	22.1

Table 4.3: Anticipated mine water temperatures block 11

Depth (m BGL)	Mean (°C)	Max. (°C)	Min. (°C)
100	11.3	12.9	10.3
200	13.6	16.9	11.6
300	15.9	21	12.9
400	18.3	25.1	14.2
500	20.6	29.1	15.6
600	23	33.1	16.9

Table 4.4: Anticipated mine water temperatures block 12

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.

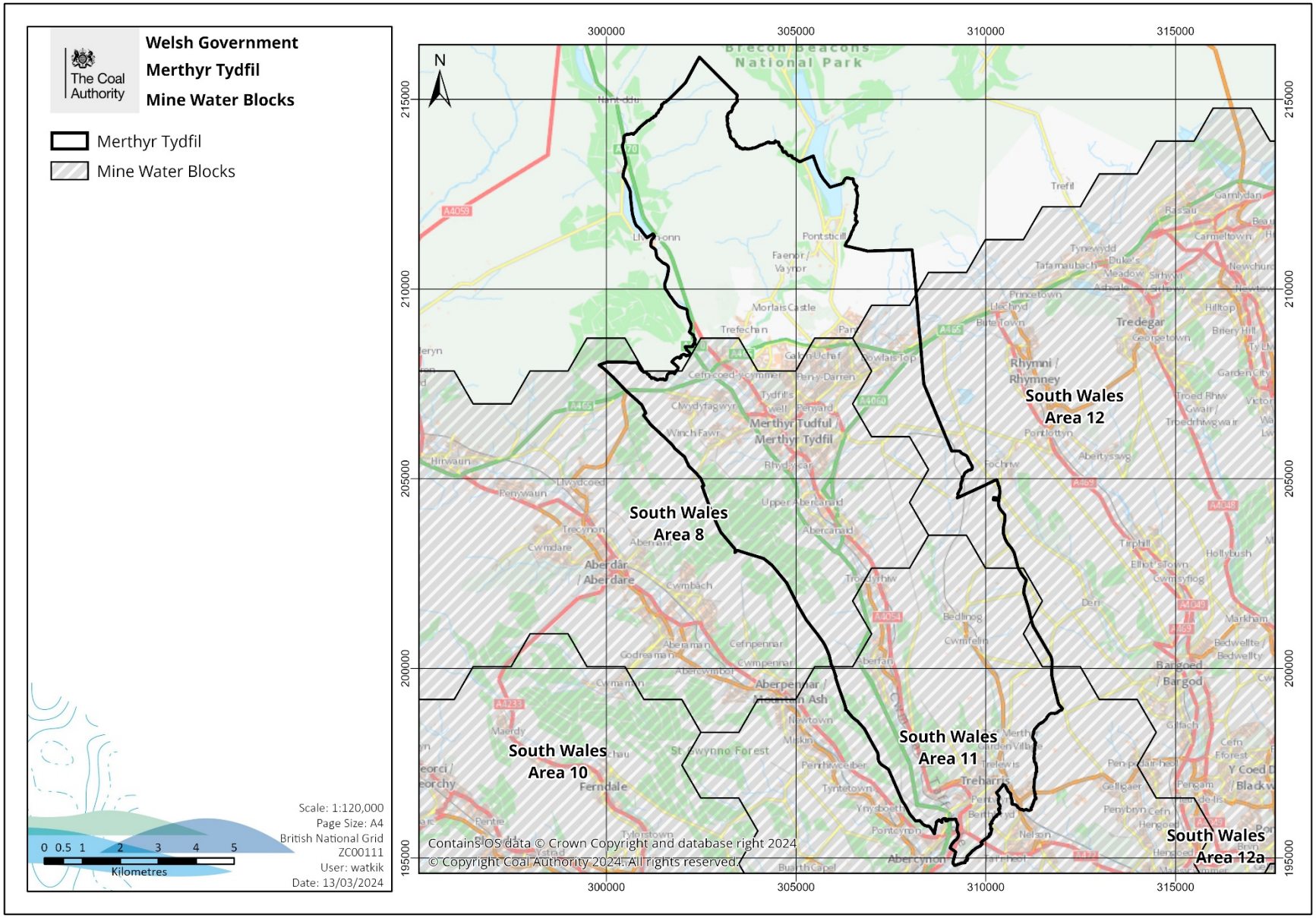


Figure 4.1: Mine water blocks in Merthyr Tydfil

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 Merthyr Tydfil County Borough boundary are outlined below and are illustrated in **Figure 5.1**.

5.1.1 Good borehole opportunities

There are "Good" opportunities for borehole based mine water heat schemes to the south or Merthyr Tydfil town, which include:

- Abercanaid; and
- Pentrebach;

where workings are at ideal depths (<300 mBGL), fully flooded, overlapping, and extensive.

There are options in both the Upper Coal Measures, and the Middle and Lower Coal Measures. These fall within South Wales Area 8 mine water block, which has recovered with evidence of sufficiently shallow water levels (<75 mBGL) and shallow unmonitored discharges.

There are however very few existing end users near the vicinity of this resource, comprising predominantly residential properties with some light industry.

5.1.2 Possible borehole opportunities

There are "Possible" opportunities for borehole based mine water heat schemes in the southern half of the region, around Merthyr Vale and Bedlinog, where workings are broadly between 300 and 500 mBGL (with single seams <300 mBGL). There is some evidence of opencast coal workings which classify areas as "Possible" in the north, closer to outcrop, and in the centre of the region. There are again not many end users in proximity to these possible

prospective areas, with possible areas for investigation including Merthyr Vale and Bedlinog, should the demand for heat be sufficient.

5.1.3 Challenging borehole opportunities

There are “Challenging” to no opportunities in the north where the Coal Measures outcrop, in the vicinity of Merthyr Tydfil town. Workings here are expected to be too shallow to be safely considered for a mine water heat scheme. There is also knowledge of opencast or surface coal workings, which will have likely removed a number of shallow workings, alongside modifying the overlying fill above any deeper mine workings.

In the south of the borough (around Treharris), there are only “Challenging” opportunities where the workings are over 500 m deep. They are expected to be flooded, with workings comprised of Middle and Lower Coal Measures. They will be expensive underground mine workings targets to drill to (although there may be shallower access points such as drifts), but depending on the level of demand at surface, could be a challenging but feasible endeavour.

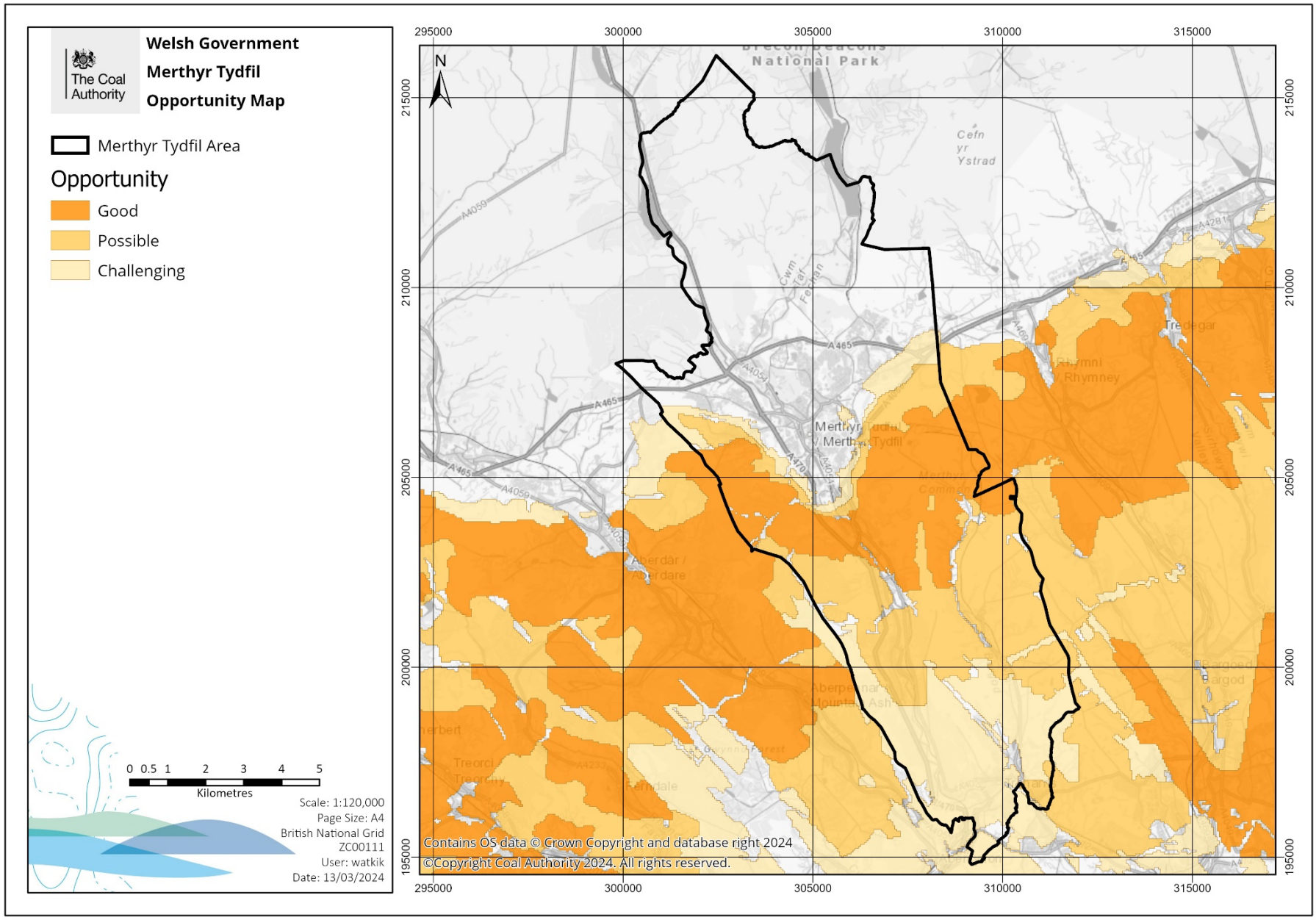


Figure 5.1: Mine water heat opportunities – borehole schemes

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 Merthyr Tydfil area are shown in **Table 5.1** and their locations in **Figure 5.3.**

In Merthyr Tydfil there is one mine water treatment scheme, Taff Merthyr, situated between Cwmfelin and Trelewis. The scheme relies on gravity-fed discharges in to a sump, from where it is pumped to the treatment scheme. The flow rates vary with rainfall and seasonally. Potential heat users at the site are limited mainly to the Rock UK Summit Centre. The nearest built-up area being Taff Merthyr Garden Village, >1km to the south of the treatment scheme.

Table 5.1: Mine water treatment schemes

Name	Flow average (L/s)	Flow range (L/s)	Typical temperature (°C)	Estimated potential heat (MWth)
Taff Merthyr / Trelewis	100	25 to 150	12	2.2 to 2.9

5.3 Gravity-fed discharge schemes

Numerous gravity mine water discharges exist in the Merthyr Tydfil 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 5.3.**

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)
Bargoed Taff No6 and No7 Levels	150 estimated	1 spot reading	11 (est)	3.5 to 4.6
Castle Shaft	100	15 to >150	11 (est)	2.1 to 2.8
Glyn Dirus Pit	65 estimated	1 spot reading	11 (est)	1.4 to 1.9
Pont y Rhyn	47	10 to >150	11 (est)	1 to 1.3
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				

Should a potential heat demand be identified close to one of these discharges (shown in **Table 5.2** / **Figure 5.3**) 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 Bargoed Taff Discharges

There are two discharges at Bedlinog /Cwmfelin, one from No6 Level and one from No7 Level, which are about 240 m apart from each other, which discharge into Bargoed Taff. Bedlinog Primary School is close by to No6 Level discharge. 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 Castle Shaft Discharge

The discharge is from an adit that is thought to connect to Castle Pit at Troedyrhiw. The discharge is to the River Taff. Potential heat users for the discharge will need further investigation. The shaft has been used for mine water level monitoring, and is thought to be unfilled. The Pont-y-Rhyn discharge is 300 m from Castle Shaft Discharge, and both discharges may be connected to the same workings. Further studies should consider the two discharges and possibly South Duffryn Discharge, any studies should also look at utilising Castle Shaft.

Figure 5.2: Photograph of Castle Shaft Discharge

5.3.3 Glyn Dirus Pit Discharge

The location of the discharge is thought to be from Glyndyriss Pit at Upper Abercanaid. 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.

5.3.4 Pont-y-Rhyn Pit Discharge

The discharge is from an adit connected to Pont-y-Rhyn Pit that discharges to the River Taff at Troedyrhiw. The discharge is close to Castle Shaft Discharge and South Duffryn Discharge. The Pont-y-Rhyn discharge is 300 m from Castle Shaft Discharge, and both discharges may be connected to the same workings. Monitoring at Pont-y-Rhyn was ceased due to unsafe nature of surrounding rock faces. Further studies should consider the two discharges and possibly South Duffryn Discharge (approximately 0.4 MW_{th}), any studies should also look at utilising Castle Shaft.

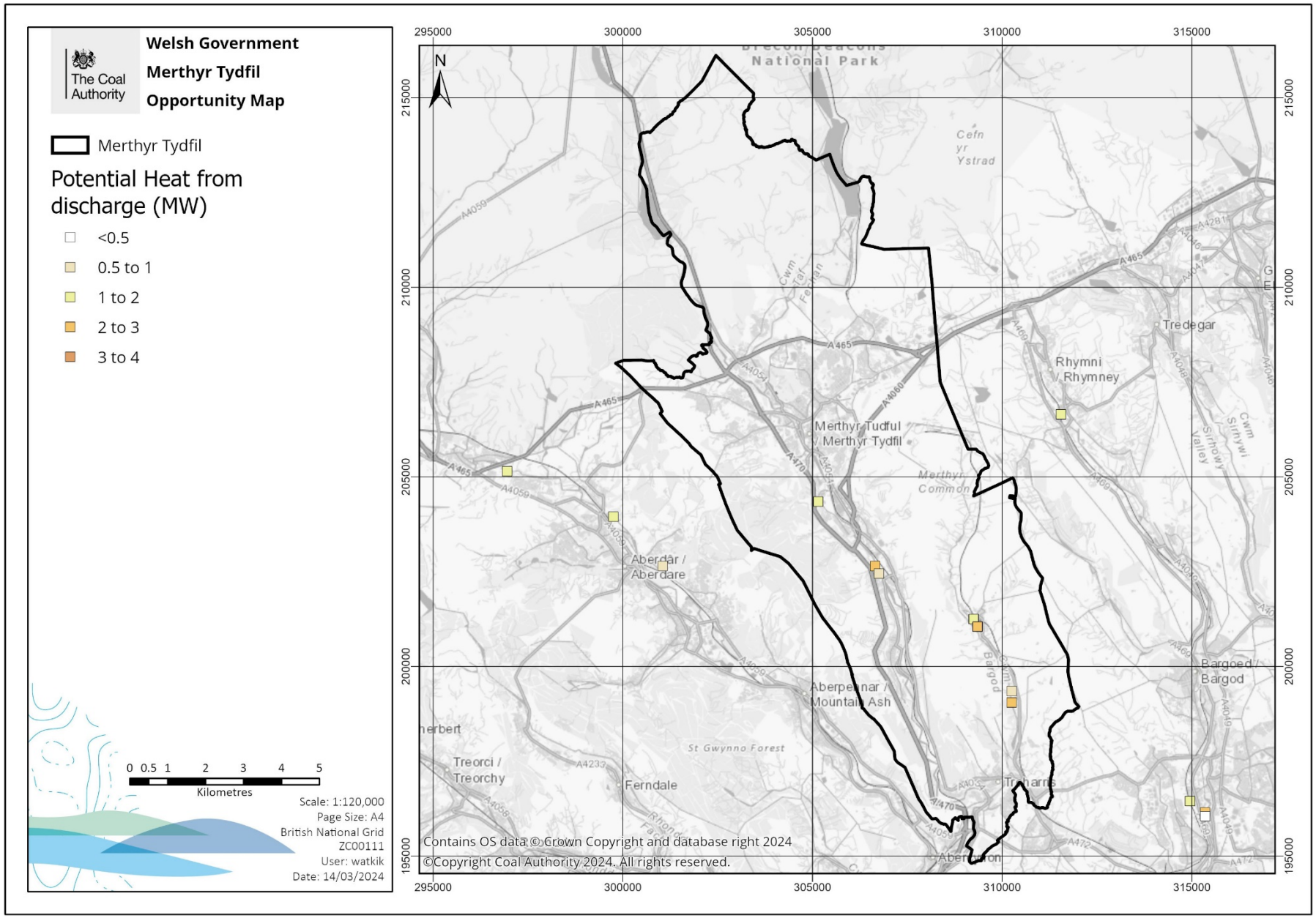


Figure 5.3: Mine water heat opportunities – treatment schemes and discharges

6 Summary

Merthyr Tydfil had active coal mines between the 1800s to late 1990s, where coal was worked across the Upper, Middle and Lower South Wales Coal Measures. A number of deep pits are noted across the region, including Taf Merthyr, Deep Navigation, and Merthyr Vale. Mine water levels across the region are considered to be <75 mBGL, with a number of surface discharges known across the region. Mine water temperatures are expected to be between 11 and 25 °C across the region, with temperatures being warmer in the south where workings are deeper.

A summary of notable mine water heat opportunities are presented in **Table 6.1**, and shown on **Figure 6.1** and **Figure 6.2**.

Table 6.1: Mine water heat opportunities within Merthyr Tydfil area

No./ Area	Opportunity name	Opportunity type	Opportunity Category	Estimated Heat Potential (MW_{th})
1	Abercanaid	Borehole scheme	Good	Subject to further testing
2	Pentrebach	Borehole scheme	Good	Subject to further testing
3	Glyn Dirus Pit	Gravity Discharge	Good	1.8
4	Castle shaft	Gravity Discharge	Good	2.6
5	Bargoed Taff No.6 and No.7 levels	Gravity Discharge	Good	4.3
6	Taff Merthyr/Trelewis	Mine Water Treatment Scheme	Possible	2.7

6.1 Borehole Schemes

6.1.1 Good Opportunities

There are two areas considered as “Good” opportunities for borehole mine water heat schemes in Merthyr Tydfil County Borough, which are shown on **Figure 6.2** as **Area 1** and **Area 2**.

- **Area 1**, covering Abercanaid, consisting predominantly of residential properties, and;
- **Area 2**, covering Pentrebach, which includes residential properties, alongside light industry hosted in the Merthyr Tydfil Industrial Park.

6.1.2 Possible Opportunities

"Possible" opportunity areas across Merthy Tydfil County Borough include Merthyr Vale, and Bedlinog, in the southern half of the borough. There are many other "Possible" areas identified across the region, but have not been highlighted due to their distance from any end-users.

6.2 Mine Water Treatment Schemes

Location 6 is the Taff Merthyr/Trelewis mine water treatment scheme, which could provide a possible output of 2.7 MW_{th}. The site is considered as "Possible" due to the limited potential heat demand already present adjacent to the site, but does not preclude the option to transport heat away from the site at greater distances.

6.3 Mine water discharges

A number of gravity mine water discharges are known to exist in the Merthyr Tydfil county borough, but only three are considered to have sufficient data to indicate a potential heat output over 0.5 MW_{th}. 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 three gravity discharges are:

- **Location 3**, Glyn Dirus Pit discharge, which has "good" potential due to its >1 MW_{th} output and proximity to potential end users;
- **Location 4**, Castle shaft discharge (in close proximity to the Pont-y-Rhyn discharge), which has "good" potential due to its >2 MW_{th} output, and proximity to potential end users;
- **Location 5**, Bargoed Taff discharges, which have good potential due to their combined potential output of >4 MW_{th} output and proximity to potential end users.

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 - 500 mBGL, or close to shallow workings/outcrop). Much of the southern half of the region is classified as "Challenging" due to the depth to the workings (>500 mBGL). 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 Taff Merthyr/Trewlewis mine water treatment scheme (potentially 2.7 MW_{th}), Glyn Dirus Pit discharge, Bargoed Taff discharge, and the possibly connected Castle Shaft and Pont-y-Rhyn discharges.

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.

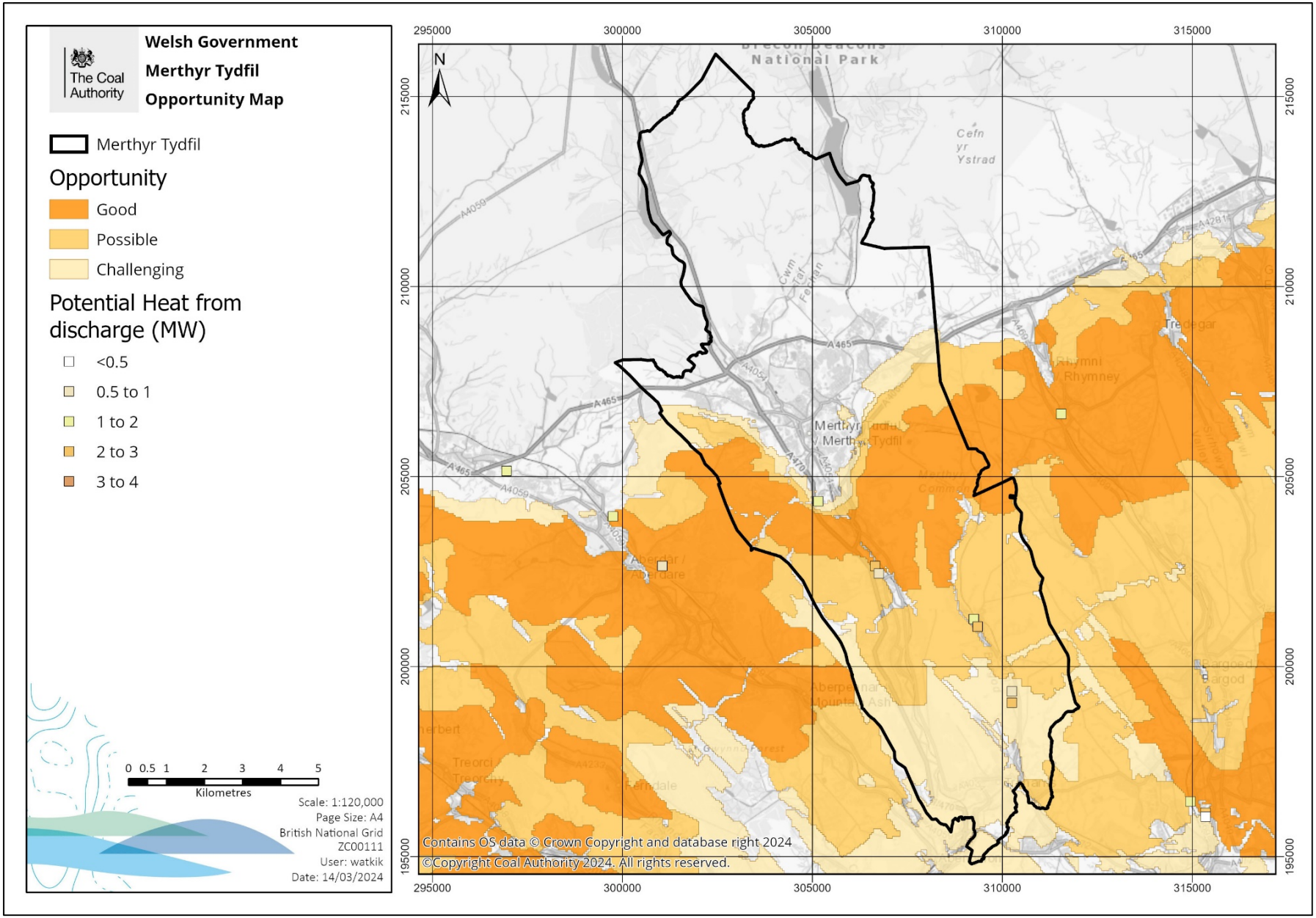


Figure 6.1: Combined mine water heat opportunities map

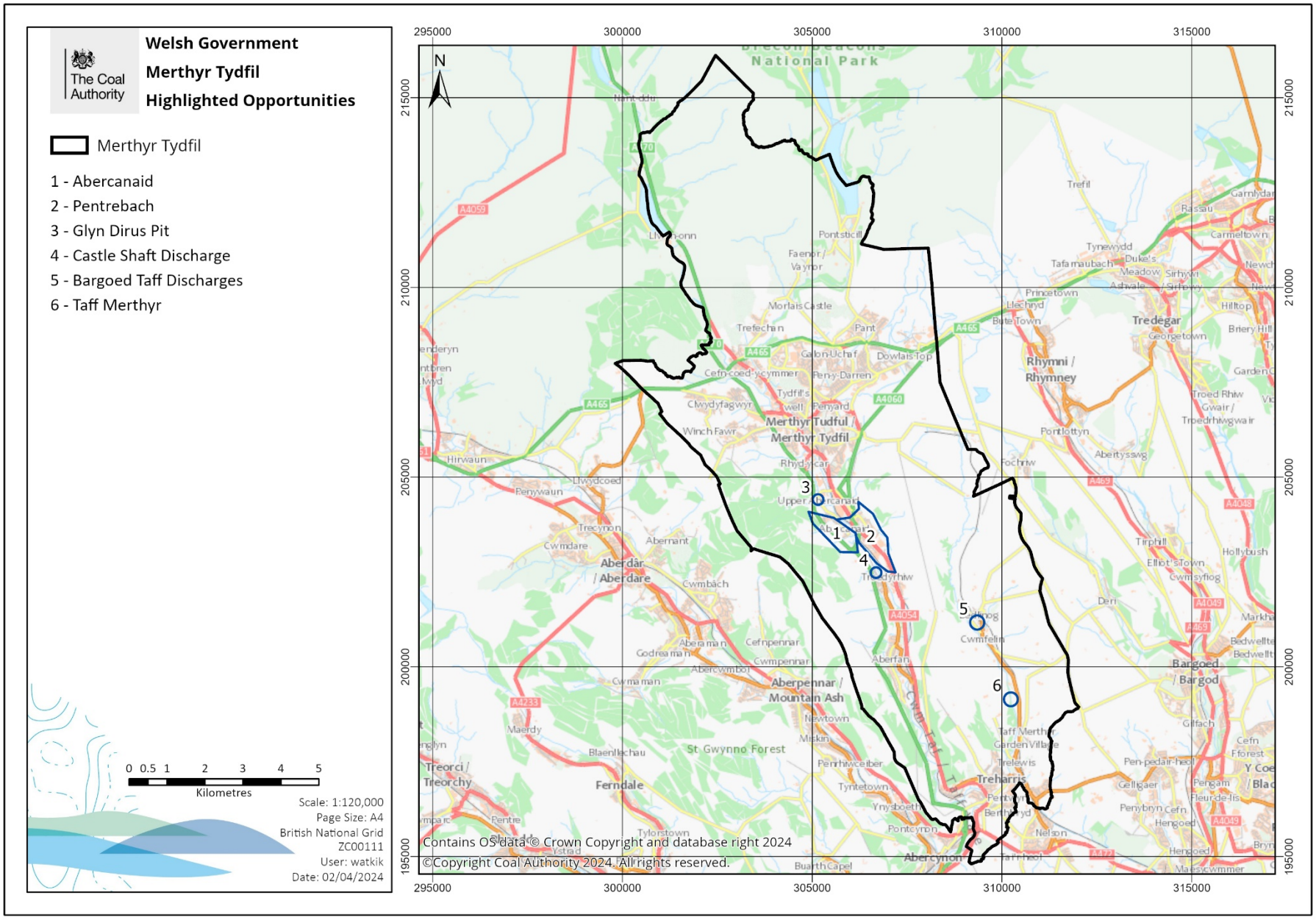


Figure 6.2: Highlighted opportunity areas within Merthyr Tydfil

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