AUTH 263 (Wollombi) Resource assessment

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Executive summary

The ‘Wollombi’ area (AUTH 263) is located approximately 20 km south of Singleton, within the Singleton and Cessnock Local Government Areas.

The Department of Regional NSW’s Geological Survey of NSW (GSNSW) undertook a resource assessment of ‘Wollombi’ based on available information, and engaged an independent consultant to undertake a commercial viability assessment of the area.

Based on the available data, AUTH 263 contains over 1.2 billion tonnes of inventory coal resources from the Great Northern, Fassifern and Whybrow Lower seams. Unquantified resources also exist within the Blakefield seam. The coal is low to medium ash, and likely markets are a combination of low to moderate ash export thermal coal, and potential semi-soft export metallurgical coal.

The coal resource assessment is based on relatively limited geological data, and the scope of the commercial viability assessment was such that potential coal transport corridors, infrastructure, tailings disposal, gas drainage, and water supply options were only considered generally, at a high level.

A commercial viability assessment concluded that AUTH 263 contains a coal resource with the potential to recover up to 240 million tonnes (Mt) of product coal, with a Net Present Value (NPV) of $79M in a base case scenario. The resource may support a commercially viable underground longwall mining operation of approximately 8 million tonnes per annum (Mtpa) over 32 years. While there is potential that a standalone mine development may be economically viable, the low NPV of the base case scenario is likely to detract from its appeal as a new standalone development project.

The potential coal resource, if proven, has the potential to help provide continuity of high quality thermal coal supply from NSW in 15-20 years. There are however, uncertainties associated with the resource, including infrastructure development, unidentified geological complexity, exploration difficulty, and future markets.

Financial analysis is highly sensitive to forecasts for the key revenue drivers of commodity prices and exchange rates, as well as operational costs. These are inherently uncertain given the estimated project lead time of 15-20 years. Further exploration would reduce the geological uncertainty however, not the uncertainty relating to infrastructure, mine development and markets.

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Introduction

Coal mining is an important industry for NSW and is a significant source of employment and economic activity in regional NSW. Coal mining revenue helps fund essential services and infrastructure such as schools, hospitals, roads and transport.

Coal mining in NSW occurs mainly in the Permian-Triassic aged Sydney, Gunnedah, and Gloucester basins.

NSW is a controlled release area for coal. New coal exploration licences can only be allocated by the NSW Government via one of three release pathways:

1. **Strategic release framework**: defined by the *Strategic release framework for coal and petroleum exploration*.
2. **Operational allocation framework**: defined by the *Guidelines for coal exploration licence applications for operational allocation purposes*.
3. **Competitive allocation pathway**: defined by the *Guideline for the competitive allocation of coal*.

A coal resource in the Wollombi region was identified as an area for potential coal exploration under the *Strategic release framework for coal and petroleum exploration* in the NSW Government's Future of Coal Statement (June 2020). The 'Wollombi' area (AUTH 263) contains potential coal resources in the Newcastle and Whittingham Coal Measures.

Location and land use

The Wollombi resource area is located approximately 20 km south of Singleton. It is bounded to the northwest by the Bulga mine, to the southeast by the Austar mine, and located east of the Yengo National Park (Figure 1).

The area is accessible by two main roads; Wollombi / Payne's Crossing Road, and Cessnock / Broke Road.

A small portion of the tenement is relatively flat in the north before crossing over the Hunter Escarpment into rugged terrain where the access is difficult due to steep sided sandstone bluffs / ridges and incised gullies.

Land use in and around the area is characterised by a combination of agriculture, forestry, mining, tourism, military, small-scale hobby farms, and conservation uses.

A large portion of the Wollombi resource area is covered by the Pokolbin and Corrabare State Forests. The Yango State Forest and State Conservation Area are in the southwestern corner of AUTH263.

The Wollombi area also contains the Singleton Military Area.

Resource assessment

A resource assessment has been prepared by the Geological Survey of NSW (GSNSW), of Mining, Exploration and Geoscience (MEG), Department of Regional NSW (DRNSW).

Coal resource estimates within this report were prepared with reference to the '*Australian Guidelines for the Estimation and Classification of Coal Resources*'. The estimates are for 'Inventory Coal', a term that describes an estimate of the unconstrained coal tonnages in-situ. The term 'Inventory Coal' is used when reporting to Government or for purposes of strategic planning internally within companies.

The assessment provides a summary of the quantity and quality of inventory coal within the area, based on currently available information. This includes:

- An assessment of the quality and quantity of inventory coal within AUTH 263
- Identification of geological constraints on coal extraction that may inhibit release of the area.

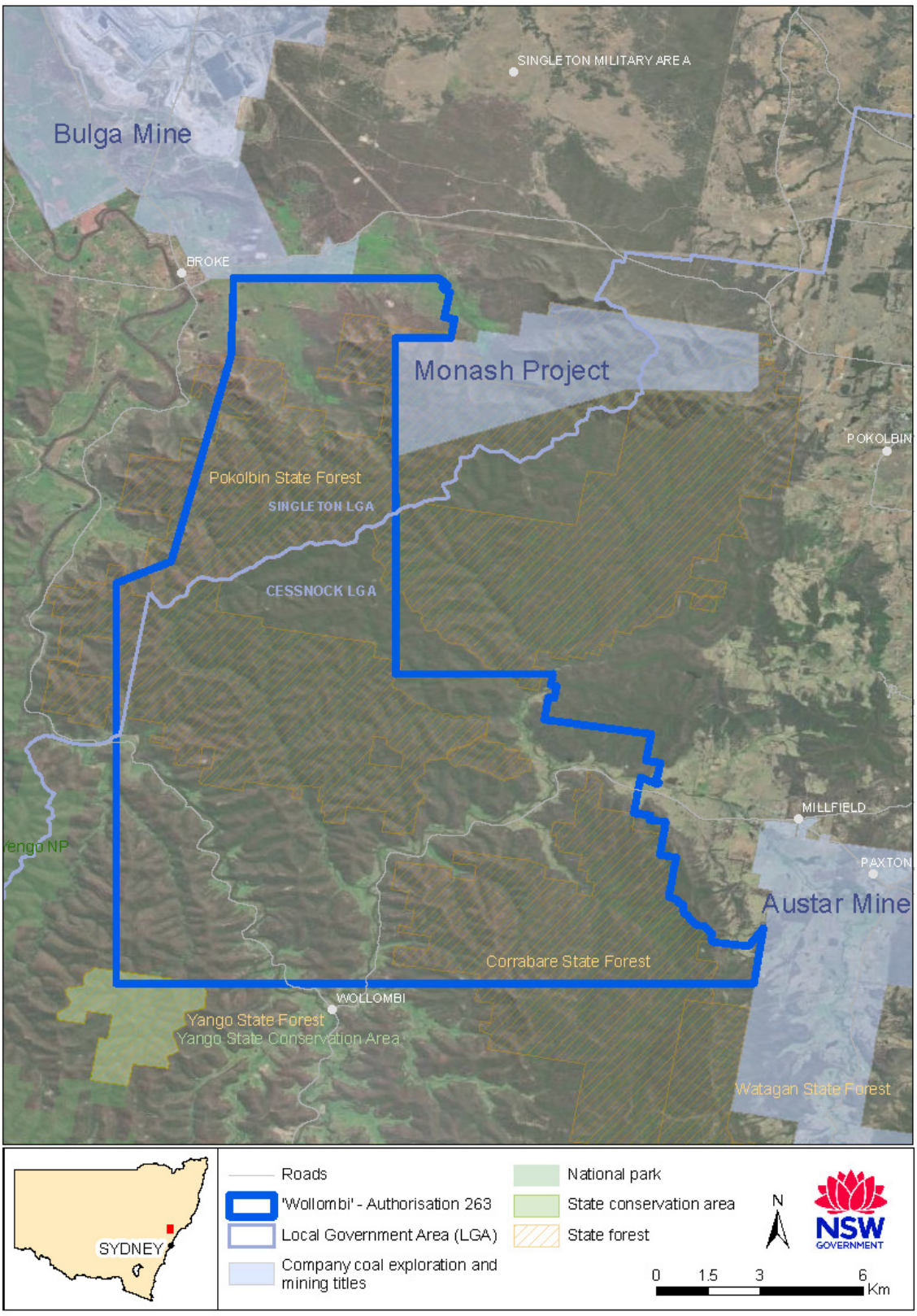

Figure 1 Location of Wollombi (AUTH 263).

Exploration history

Exploration drilling in the greater Wollombi region has been undertaken over decades. There are nine drillholes within AUTH 263 (7 coal exploration drillholes, 2 petroleum wells), which were drilled in the period between 1966 and 2013 (Figure 2). The rugged terrain, heavy vegetation, and limited access tracks has influenced where exploration drilling has occurred to date, and exploration has been in more accessible areas (Figure 1).

The first hole drilled in the area was a petroleum well drilled by Australian Oil and Gas in 1966. This was followed by 3 boreholes drilled in 1971 by AMAD NL for their Millfield coal exploration drilling program, and by Thiess Holdings Ltd for their Broke Prospect coal exploration program. The Department of Mineral Resources drilled four boreholes in AUTH 263 between 1996 and 1997 as a part of stratigraphic assessment drilling programs in the Hunter Coalfield. AGL Energy drilled one petroleum well in 2013 for coal seam gas exploration.

AUTH 263 was assessed by the Coal Compensation Board (CCB) in 1990, concluding that there was potential for economic development of medium ash thermal coal resources in the Greigs Creek seam (currently known as the Vales Point seam). It is now thought by GSNSW that this was a miscorrelation and the report was actually based on the Great Northern seam.

In the CCB assessment, the mineable in-situ reserves were estimated at 2,520 (Mt), with an estimated saleable product of 1,000 Mt. There was insufficient data for this study to undertake a full resource assessment that included all seams present below the Great Northern seam, which have the potential to contribute further reserves. An economic assessment indicated that the resources were capable of supporting a mining operation for over 70 years, at rates varying between 4 Mt per annum to 20 Mt per annum.

The Department of Mineral Resources, NSW Geological Survey, completed the Broke drilling program in AUTH 263 in 1997, which totalled four drillholes in the northern part of AUTH 263. This program focussed on the Great Northern, Fassifern and Whybrow Lower seams. Coal resources estimated as part of this report were 1,145 Mt for the Great Northern seam, and 116 Mt for the Fassifern seam. No resources were estimated for the Whybrow Lower seam as data was limited.

Local geology

The Wollombi area is within the Hunter Coalfield of the Sydney Basin. The surface geology of the Wollombi area is predominantly units of the Triassic Narrabeen Group (Figure 2). The main coal seams are within the Permian aged Newcastle Coal Measures and the Whittingham Coal Measures (Figure 3).

The top of the Newcastle Coal Measures crop to the north and east along the Hunter Escarpment. The strata generally dips to the south west at around two to three degrees. However, on the eastern side south of AUTH 263, the dip is modelled to be around 10 degrees before flattening out.

The 1999 Department of Mineral Resources Broke drilling program report identified the Broke lineament as a potential fault. This lineament crosses the area in the north and south eastern parts of the lease.

Six boreholes in the AUTH 263 area intersected igneous intrusions. Two of these intersections affected the Whybrow Lower seam, but in areas where the seam is considered too deep for mining. All other intrusions did not affect seams of interest.

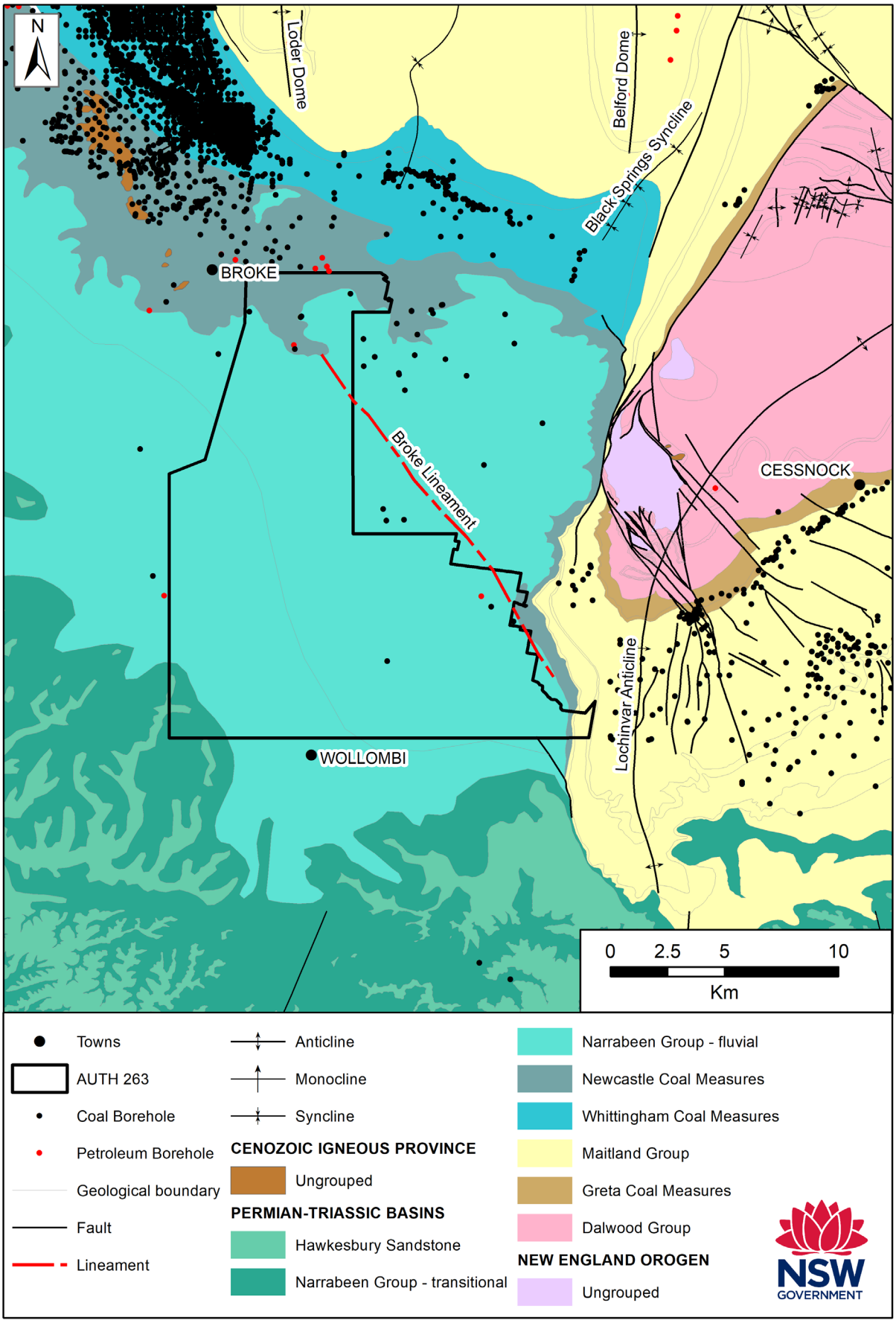

Figure 2 Surface geology of the Wollombi (AUTH 263) area and surrounds.

SYDNEY BASIN HUNTER COALFIELD				
GROUP	**SUBGROUP**	**FORMATION**	**COAL MEMBERS (Muswellbrook Area)**	**COAL MEMBERS (Foybrook Area)**
Wianamatta Group				
Hawkesbury Sandstone				
Narrabeen Group	Gosford Subgroup			
	Clifton Subgroup			
	Widden Brook Conglomerate			
Newcastle Coal Measures	Moon Island Beach Subgroup		Vales Point Coal Member	
			Wallarah Coal Member	
			Great Northern Coal Member	
	Awaba Tuff			
	Boolaroo Subgroup		Fassifern Coal Member	
			Upper Pilot Coal Member	
			Lower Pilot Coal Member	
			Hartley Hill Coal Member	
	Warners Bay Tuff			
	Adamstown Subgroup		Australiasian Coal Member	
			Montrose Coal Member	
			Wave Hill Coal Member	
			Fern Valley Coal Member	
			Victoria Tunnel Coal Member	
	Nobbys Tuff			
	Lambton Subgroup		Nobbys Coal Member	
			Dudley Coal Member	
			Yard Coal Member	
			Borehole Coal Member	
Watts Sandstone				
Denman Formation				
Wittingham Coal Measures	Jerrys Plains Subgroup	Mount Leonard Formation	Whybrow Coal Member	
		Althorpe Formation		
		Malabar Formation	Redbank Creek Coal Member	
			Wambo Coal Member	
			Whynot Coal Member	
			Blakefield Coal Member	
		Saxonvale Member		
		Mount Ogilvie Formation	Glen Munro Coal Member	
			Woodlands Hill Coal Member	
		Milbrodale Formation		
		Mount Thorley Formation	Arrowfield Coal Member	
			Bowfield Coal Member	
			Warkworth Coal Member	
		Fairford Formation		
		Burnamwood Formation	Mt Arthur Coal Member	
			Piercefield Coal Member	
			Vaux Coal Member	
			Broonie Coal Member	
			Bayswater Coal Member	
	Archerfield Sandstone			
	Vane Subgroup	Bulga Formation		
		Foybrook Formation	Wynn Coal Member	Lemington Coal Member(s)
			Edderton Coal Member	Pikes Gully Coal Member
			Clanricard Coal Member	Arties Coal Member
			Bengalla Coal Member	Liddell Coal Member
			Edinglassie Coal Member	Barrett Coal Member
			Ramrod Creek Coal Member	Hebden Coal Member
	Saltwater Creek Formation			
Maitland Group	Mulbring Siltstone			
	Muree Sandstone			
	Branxton Formation			
Greta Coal Measures	Rowan Formation		Hilltop Coal Member	Hilltop Coal Member
			Fleming Coal Member	Brougham Coal Member
			Hallet Coal Member	Grasstress Coal Member
			Muswellbrook Coal Member	Thiess Coal Member
			St Heliers Coal Member	Puxtrees Coal Member
			Lewis Coal Member	Balmoral Coal Member
			Loder Coal Member	
	Skeletar Formation			
Gyarran Volcanics	Farley Formation			
	Rutherford Formation			
	Allandale Formation			
	Lochinvar Formation			
Seaham Formation				

Figure 3 Stratigraphy of the Hunter Coalfield of the Sydney Basin.

Coal Geology

The main seams of interest are the Great Northern and Fassifern seams from the Newcastle Coal Measures (Figure 4), and the Whybrow Lower seam and Blakefield seam from the Whittingham Coal Measures (Figure 5 and Figure 6). Changes in seam thickness and interburden are typically gradual and identifiable over large areas.

Great Northern seam

The Great Northern seam ranges from 0 to 802 m deep over AUTH 263 and deepens towards the south (Figure 7). It is between 0.5 and 6 m in thickness, averaging about 3.8 m (Figure 8).

The raw ash is from 15 and 30 per cent (air dried) and averages 20 per cent (Figure 9). The available washability data suggests an 80 to 95 per cent yield to give a 12 to 17 per cent ash product at a cumulative float of 1.60 g/cm^3. The resource area for this seam covers most of AUTH 263. The saleable product would be a low ash thermal coal if washed, or a low to medium ash thermal coal without washing.

The Great Northern coal is generally well understood from other places where it is mined, predominantly in the Newcastle Coalfield. Modelling indicates that the Great Northern seam in the Wollombi area shows similar quality characteristics to where it is mined elsewhere in the Newcastle Coalfield.

Fassifern seam

The Fassifern seam is separated from the Great Northern seam by the Awaba Tuff, this separation is from 3 to 18 m. Depth ranges from 0 to 900 m, deepening towards the south (Figure 10). The Fassifern seam is from 0 to 2.5 m and is thickest in the northern parts of AUTH263 (Figure 11).

The raw ash ranges from 22 to 44 per cent (air dried) and averages 34 per cent (Figure 12). The available washability data suggests a 75 to 85% yield to give a 12 to 17 per cent ash at a cumulative float of 1.60 g/cm^3. The potential resource area for this seam is in the northern part of AUTH 263. The saleable product would be a low ash thermal coal if washed or a low to medium ash thermal coal without washing.

The Fassifern coal is generally well understood from other places where it is mined, predominantly in the Newcastle Coalfield. Modelling indicates that the Fassifern seam in the Wollombi area shows similar quality characteristics to where it is mined elsewhere in the Newcastle Coalfield.

Whybrow Lower seam

The Whybrow Lower seam is around 300 m below the Fassifern seam. Data is limited for this seam. Depth of the Whybrow Lower seam ranges from less than 100 m in the north of AUTH 263, up to 1,200 m in the south (Figure 13).

The thickness the Whybrow Lower seam ranges from 1.4 to 2.1 m with an average of 2 m (Figure 14). The Whybrow Upper, located between the Fassifern and Whybrow Lower, is not considered to contain potential resources due to thickness and lack of continuity across the area.

The raw ash of Whybrow Lower seam is between 24 and 29 per cent (air dried) averaging 27 per cent (Figure 15). The available washability data suggests a 75 to 80 per cent yield with a 14 per cent ash at a cumulative float of 1.60 g/cm^3.

The potential resource for this seam is in the northern part of AUTH 263. This coal may be sold as a semi-soft metallurgical, PCI or low ash thermal if washed.

The Whybrow Lower is significantly deeper than the Fassifern seam (by approximately 300 m), and the commercial viability of this seam is likely to be affected by depth.

Blakefield seam

The Blakefield seam is below the Whybrow seam. Data is limited for this seam and quality data only exists outside the lease. Depth ranges from 250 m in the north of AUTH 263, up to 1,300 m in the south.

The main ply of interest in the Blakefield seam is ply 1. In the north of AUTH 263, where the depth is less than 600 m, the thickness of the Blakefield seam ply 1 ranges from 2.2 to 3.6 m with an average of 2.9 m.

In this northern area of AUTH 263, the raw ash of the Blakefield seam ply 1 is between 18.4 and 42.2 per cent. The ash appears to increase to the east. The coal quality data suggests that this coal may be sold as semi-soft metallurgical, PCI or low ash thermal coal if washed. The commercial viability of this seam is likely to be affected by depth.

Other seams

There may be potential in the ply 3 of the Hartley Hill seam (Figure 3) in the south east of AUTH 263 where it thickens to over 2 m. The seam has an ash of around 22 per cent and has some coking properties which may be improved if washed. Further data for this seam is required to confirm this.

There also may be potential in ply 3 of the Australasian seam (Figure 3), in the north of AUTH263. This ply thickens to over 2 m and has some coking properties which may be improved if washed. Further data for this seam is required to confirm this.

Coal quality

Coal quality for the prospective seams/plies in the Wollombi area are summarised in Table 1.

The quality of the Great Northern and Fassifern seams is similar to where these same seams are mined in the Newcastle Coalfield. The Whybrow seam is similar to where it is mined at Bulga Mine to the North.

For the major seams of the Wollombi area, coal quality results show, for washed coal an average yield of between 70 to 80 per cent delivers a product coal with ash of 14 to 15 per cent for a density separation of 1.60 g/cm^3. Further assessment of the washability of any resource areas is essential to support planning for any potential development.

Table 1 Coal analysis summary for boreholes within and surrounding Wollombi (AUTH 263).

seam (and ply)	Relative Density	Raw Moisture % (ad)	Raw Ash % (ad)	Raw Volatile Matter % (ad)	Raw CSN	Raw Calorific Value (MJ/kcal)	Total Sulfur	CF1.60 Yield	CF1.60 Ash	Number of Samples (Raw ash)
Great Northern (GTN)	1.44	2.9	18.53	25.69	0.8	24.93	0.37	91.3	14.6	14
Fassifern (FASS)	1.51	3.10	26.60	25.70	0.9	24.88	0.42	79.8	14.9	12
Hartley Hill (HTH3)	1.55	2.77	28.97	26.32	1.6		0.51			7
Australasian (AUS3)	1.59	2.46	33.21	26.23	1.7	22.69	0.45			9
Whybrow Lower (WB2)	1.57	3.01	32.14	27.07	2.8	26.16	0.55	72.5	14.1	13
Blakefield (BLK1)	1.51	2.37	26.50	29.68	4.2		0.36	67.2	11.5	6

Geological constraints

Faulting is inferred in the area, however, it has not been identified in the area based on borehole data, due to the wide spacing of the boreholes. The Broke lineament which runs north-west to south-east was interpreted in 1999 to be down thrown to the south-west (Figure 2). Because of limited data the displacement is unknown and thus was not included in the model.

Six boreholes in the AUTH 263 area intersected igneous intrusions. Two of these intersections affected the Whybrow Lower seam, but in areas where the seam is considered too deep for mining. All other intrusions did not affect seams of interest. However, the limited borehole data means other intrusions may be present but have not been intersected.

Potential development, products and market

Any potential extraction at Wollombi would be by underground methods only, due to depth of coal seams and the topography of the area.

The depth of the coal seams increases to the south. In the region near the Wollombi village itself, the coal seams are thought to be at depths exceeding 600 m. The coal seams occur at shallower depths in the northern part of AUTH 263.

The Great Northern and Fassifern seams are extensively mined by underground methods in the Newcastle coalfield. It is expected that this deposit will be somewhat similar to those operations. Underground mining would occur as a longwall operation, with areas of bord and pillar where seam conditions do not suit longwall mining. The Great Northern and Fassifern do not have enough interburden between them to allow for the mining of both seams.

The Whybrow Lower and Blakefield seams require further data to assess potential development options, but any potential extraction would be by underground methods only due to depth of the seam. The depth of these seams will likely affect the commercial viability of extraction, but the potential to produce a semi-soft metallurgical or PCI product may offset some of the commercial constraints to development.

Likely markets are low/medium ash thermal coal export products, and potential semi-soft metallurgical or PCI markets if the Whybrow Lower and Blakefield seams are included.

Run-of-mine coal from the Great Northern and Fassifern seams could be sold unwashed as a low to medium ash product or washed as a low ash product. Run-of-mine coal from the Whybrow Lower and Blakefield seam would require washing to meet export thermal or metallurgical coal markets.

Inventory Coal Estimation

Resource modelling of AUTH 263 Wollombi area includes 37 boreholes. Eight of these boreholes are within AUTH 263. Lithology and coal quality data was included where available.

The inventory coal estimation includes the whole Wollombi area, based on geological factors only, therefore surface features such as roads and rail have not been excluded.

There are large areas within AUTH 263 that have no drillhole data, and only limited drillholes provide useful data on all seams in the sequence. The geological and quality models extrapolate across areas with limited data, and there is a risk that further geological drilling will change these models and the respective resource assessments significantly. There is also little data on structural elements such as faulting and igneous intrusions that may adversely affect the resource.

While the amount of geological data is sufficient for estimating regional (inventory) coal quantities, the level of confidence in the estimate is low, and further drilling may significantly change the

model and the respective resource assessment significantly. A significant amount of additional exploration work, including drilling, would be required to increase confidence of the resource estimated in the area.

Coal resource estimates within this report refer to the '*Australian Guidelines for the Estimation and Classification of Coal Resources'* (JORC Code). The estimates are for 'Inventory Coal', a term that describes an estimate of the unconstrained coal tonnages in situ.

Inventory coal resources within AUTH 263 Wollombi area are estimated at 1,272 Mt, with a raw ash of 22 per cent (Table 2). The estimation uses the following constraints;

- Minimum thickness of 1.6 m
- Maximum 35 per cent raw ash
- Maximum depth of 800 m

The resource assessment is based on limited data and only on known geological factors. Further exploration will reduce the geological uncertainty of this resource assessment.

Table 2 Inventory estimation for Wollombi (AUTH 263).

seam Name	Depth (m)	Million Tonnes (Mt)	seam Thickness (m)	Relative Density (g/cc)	Raw Ash (%, ad)	Raw Moisture (%, ad)	Raw Volatile Matter (%, ad)	CF1.60 Yield (%, ad)	CF1.60 Ash (%, ad)
Great Northern seam	0 - 200	39	3.15	1.46	20.9	3.0	24.7	88.1	16.4
	200 - 400	170	3.64	1.45	19.6	3.0	24.8	87.7	15.6
	400 - 600	616	3.78	1.45	20.0	3.1	25.1	86.7	15.6
	600 - 800	86	4.88	1.45	20.1	3.1	24.3	85.4	15.9
TOTAL		***911***		***1.45***	***20.0***	***3.1***	***24.9***	***86.8***	***15.7***
Fassifern seam	0 - 200	22	2.22	1.50	25.2	2.9	26.2	80.4	15.2
	200 - 400	23	2.06	1.50	25.8	2.9	25.7	76.9	14.8
	400 - 600	20	1.85	1.50	25.9	2.8	25.6	75.8	14.5
	600 - 800	0							
TOTAL		***66***		***1.50***	***25.6***	***2.9***	***25.8***	***77.7***	***14.8***
Whybrow Lower seam	0 - 200	5	1.83	1.53	29.5	3.4	26.8	80.0	14.0
	200 - 400	23	1.81	1.53	28.3	2.8	24.7	80.0	14.0
	400 - 600	35	1.93	1.51	26.8	3.1	26.8	80.0	14.0
	600 - 800	232	2.04	1.51	27.3	3.0	26.7	80.0	14.0
TOTAL		***296***		***1.51***	***27.4***	***3.0***	***26.5***	***80.0***	***14.0***
Grand Total		**1,272**		**1.47**	**22.0**	**3.0**	**25.4**		

This estimate was constrained to a minimum 0.3 m ply thickness, 35 per cent raw ash and a maximum depth of 800m.

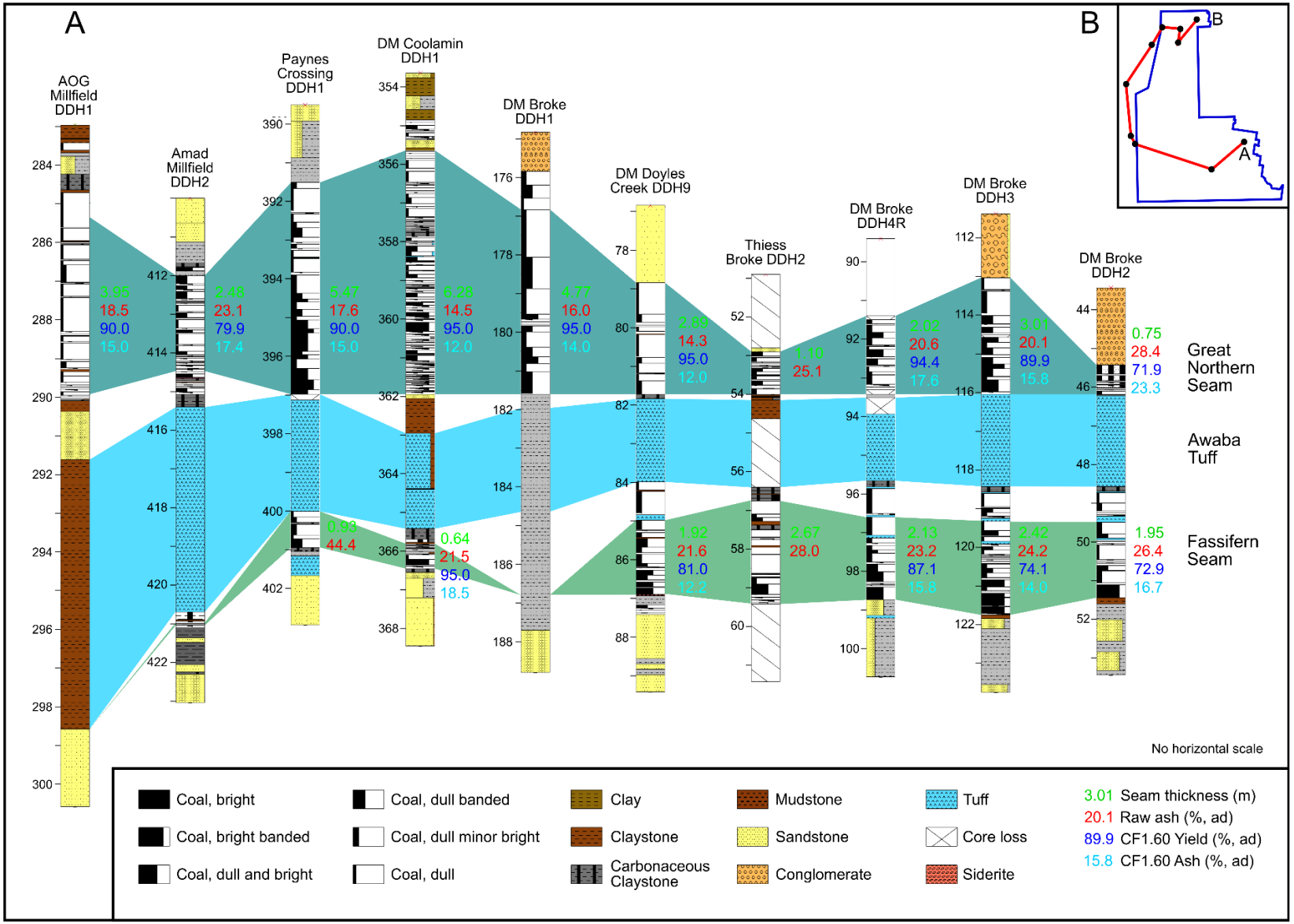

Figure 4 Seam correlation across Wollombi (AUTH 263) - Profile of Great Northern and Fassifern seams (no horizontal scale).

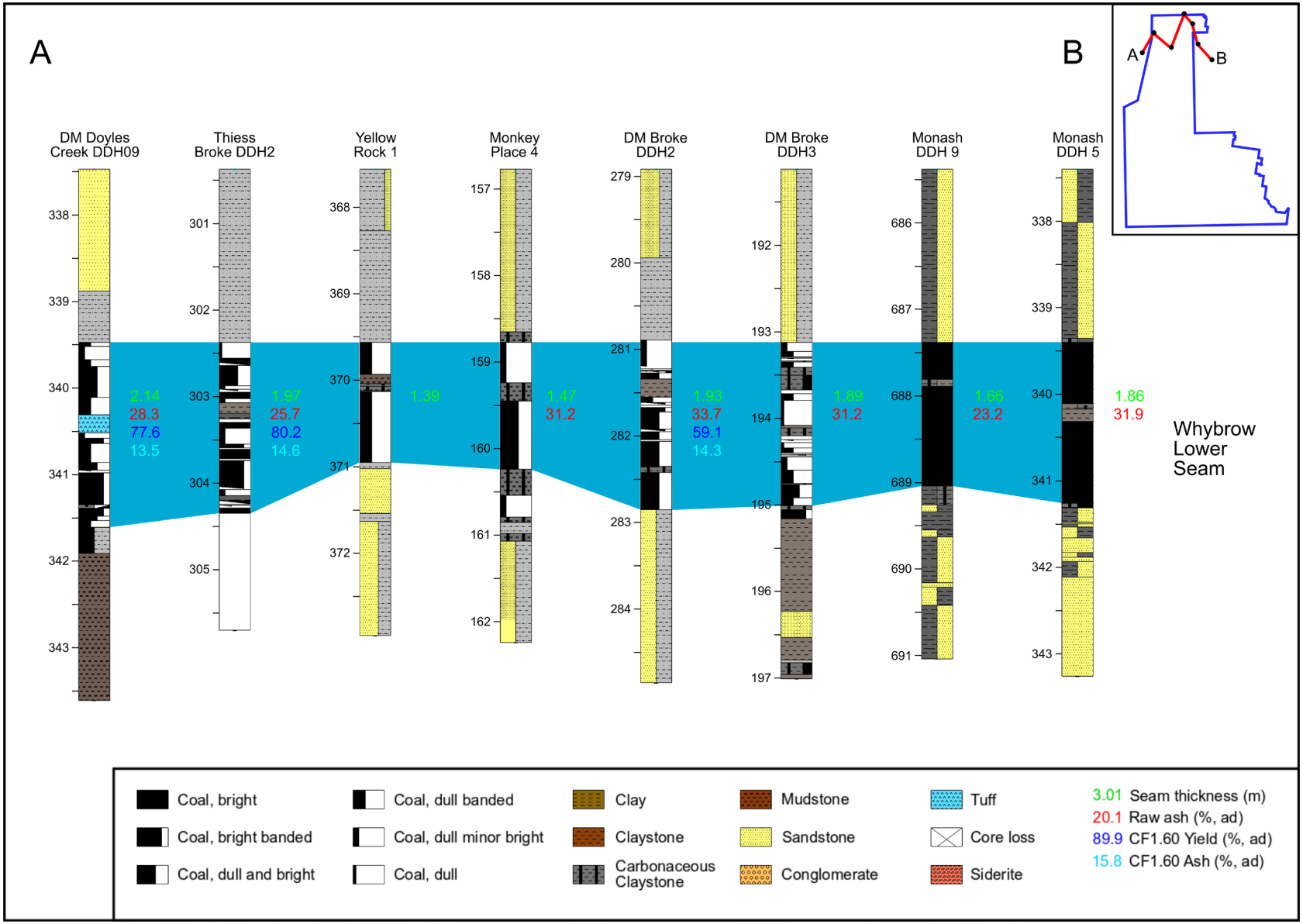

Figure 5 Seam correlation across Wollombi (AUTH 263) - Profile of Whybrow Lower seam (no horizontal scale).

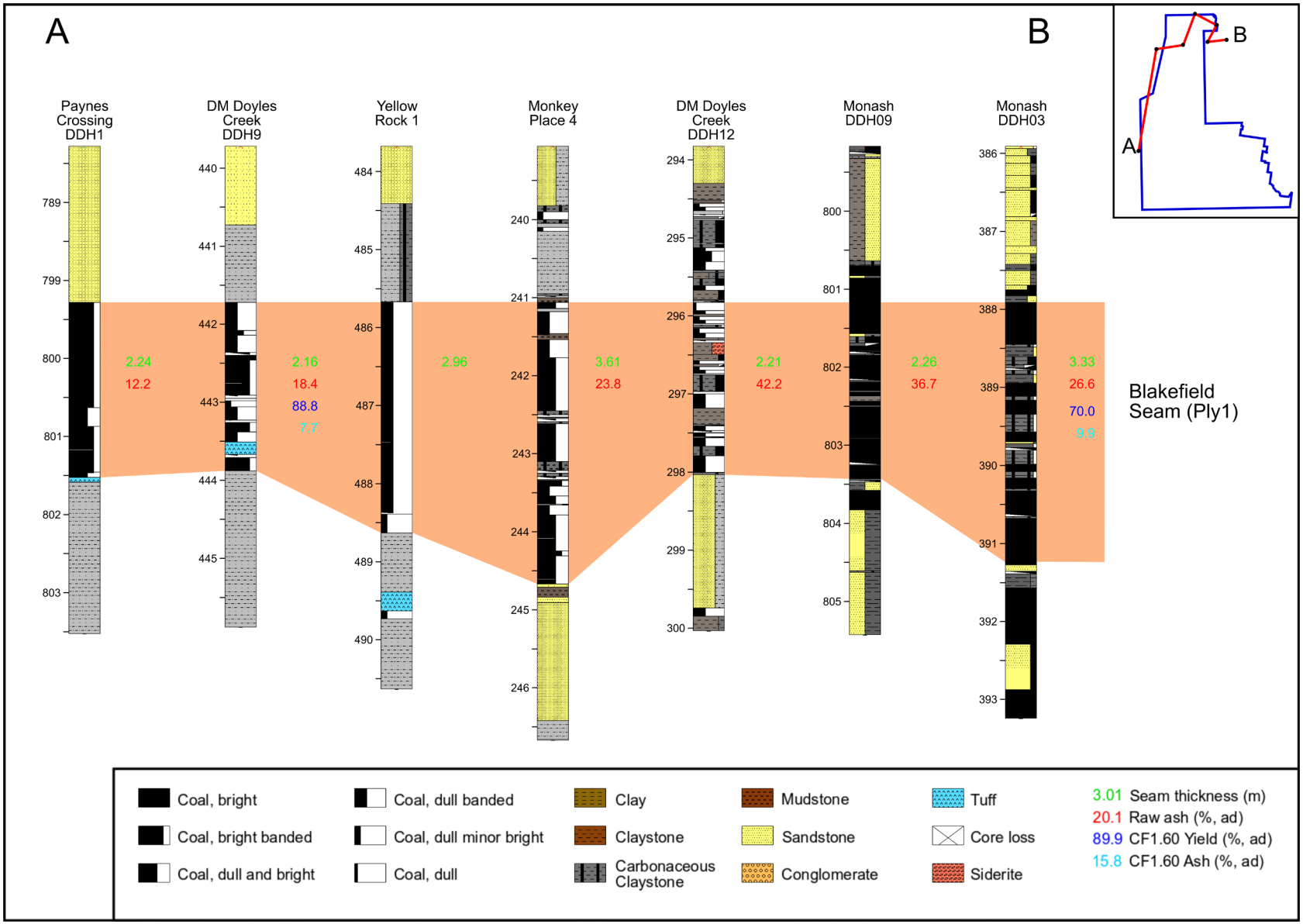

Figure 6 Seam correlation across Wollombi (AUTH 263) - Profile of Blakefield seam (no horizontal scale).

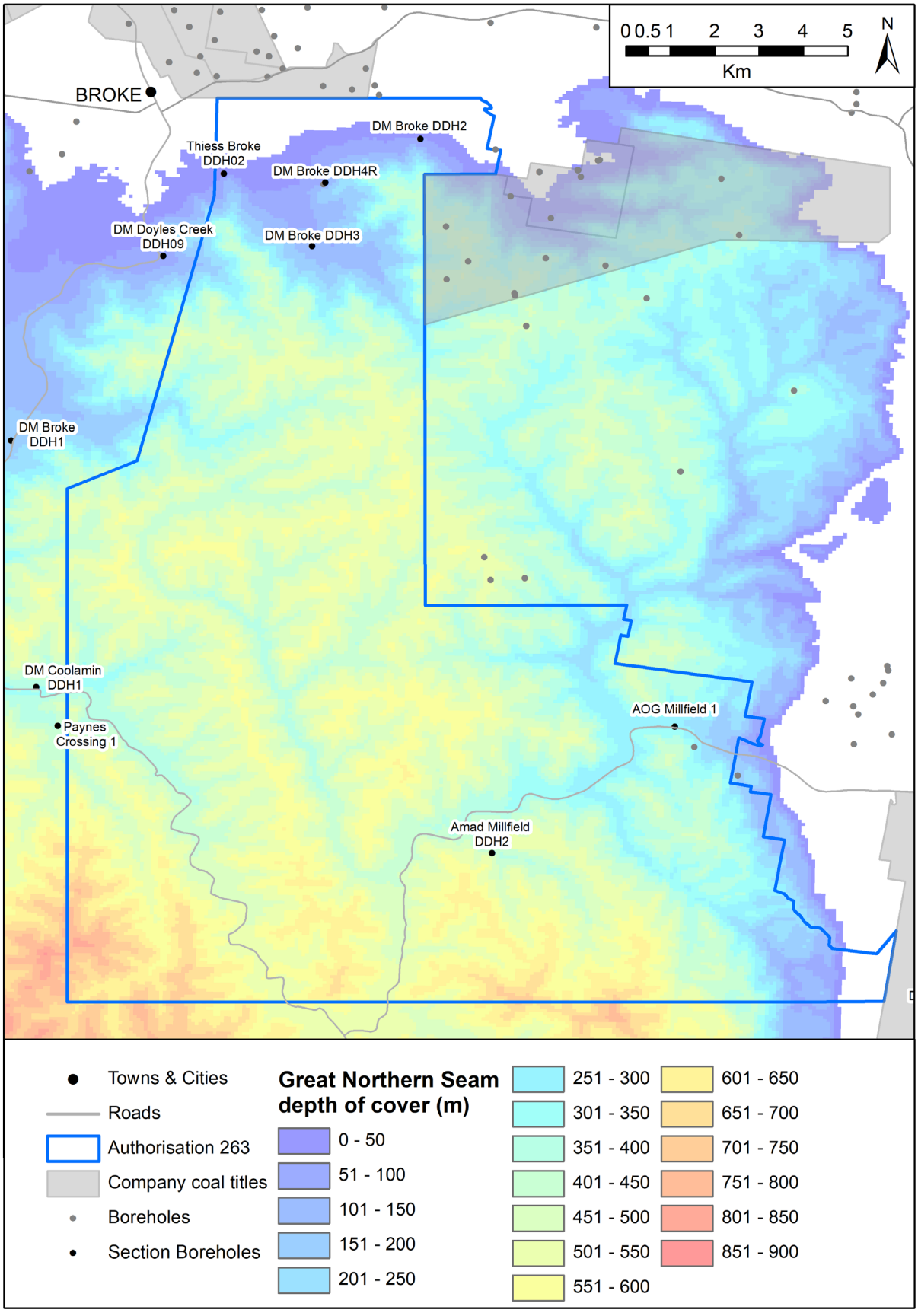

Figure 7 Great Northern seam depth of cover (metres).

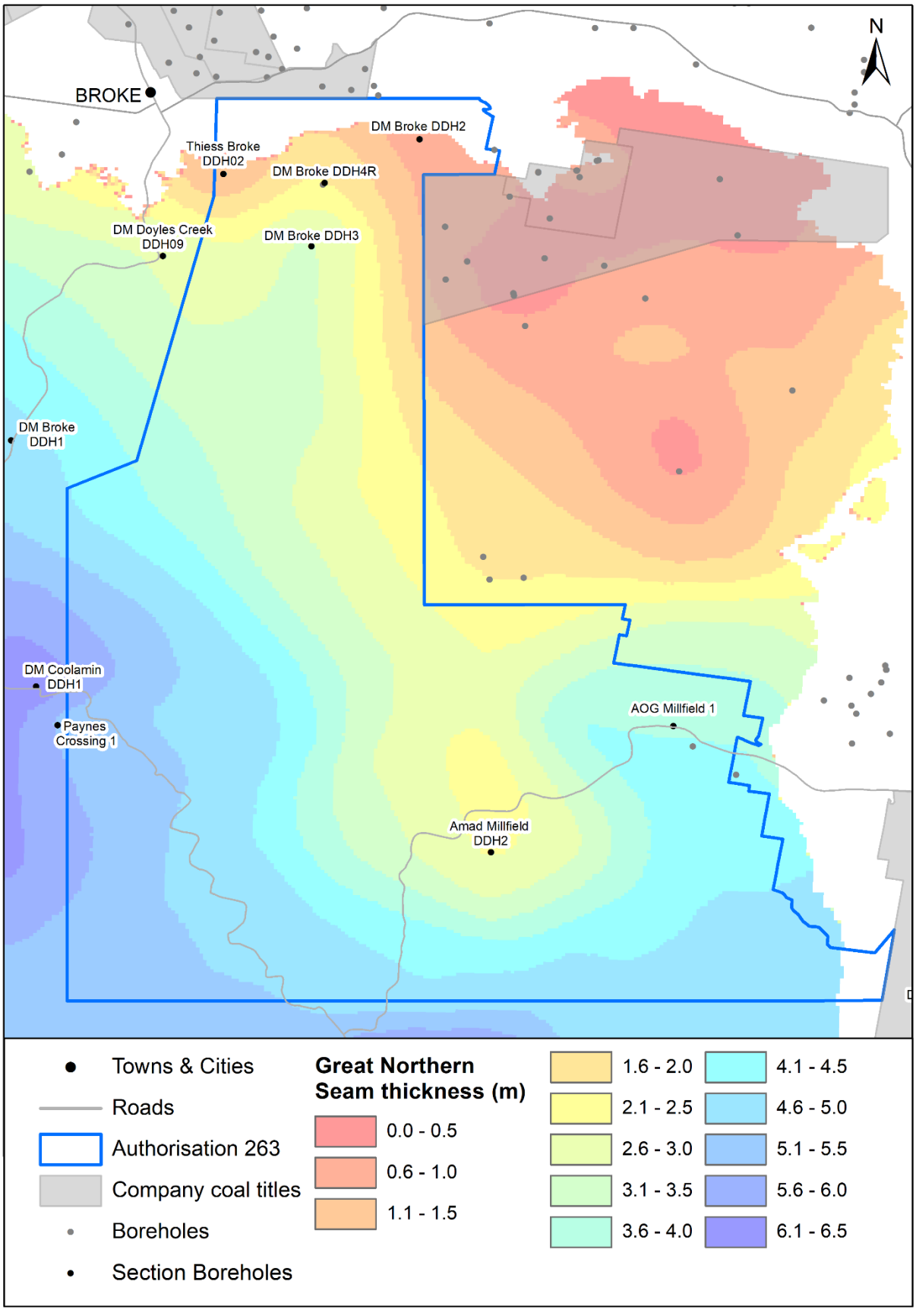

Figure 8 Great Northern seam thickness (metres).

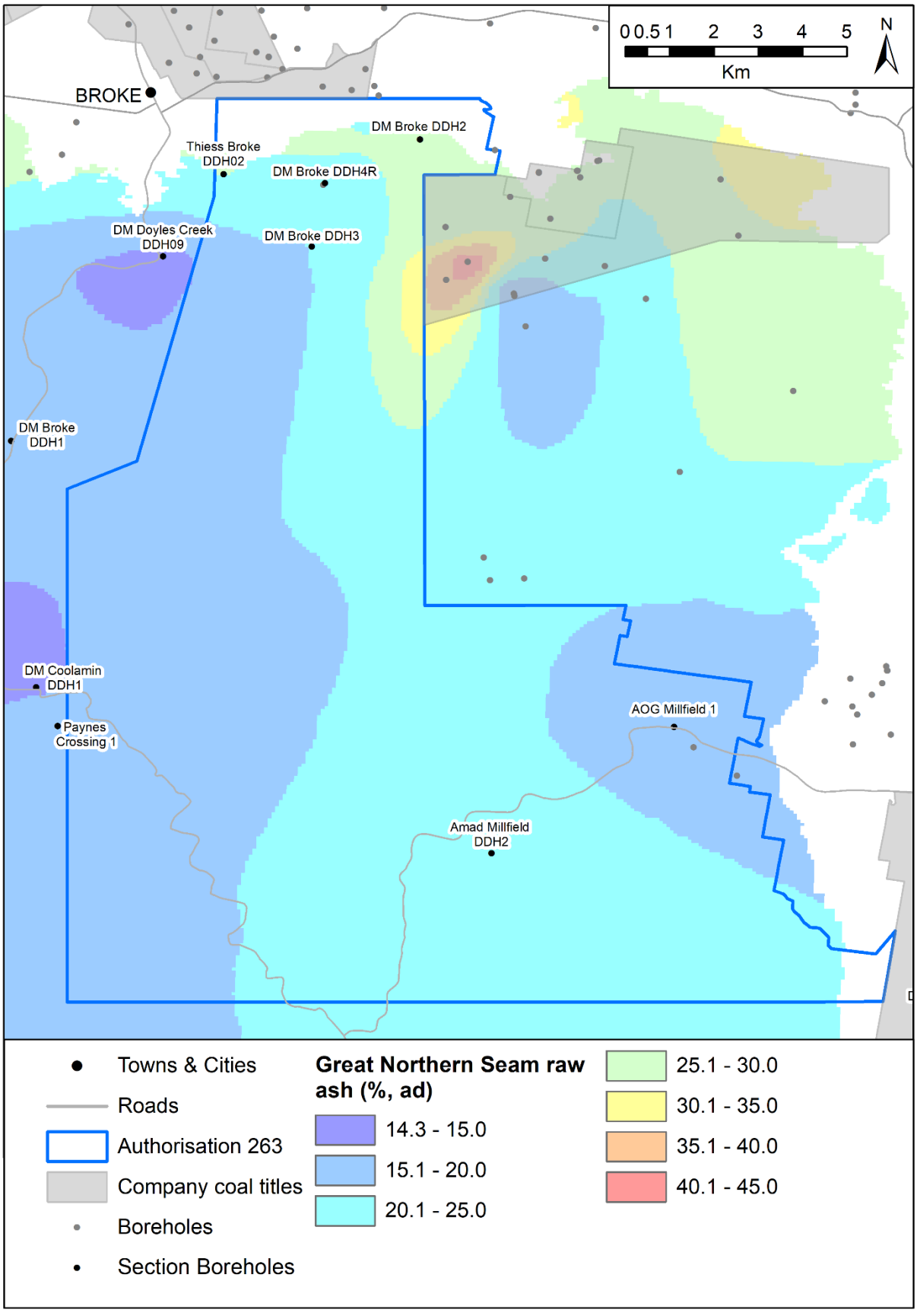

Figure 9 Great Northern seam raw ash (per cent, air dried basis).

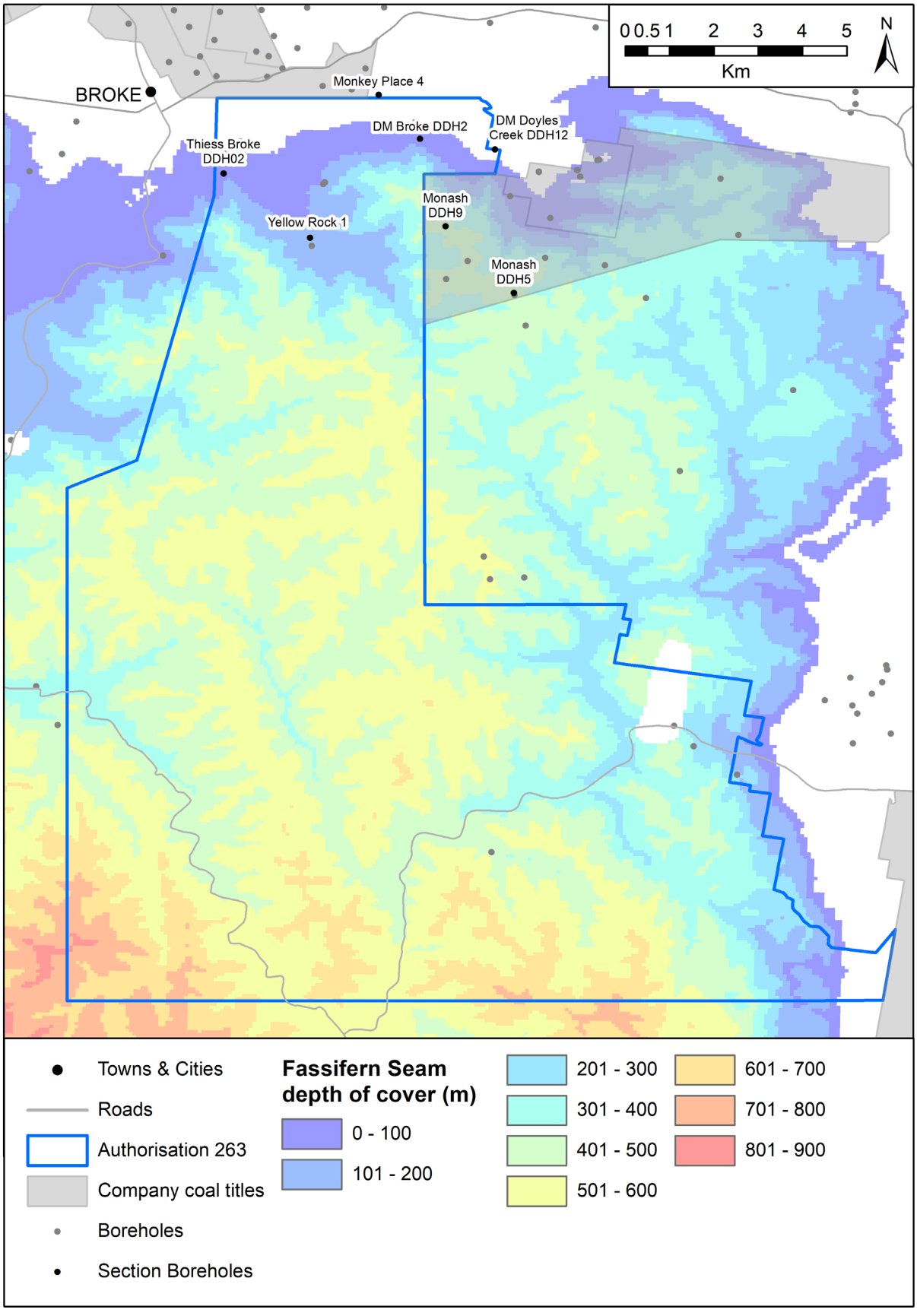

Figure 10 Fassifern seam depth of cover (metres).

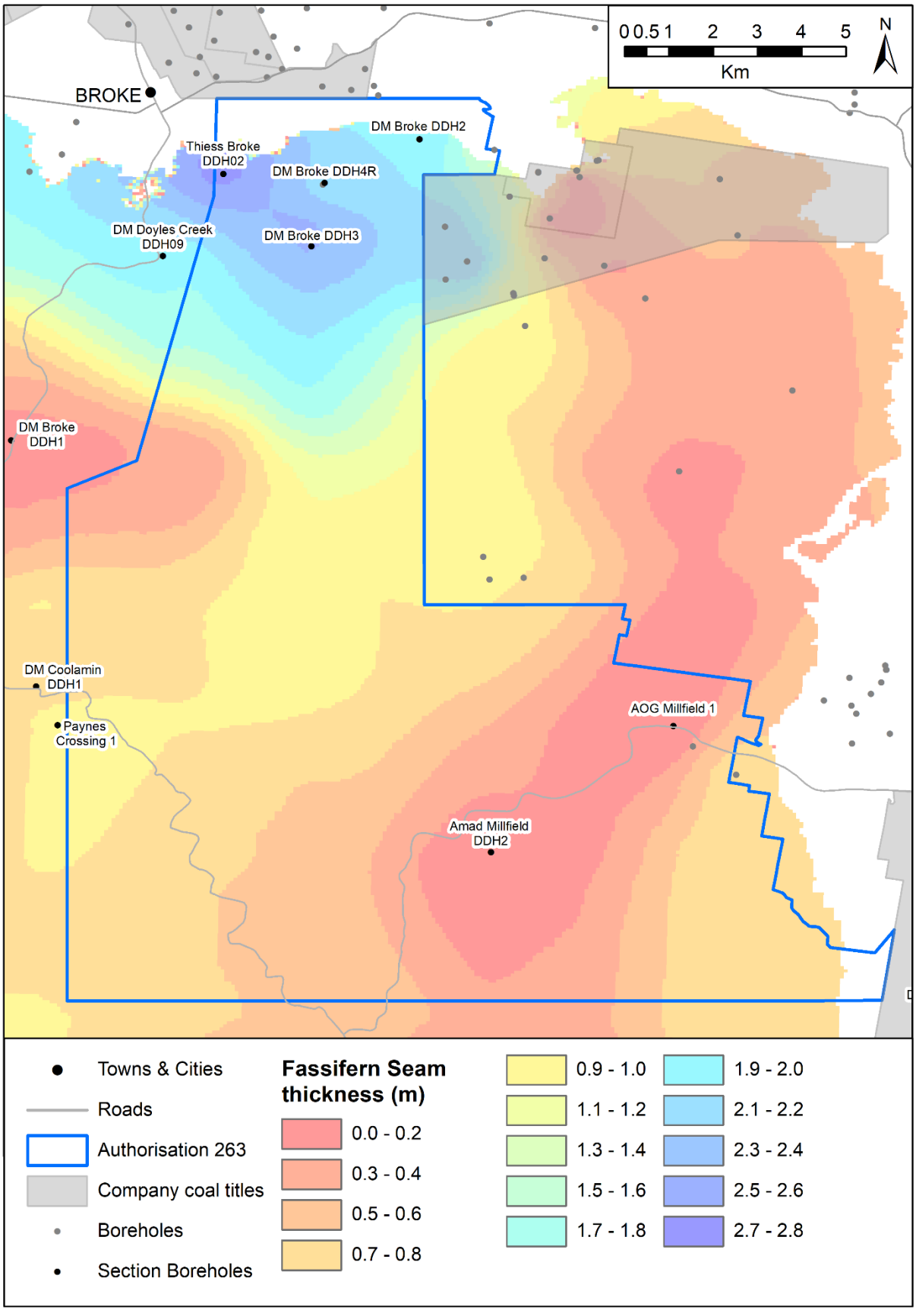

Figure 11 Fassifern seam thickness (metres).

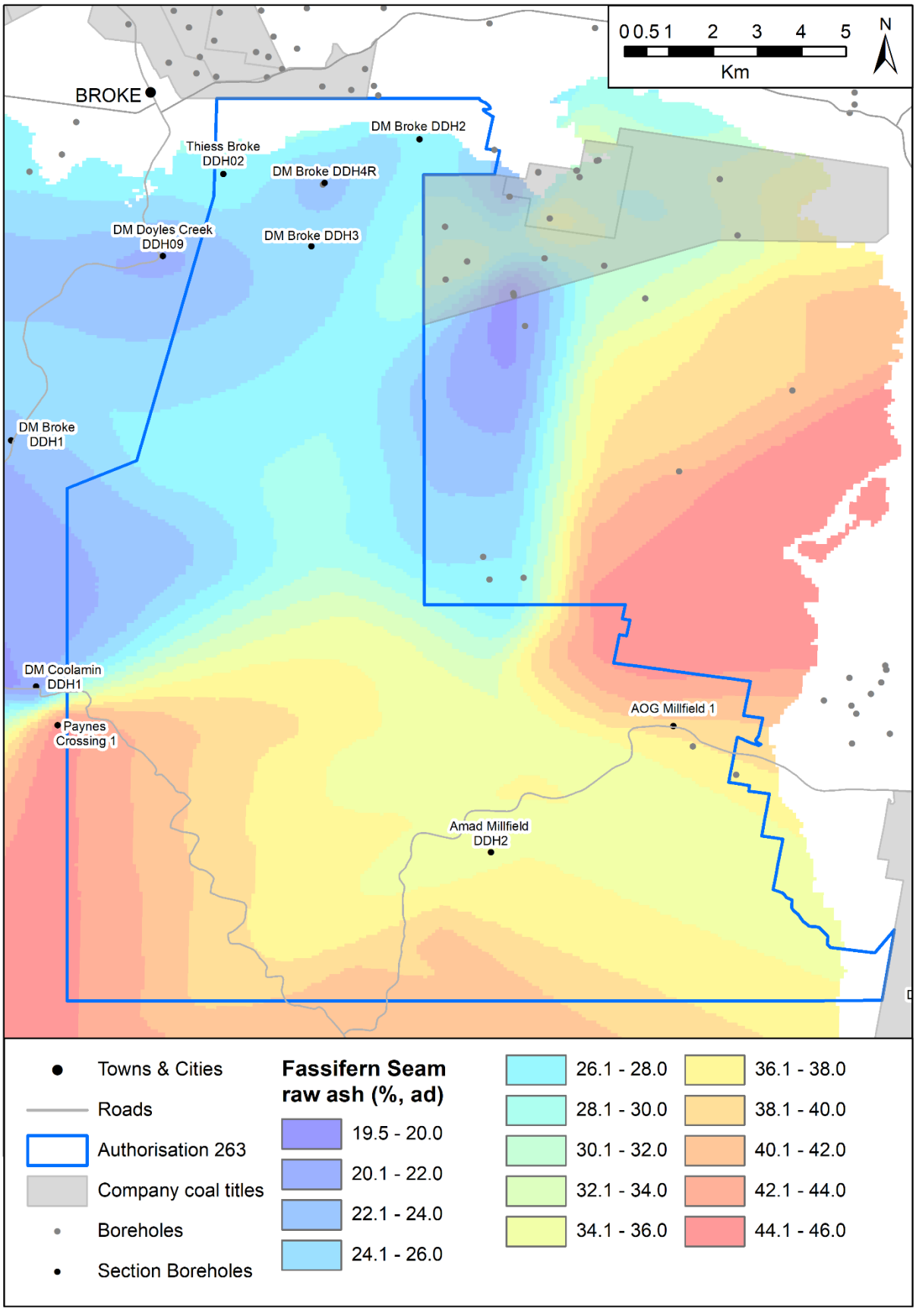

Figure 12 Fassifern seam raw ash (per cent, air dried basis).

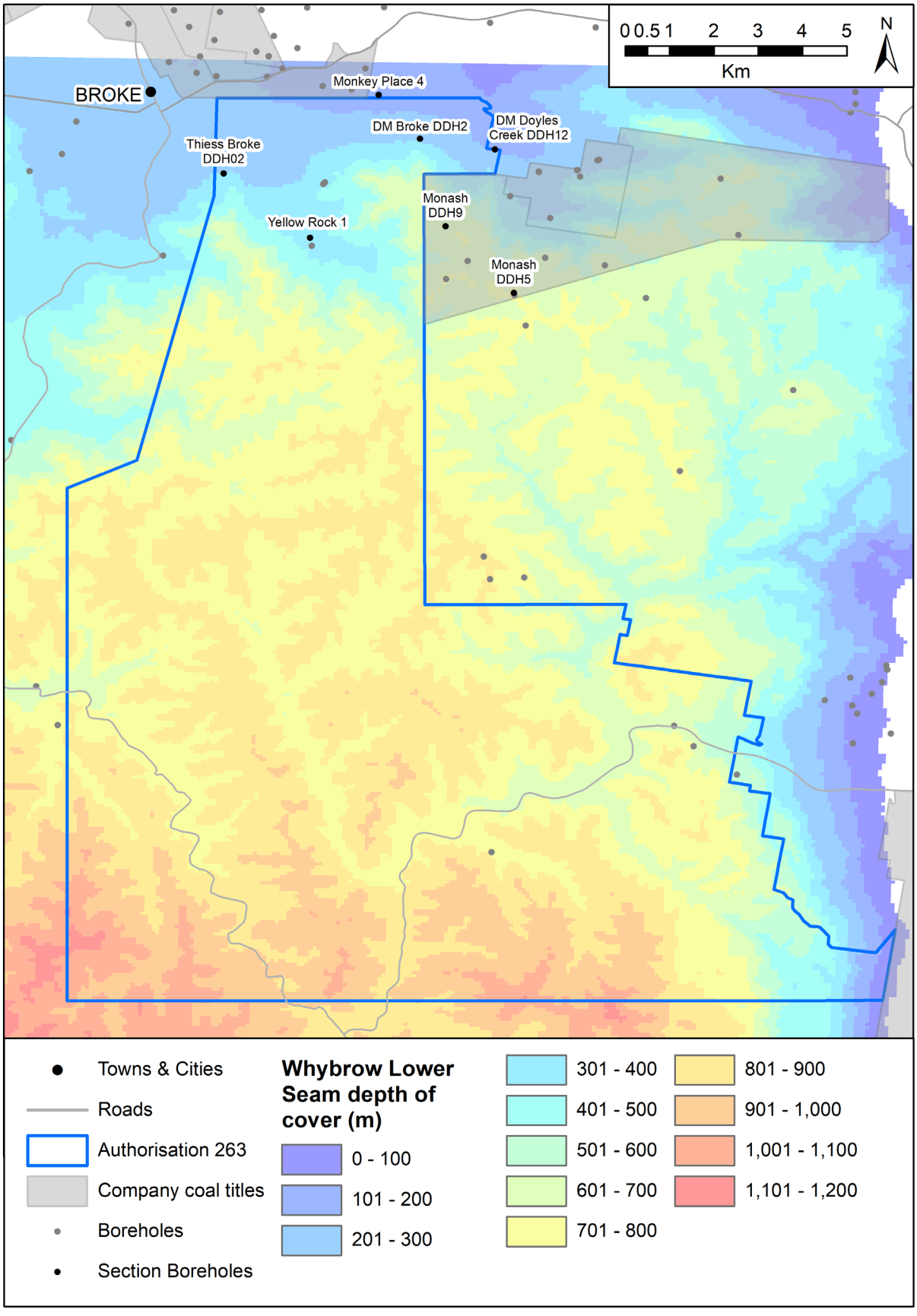

Figure 13 Whybrow Lower seam depth of cover (metres).

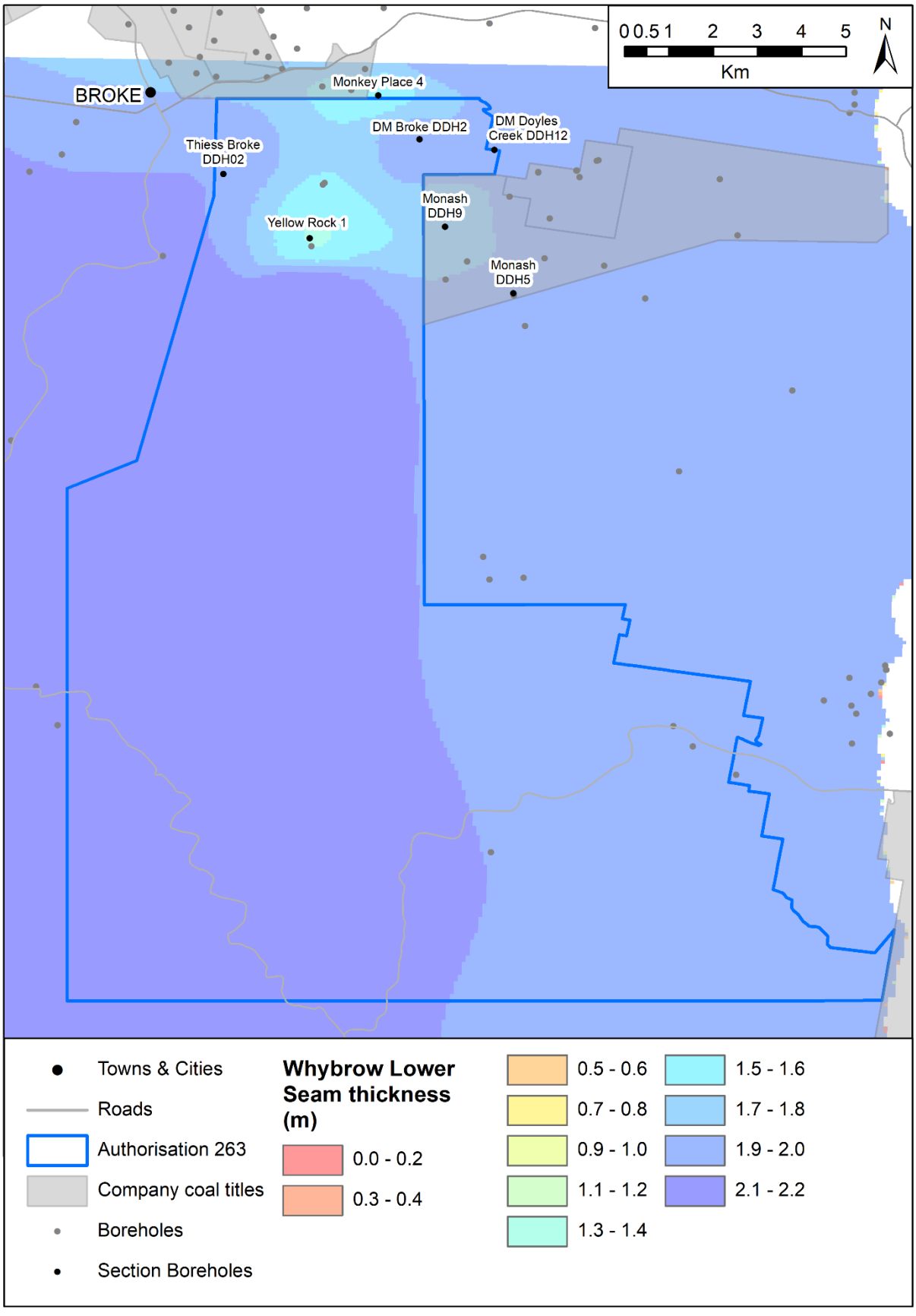

Figure 14 Whybrow Lower seam thickness (metres).

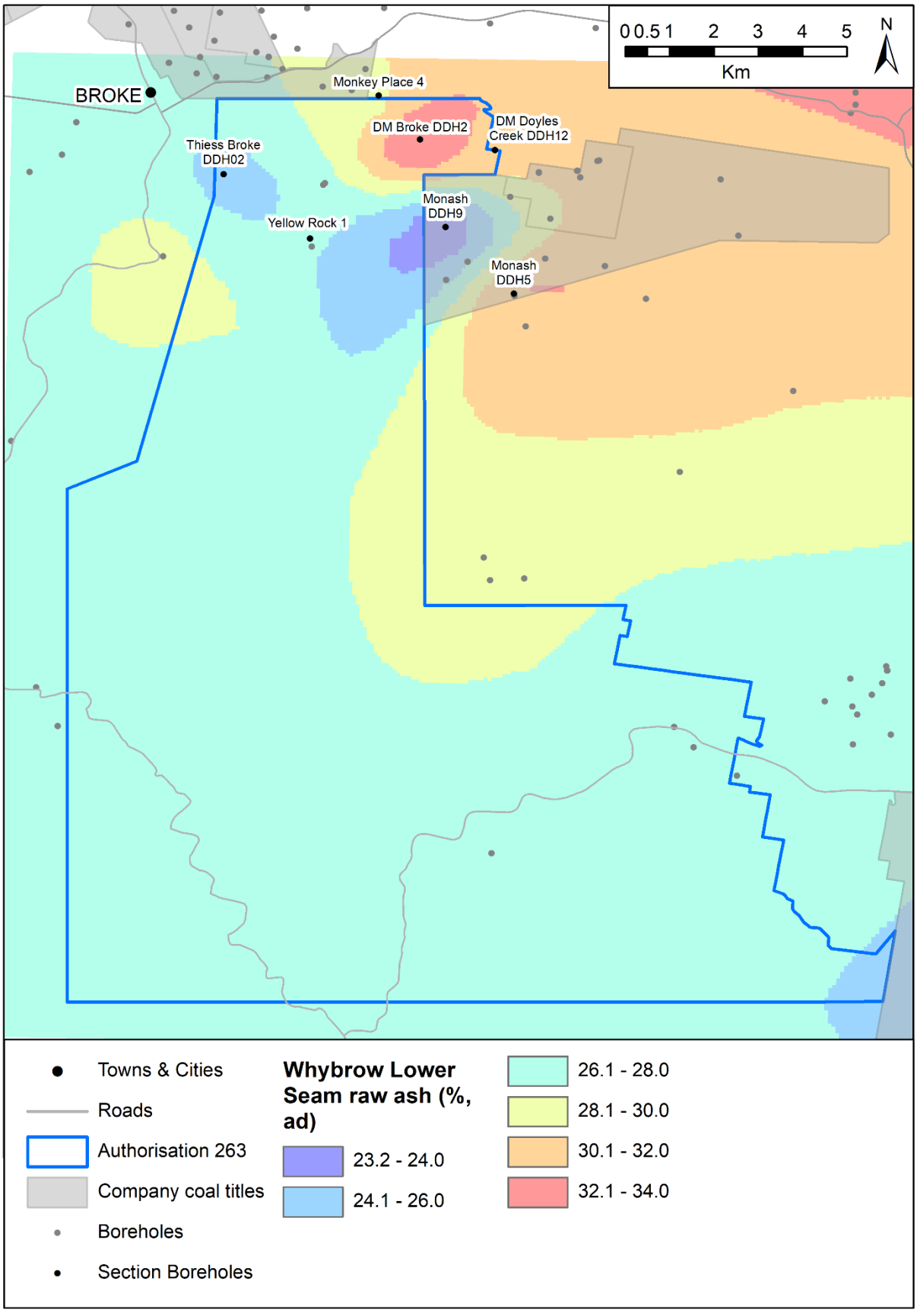

Figure 15 Whybrow Lower seam raw ash (per cent, air dried basis).

Commercial viability assessment

The Department of Regional NSW engaged an independent consultant to undertake a high level commercial viability assessment of AUTH 263 and this section summarises the results of that assessment.

AUTH 263 can be classified as an early-stage exploration project that is not underpinned by coal resources or reserves reported in accordance with the JORC Code. The estimates of project value are the results of conceptual mine design and financial modelling and are not reported in accordance with the *Australasian Code for Public Reporting of Technical Assessments and Valuations of Mineral Assets* (VALMIN Code 2015).

A discounted cash flow analysis (DCF) was used to generate a highly conceptual net present value (NPV). DCF analysis is not commonly used for an asset at this early stage of exploration and assessment, but it was used in this instance as the most appropriate measure of potential project value with consideration given to likely operating and capital cost structures, product quality and conceptual annual production rates.

The assessment concluded that AUTH 263 contains a coal resource with the potential to recover up to 240 (Mt)of product coal from the Great Northern seam, with a Net Present Value (NPV) of $79M in a base case scenario. The resource may support an underground longwall mining operation of approximately 8 (Mtpa) over 32 years.

The assessment is constrained by limited available geological data, and the commercial viability assessment has considered potential transport, infrastructure, tailings, gas drainage, and water supply options at a high level only. Financial analysis is highly sensitive to forecasts for the key revenue drivers of commodity prices and exchange rates, as well as operational costs. These are highly uncertain given the estimated project lead time of 15-20 years.

Conceptual mine planning

Conceptual mine planning was undertaken to inform financial and economic analysis.

Potential extraction areas were identified within the Great Northern seam only. The main constraints considered in the conceptual layout were coal seam depth, slope, and significant surface water features.

The conceptual layout incorporated the following cut-offs and assumptions:

- Great Northern seam only
- 600 m depth of cover to Great Northern seam
- Avoiding area of high seam slope (or potential faulting) on eastern side of AUTH 263
- 100 m standoff each side of three surface water features (Wollombi Brook, Sweetmans Creek, and central unnamed watercourse)
- 38 degree angle of draw from surface features
- Subsidence can occur in State Forests
- Boxcut and rail access from north

The conceptual layout proposes 9 longwall areas, of varying extraction height (2.4 – 5.4 m). Longwalls are proposed at 246 m width, and lengths between 600 m and 6 km (Figure 15).

Production was estimated at an average rate of 8 Mtpa, utilising two longwalls extracting up to 5 Mtpa, and development of approximately 0.5 Mtpa. Development is planned to commence in the northwest (longwall areas 1 to 3), progressing towards the south east (longwall area 4), and then the southwest (longwall areas 5 to 9) (Figure 16).

The geological model of the area is constrained by limited data, and some assumptions have been made. The seams are thought to dip gently to the south, at approximately 2 degrees. The coal

quality is assumed to be consistent throughout the project area, with no significant seam splitting. There are however, insufficient drillholes in the area to adequately define geological features such as faults and intrusions. Further exploration may identify additional faulting and inconsistencies in seam quality and continuity that would negatively impact on the resource.

Rail and infrastructure from the north was selected due to existing rail capacity servicing Bulga mine, and less issues with topography/access than the alternate potential location near Millfield. The conceptual rail transport corridor has been assumed to run along the western border of the Singleton Military Area, however, further assessment of the suitability of this route is needed. Alternate transport options could include road or overland conveyor to reduce start-up capital expenditure. Transport and infrastructure options require further assessment.

Gas drainage was estimated at 8.5 m^3/ tonne, based on limited gas desorption data (1 drillhole) and an understanding of the properties of Great Northern seam from where it is extracted in other locations. Further exploration may indicate higher gas content in the seam, and may result in higher gas drainage requirements and costs.

The Awaba Tuff, directly beneath the Great Northern seam, has the potential to cause issues with floor stability, and will require further assessment. This assessment considers extraction of the full height of the Great Northern seam, but it may be necessary to leave some coal in the floor to mitigate potential floor effects of the Awaba Tuff.

The Fassifern, Whybrow Lower and Blakefield seams were not considered in detail for the conceptual planning but may provide upsides to any potential extraction of the Great Northern seam. The seams contain considerable tonnages and are of adequate thickness for underground extraction.

The vertical separation between the Fassifern seam and the Great Northern seam is small, and therefore only the Great Northern would be mined over most of the area. However, parts of the Fassifern seam could potentially be extracted via bord and pillar in early years of production in the northern part of AUTH 263. The Awaba Tuff is in the roof of the Fassifern seam, and may cause issues with roof stability for any potential extraction of this seam, requiring further assessment.

The Whybrow Lower and Blakefield seams contain potential thermal and semi-soft metallurgical product, based on limited data, but are constrained by depth. In the southern part of AUTH 263 the seams are at depths exceeding 600 m, but the seams may be potentially extracted via bord and pillar in early years of production in the northern part of AUTH 263.

Coal quality and likely coal markets

The Great Northern coal is the only seam considered in this assessment. The coal is suitable for export thermal markets.

Coal quality data suggest either a 5500 kcal bypass product or 6000 kcal washed product can be achieved from this seam, at yields between 85-91 per cent. Conceptual planning suggests an initial bypass product during development, followed by a washed product (using the earlier workings for tailings storage).

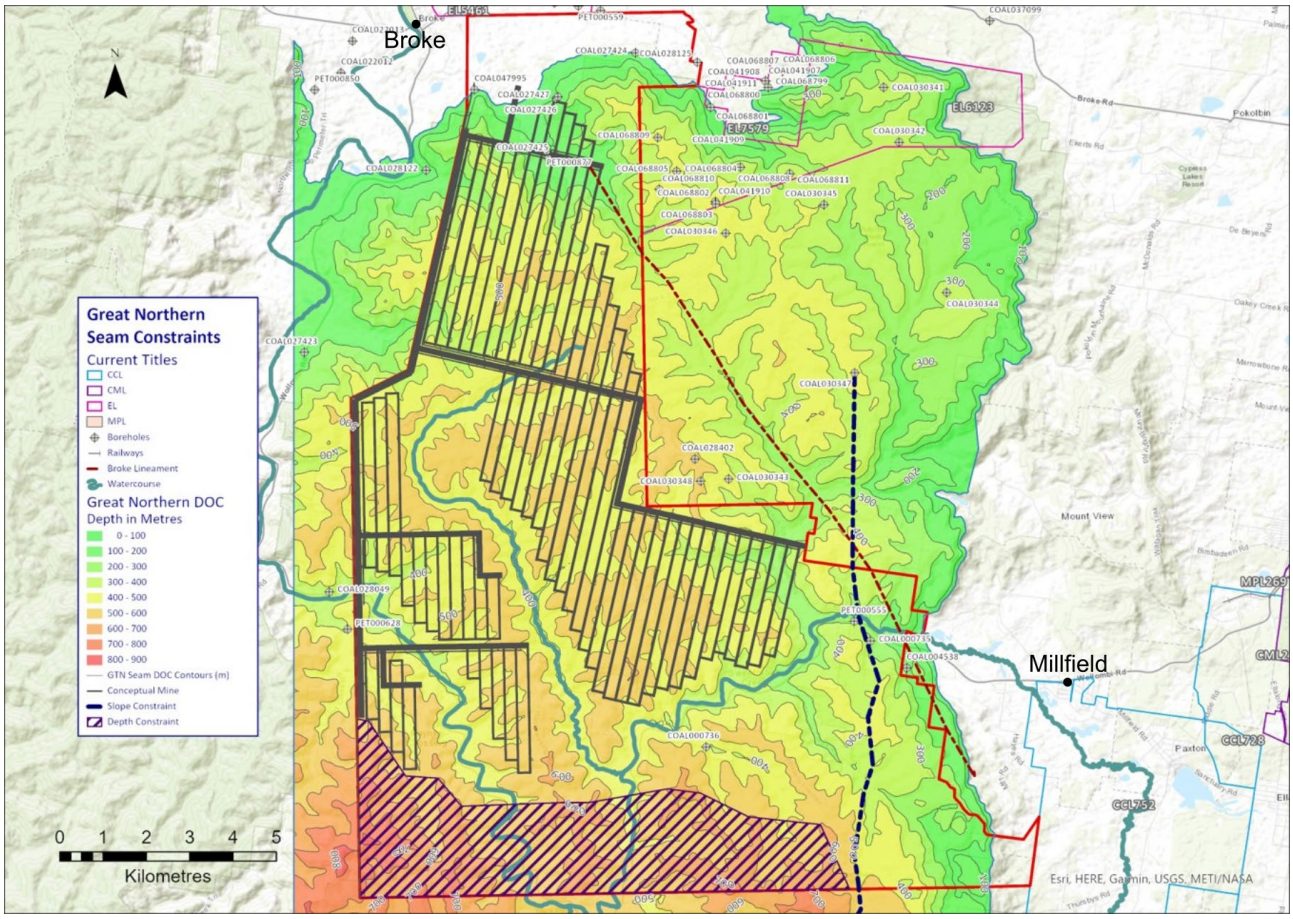

Figure 16 Conceptual layout of Wollombi (AUTH 263) showing seam depth, slope and creek constraints.

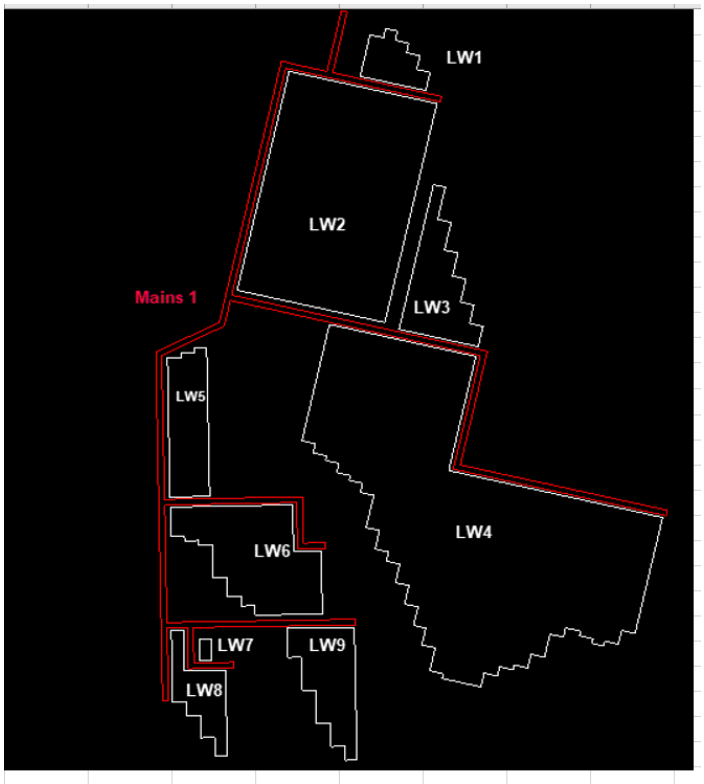

Figure 17 Conceptual layout of Wollombi (AUTH 263) by longwall area.

Financial and economic analysis

The assessment indicates that AUTH 263 contains coal resources that may support a commercially viable standalone mining operation under certain conditions.

There is potentially 240 Mt of recoverable product coal from the Great Northern seam, with potential additional bord and pillar recovery in early stages of mining from the Fassifern, Whybrow Lower and Blakefield seams. The Whybrow Lower and Blakefield seams have potential to produce a semi-soft metallurgical product.

The potential value of AUTH 263, based on a DCF analysis, is summarised in Table 3. Sensitivities to the NPV for five key parameters are also presented: coal price, exchange rate, mining cost (as a percentage variation of the annual operating cost), start-up capital and discount rate. Financial parameters used in the base case assessment are outlined in Table 4.

Table 3 Financial analysis for Wollombi (AUTH 263).

Sensitivities	Downside		Base Case	Upside	
Coal price (US$/tonne)	55	60	**68.5**	75	80
NPV ($ million)	**-968**	**-515**	**79**	**572**	**934**
Exchange rate (US$/A$1)	0.85	0.80	**0.77**	0.75	0.70
NPV ($ million)	**-351**	**-69**	**79**	**225**	**596**
Mining cost	120%	110%	**100%**	90%	80%
NPV ($ million)	**-498**	**-189**	**79**	**397**	**701**
Start-up capital	120%	110%	**100%**	90%	80%
NPV ($ million)	**-112**	**-16**	**79**	**174**	**270**
Discount rate	10%	9%	**8%**	7%	6%
NPV ($ million)	**-90**	**-12**	**79**	**186**	**313**

Table 4 Financial parameters, Base Case.

Financial summary	Unit	Amount
Mine life	Years	32
Coal mined (Run-of-mine (ROM))	Million tonnes	270
Coal product	Million tonnes	240
Revenue	AU$ / tonne	90.71

Financial summary	Unit	Amount
Revenue Sale price estimated at $68.50 USD / tonne for 6000 kcal product. Sale price adjusted based on annual reported product energy. Consensus Economics March 2021 long-term price forecast (Real) used. 0.77 AU / USD foreign exchange rate used. Consensus Economics March 2021 long-term forecast used at year 2027.	AU$M	21,733
Development costs (continuous miner)	AU$ / tonne	158.94
Longwall costs	AU$ / tonne	10.68
Mining costs	AU$ / ROM tonne	35.12
Overheads	AU$ / ROM tonne	8.34
Crushing costs	AU$ / ROM tonne	1.5
Processing	AU$ / ROM tonne	5.5
Rail costs	AU$ / Product tonne	4.4
Port costs	AU$ / Product tonne	3.5
Demurrage	AU$ / Product tonne	2.0
Selling	AU$ / Product tonne	1.78
Royalty 6.2% of revenue royalty rate, with $0.50 rebate for bypass, $3.50 rebate for processed coal. Levies not used.	AU$ / Product tonne	5.36
FOB costs	AU$ / Product tonne	72.03
Start-up capital • Equipment capital $430M (2 longwalls @ $170M each, 3 continuous miner systems @ $30M each) • Underground infrastructure $150M • CHPP $185M • On-site infrastructure $120M • Off-site infrastructure (rail) $91M • In-directs $200M (including contingencies)	AU$M	1,176
Total capital expenditure Sustaining capital 1%	AU$M	1,741

Financial summary	Unit	Amount
NPV Post tax basis with 30% tax applied, in real terms (un-escalated and base date of 2021)	AU$M	79
Discount rate (real, post tax)	%	8

Uncertainties

AUTH 263 contains a large potential resource of high quality thermal coal, in a mining region with skilled workforce, existing rail capacity, and mining service providers available. Some of the uncertainties identified would have a positive impact any development however most uncertainties will negatively impact on any development.

Many Hunter Valley open cut mining operations are reaching considerable depth and high cost, and extensions may involve potentially un-approvable voids. AUTH 263 may provide replacement capacity for existing mines that may be constrained within the next 15-20 years, providing continuity of thermal coal supply. Any potential development of AUTH 263 may also be able to leverage off existing infrastructure and use existing voids from nearby mines for tailings.

The initial financial analysis is based on limited preliminary data and conceptual extraction of the Great Northern seam only. There are potential additional resources within the Fassifern, Whybrow and Blakefield seams, with potential to produce a semi-soft metallurgical product. The extent of potential extraction of these seams is uncertain, but inclusion of these resources in further assessment may increase the value of the resource.

Uncertainties associated with potential development of the coal resources in AUTH 263 that may impact negatively include surface water and groundwater resources, infrastructure, land acquisition, water supply and transport corridors, unidentified geological complexity and gas drainage.

Potential mine infrastructure areas, that are accessible to the resource, are limited due to the nature of the terrain (Figure 1). The conceptual mine plan proposed in the commercial viability assessment has an infrastructure area to the north of AUTH 263, near Broke. This is also in proximity to the viticulture Critical Industry Cluster. An alternate potential mine infrastructure area is near Millfield, however as with the northern area this area in in close proximity to a town.

Access to coal transport corridors requires further assessment. The conceptual rail transport corridor has been assumed to run along the western border of the Singleton Military Area. Any corridor would require land access agreements or land purchases.

Adequate and appropriate water supply and tailings disposal need further assessment.

There are known geological features that negatively impact on the resource such as faulting and intrusions within AUTH 263, but due to lack of geological data the extent of these features and impacts is uncertain. Limited gas desorption data is available to estimate potential gas drainage requirements and possible greenhouse gas emission impacts. Further exploration would increase understanding of the geology of the area, and confirm seam quality, continuity, and gas content but, if more adverse geological features were found, the estimated recoverable resource of 240 Mt would be likely reduced.

Three creeks were considered in the conceptual mine plan as subsidence sensitive features. However, further restrictions on coal extraction, to limit ground subsidence, may be required to

avoid or reduce potential impacts on biodiversity and ecosystems, heritage, groundwater and surface water resources and cliff lines.

In addition to the uncertainties around key cost parameters, the commercial viability of the resource is dependent on timing of the resource development. Conceptual planning has estimated approximately 15-20 years lead time to development of this resource. Further exploration would reduce the geological uncertainties however, not those uncertainties relating to infrastructure, mine development and markets.

While there is potential that a standalone mine development may be economically viable, a low NPV of the base case scenario is likely to detract from its appeal as a new standalone development project.

Conclusions

Geological and resource modelling completed by the GSNSW estimates 1,272 Mt of in-situ inventory coal resources in AUTH 263. The coal is low to medium ash, and likely markets are a combination of low to moderate ash export thermal coal, and potential semi-soft export metallurgical coal.

A commercial viability assessment concluded that AUTH 263 contains a coal resource with the potential to recover up to 240 million tonnes of product coal from the Great Northern seam, with a Net Present Value (NPV) of $79M in a base case scenario. An NPV value of this amount is likely to detract from its appeal as a new standalone development.

The coal resource assessment is based on relatively limited data, and therefore the scope of the commercial viability assessment was such that potential transport, infrastructure, tailings, gas drainage, and water supply options were only considered generally, at a high level.

Financial analysis is highly sensitive to forecasts for the key revenue drivers of commodity prices and exchange rates, as well as operational costs. These are inherently uncertain given the estimated project lead time of 15-20 years. There are also uncertainties associated potentially developing the resource including areas to locate infrastructure, unidentified geological complexity and mining constraints.

The potential coal resource however, if proven and subsequently developed, would help provide continuity of high quality thermal coal supply from NSW commencing in 15-20 years time, to help replace the capacity of existing coal mines that may be at the end of mine life, by this time.

Reference

Xenith Consulting (2021) *Commercial Viability Assessment AUTH 263*, Report provided to Department of Regional NSW, Unpublished report