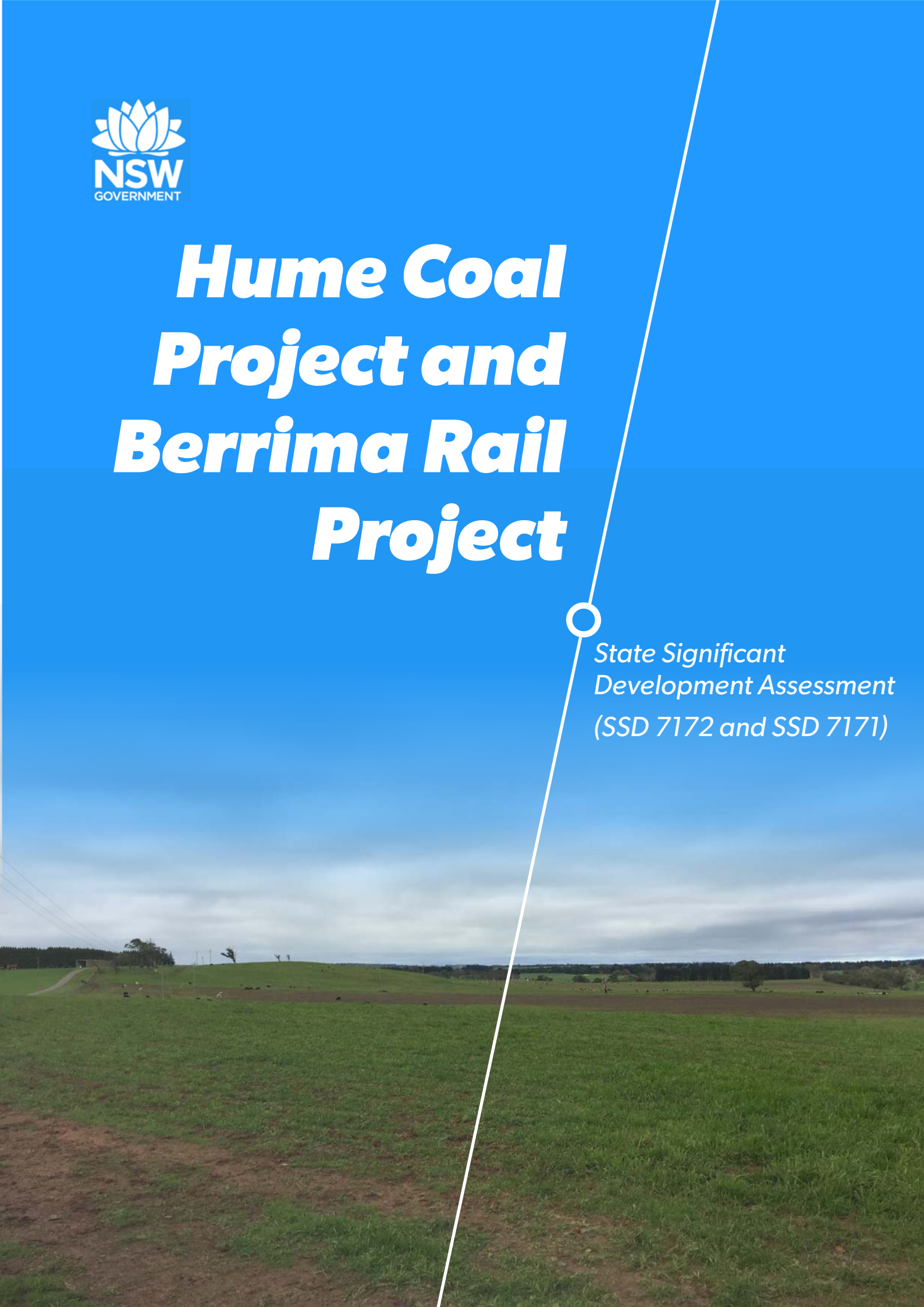
Hume Coal Project and Berrima Rail Project

State Significant Development Assessment (SSD 7172 and SSD 7171)



December 2018

Cover photo

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Executive Summary

Project

Hume Coal Pty Limited (the Applicant) is a subsidiary of the Pohang Iron and Steel Company (POSCO), which is a large steelmaking company with its headquarters in South Korea.

The Applicant is proposing to build a new underground coal mine in the Southern Highlands region of NSW (the Hume Coal Project) and associated rail infrastructure to support the mining operations (the Berrima Rail Project).

The Hume Coal Project is located approximately 100 kilometres (km) southwest of Sydney and 7 km northwest of Moss Vale in the Wingecarribee local government area. It would extract up to 3.5 million tonnes per annum (Mtpa) of coal (about 55% coking and 45% thermal coal).

There are two particularly unique aspects of the proposed mine. Firstly, it would use the 'pine feather' method of extraction, which has not previously been used in NSW or Australia. Secondly, it relies on the storage of 'produced' mine water in the completed mine workings.

The Berrima Rail Project is located adjacent to the Hume Coal Project and involves the development of a new rail spur and loop connected to the Berrima Branch Line. It would allow the transportation of coal from the mine by rail to the Port Kembla Coal Terminal for export or to domestic users.

While the Applicant submitted two separate development applications, the two projects form an integrated whole. The Department of Planning and Assessment (the Department) has assessed the two projects together and refers to them as 'the project' in this report.

Statutory Context

Both the Hume Coal Project and the Berrima Rail Project are classified as State Significant Development (SSD) under the *Environmental Planning and Assessment Act 1979* (the EP&A Act) and require the consent of the Minister for Planning.

However, under section 4.5(a) of the EP&A Act and clause 8A of the *State Environmental Planning Policy (State and Regional Development) 2011*, the Independent Planning Commission (the Commission) must determine the development applications as there were more than 25 submissions objecting to both projects.

On 4 December 2018, the Minister asked the Commission to hold a public hearing into the project, and provided the following terms of reference:

1. *Conduct a public hearing into the carrying out of the Hume Coal Project and associated Berrima Rail Project, and:*
   - *(a) consider the following information: the EIS for the projects, all submissions received on the projects, any relevant expert advice, and any other relevant information;*
   - *(b) assess the merits of the Hume Coal Project and Berrima Rail Project as a whole having regard to all relevant NSW Government policies, and paying particular attention to the:*
     - *impacts on surface water and groundwater resources, including on private bores;*
     - *social and economic impacts of the projects on the locality and region; and*
     - *suitability of the site; and*
   - *(c) prepare a report summarising the actions taken by the Commission in conducting the public hearing and outlining the Commission's findings on the projects, including any recommendations.*
2. *Hold the public hearing as soon as practicable after the Department of Planning and Environment provides its preliminary assessment report to the Commission.*
3. *Submit its report on the public hearing to the Department of Planning and Environment within 8 weeks of holding the public hearing, unless otherwise agreed with the Planning Secretary.*

Once the Department receives the Commission's report on the public hearing, it will finalise its assessment of the merits of the project having regard to any recommendations of the Commission, and refer the application back to the Commission for determination.

Engagement

The Department publicly exhibited the Environmental Impact Statement (EIS) from 30 March 2017 to 30 June 2017. Prior to exhibition, the Department received requests from the community to extend the statutory minimum exhibition period of 28 days. Given the EIS was over 10,000 pages, the Department decided to extend the exhibition period to 92 days.

The Department received a total of 12,666 submissions on the project, which comprised of 7,143 on the Hume Coal Project, 5,206 on the Berrima Rail Project, and 317 submissions on both projects. Over 5,000 submissions were received from the local area with 97% of these submissions objecting to the project.

To date, the Department has undertaken extensive consultation with community stakeholders, including two public information sessions during the exhibition period, a total of 5 site visits and over 10 meetings with key community groups. It has also met with the Applicant and key agencies on a regular basis.

Wingecarribee Shire Council objected to the project and noted that it has a policy against any coal mining in its local government area. Council raised particular concerns about the project's impacts on groundwater, surface water (within the catchment), agricultural land and tourism.

While none of the other government agencies objected to the project, many of them raised concerns about potential impacts. In particular, the Department of Industry – Water (DoI Water), the Environment Protection Authority (EPA) and WaterNSW raised concerns about impacts on groundwater and surface water. The Resources Regulator also noted that the mining method is untested and has concerns about mine worker safety.

Assessment

The assessment of this project has been complex due to the uniqueness of the proposal, the volume of documentation, and the complexity of the technical issues. Consequently, the Department has commissioned independent experts on the key assessment issues, including Emeritus Professor Jim Galvin (mining engineering), Professor Ismet Canbulat (mining engineering), Mr Hugh Middlemis (groundwater), Dr Renzo Tonin (noise) and Mr Andrew Tessler (economics).

In assessing the merits of the project, the Department has considered the submissions on the EIS, the likely environmental, social and economic impacts of the project, the suitability of the site, the relevant environmental planning instruments (EPIs), and the public interest, in accordance with the requirements of the EP&A Act.

Groundwater

The project is predicted to have significant impacts on a highly productive groundwater aquifer (as classified under the NSW *Aquifer Interference Policy*), including drawdown impacts on up to 118 privately owned bores. Both the Department and DoI Water consider that the predicted drawdown impacts on this aquifer would be the most significant for any mining project that has ever been assessed in NSW.

The significant groundwater drawdown impacts are largely due to a range of project-specific factors, which means there are limited opportunities to further minimise impacts. These factors include:

- the presence of high-quality groundwater aquifers that can produce high yields;
- a comparatively high density of properties with a large number of groundwater bores; and
- the shallow depth of the coal seam and its proximity to the key groundwater aquifer.

The Applicant has proposed a strategy to 'make good' on the predicted drawdown impacts. While the proposed make good measures (e.g. deepening pumps or replacing bores) may be feasible from a strictly technical standpoint, the NSW *Aquifer Interference Policy* expressly contemplates the possible scenario where there are "*no suitable or practical mitigation or prevention options*", and the Department considers this project represents such a case.

Given the significant opposition to the project in the local area, the proposed make good process would inevitably result in a large number of negotiations and disputes with local landowners, unavoidable delays to the development of the project, and significant disruption to the community.

Mine Design

The mine design issues for this project are extremely complex. There is a substantial degree of residual uncertainty about the mine design and, in particular, the methodology underpinning the geotechnical model. In that context, the Department has adopted a precautionary approach to its assessment.

The unconventional pine feather mining method was largely selected to minimise subsidence levels and associated impacts to surface features. However, the combination of an untested mining method and an unconventional method of storing large quantities of mine water underground is likely to result in serious operational safety risks. These risks are exacerbated by uncertainties about the local geology and the level of risk assessment undertaken to date.

The Department considers that the various safety risks may lead to the transfer of additional mine water to the surface and a need to discharge into watercourses. The Applicant has not assessed this issue or proposed a water treatment plant.

The Department, the EPA and WaterNSW consider that any discharge of mine water (whether treated or untreated) may result in significant impacts on surface water.

Further, there is a risk that the operational safety issues associated with the unconventional mine design may result in an unexpected sterilisation of coal, which may significantly reduce the economic benefits of the project.

Economic

While there are differences in opinion and various residual uncertainties about the scale of the project's economic benefits, the Department considers that the project is likely to have some economic benefits for the state of NSW.

However, the Department notes that there are fundamental difficulties in efficiently recovering the coal resource for this project, particularly due to the shallow depth of the coal and the risk of environmental impacts.

Importantly, even the Applicant's estimated net economic benefits of $373 million is relatively low in comparison to many other coal mining projects in the Southern Coalfield and across NSW.

Other Impacts

The Department has also undertaken a comprehensive assessment of the full range of other potential impacts, including economics, noise, vibration, air quality, greenhouse gas emissions, traffic, biodiversity, heritage, agriculture and rehabilitation.

The Department considers that the majority of these potential impacts would be similar to, or less than, other approved underground mining projects. The Department accepts that these potential impacts are likely to be able to be managed, mitigated or offset to achieve an acceptable level of environmental performance, subject to the provision of additional information or via suitable conditions of consent.

Evaluation

The Department acknowledges that the Applicant has taken a number of important steps in designing the project to avoid and/or mitigate potential impacts of the project on the environment and the community, including:

- locating the proposed mine's surface infrastructure away from most sensitive receivers, adjacent to a major highway and on largely cleared land with limited native vegetation;
- selecting an unconventional mining method in an attempt to limit subsidence-related impacts on sensitive features at the surface, particularly in comparison to the longwall mining that is used in other parts of the Southern Coalfield; and
- selecting an unconventional method of mine water management that would use the storage capacity of the mine workings in an attempt to reduce groundwater inflows and prevent surface water discharges.

However, the targeted coal resource is located in a shallow seam that is inherently difficult to extract without causing adverse environmental impacts and disturbing existing land uses. The project is also located within the upper reaches of Sydney's drinking water catchment.

In addition, while coal mining plays a part in the Southern Highlands region's history and heritage, the region is now more widely known for its rural land uses, small-scale agriculture, scenic landscapes and tourism. The area surrounding the proposed coal mine features relatively dense, small-scale agricultural lots with most properties holding registered bores in order to gain access to productive groundwater aquifers.

These unique characteristics have led to an unconventional mine design that presents a range of uncertainties and safety risks, as well as the likelihood of significant impacts on water resources. Consequently, the Department is concerned that the project site is not suitable for the development of a new coal mine.

In addition, the Department is concerned that the project does not conform with the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*, which is the key planning policy that regulates mining in NSW and requires consideration of whether the project is compatible with other land uses.

While the project is likely to have some level of economic benefits for the state of NSW, the scale of these benefits needs to carefully weighed up against the potential impacts of the project on the environment and the community.

The Department considers that the economic benefits cannot be realised without significant adverse impacts on the environment and the local community, particularly in relation to groundwater impacts. At this stage, the Department does not consider that the economic benefits outweigh the likely adverse impacts on the environment and community.

Further, the Department considers that there is a threat of serious harm to both groundwater and surface water resources, and there is currently considerable scientific uncertainty about the level of environmental damage to both. As a result, the 'precautionary principle' is triggered and the project as currently proposed should not be considered an 'ecologically sustainable development'.

Consequently, based on the information currently available, the Department considers that the project is not in the public interest and should not be approved.

Contents

1. Introduction

Hume Coal Pty Limited (the Applicant) is a subsidiary of the Pohang Iron and Steel Company (POSCO), which is a large steelmaking company with its headquarters in South Korea. POSCO is looking to secure coal supplies for its existing operations over the next 20 years, including coking and thermal coal.

The Applicant is proposing two separate but related projects in the Southern Highlands region, including a new underground coal mine (the Hume Coal Project) and associated rail infrastructure to support the mining operations (the Berrima Rail Project).

The Hume Coal Project is located approximately 100 kilometres (km) southwest of Sydney and 7 km northwest of Moss Vale in the Wingecarribee local government area (see **Figure 1**).

The Berrima Rail Project is located adjacent to the Hume Coal Project and involves the transportation of coal from the mine by rail to the Port Kembla Coal Terminal for export or to domestic users.

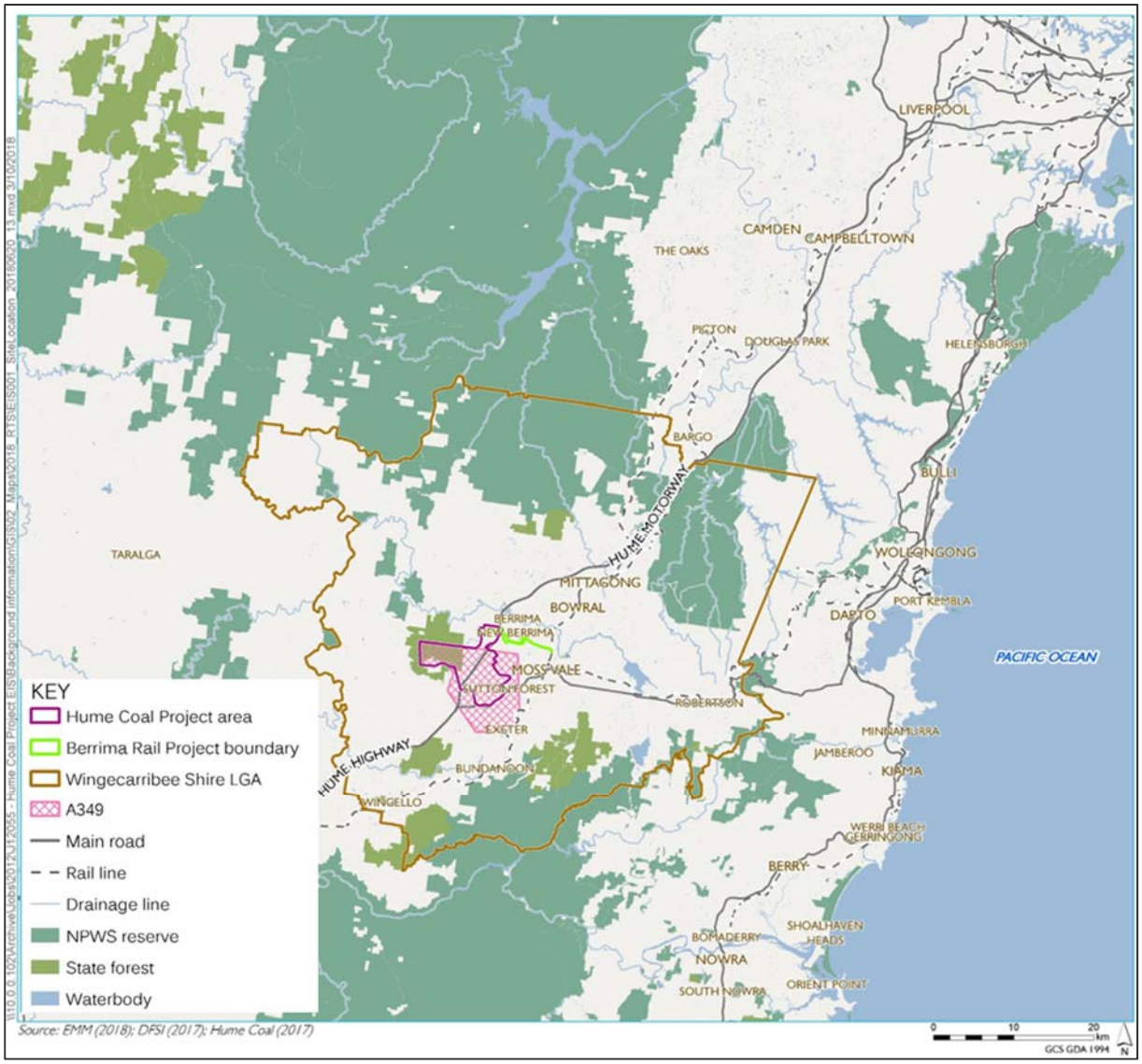

Figure 1 | Regional context

2. Project

In 2017, the Applicant submitted two separate development applications for the Hume Coal Project (SSD 7172) and associated Berrima Rail Project (SSD 7171).

The Hume Coal Project involves the development of a new underground coal mine and associated surface facilities. The mine would use the 'pine feather' mining method to extract up to 3.5 million tonnes per annum (Mtpa) of product coal (about 55% coking and 45% thermal coal).

The Berrima Rail Project provides the supporting rail infrastructure for the Hume Coal Project and involves the development of a new rail spur and loop connected to the Berrima Branch Line. From Berrima, coal would be transported to Port Kembla for export or to domestic users.

The two projects are located adjacent to each other and are inextricably linked. The reason there is a separate application for the Berrima Rail Project is that the rail line is owned and operated by Boral.

As the two separate development applications are linked, the Department has assessed the two projects together and refers to them as 'the project' in this report.

The key components of the project are summarised in **Table 1** and depicted in **Figures 2, 3, 4** and **5**. The project is described in full in the Environmental Impact Statement (see **Appendix A**).

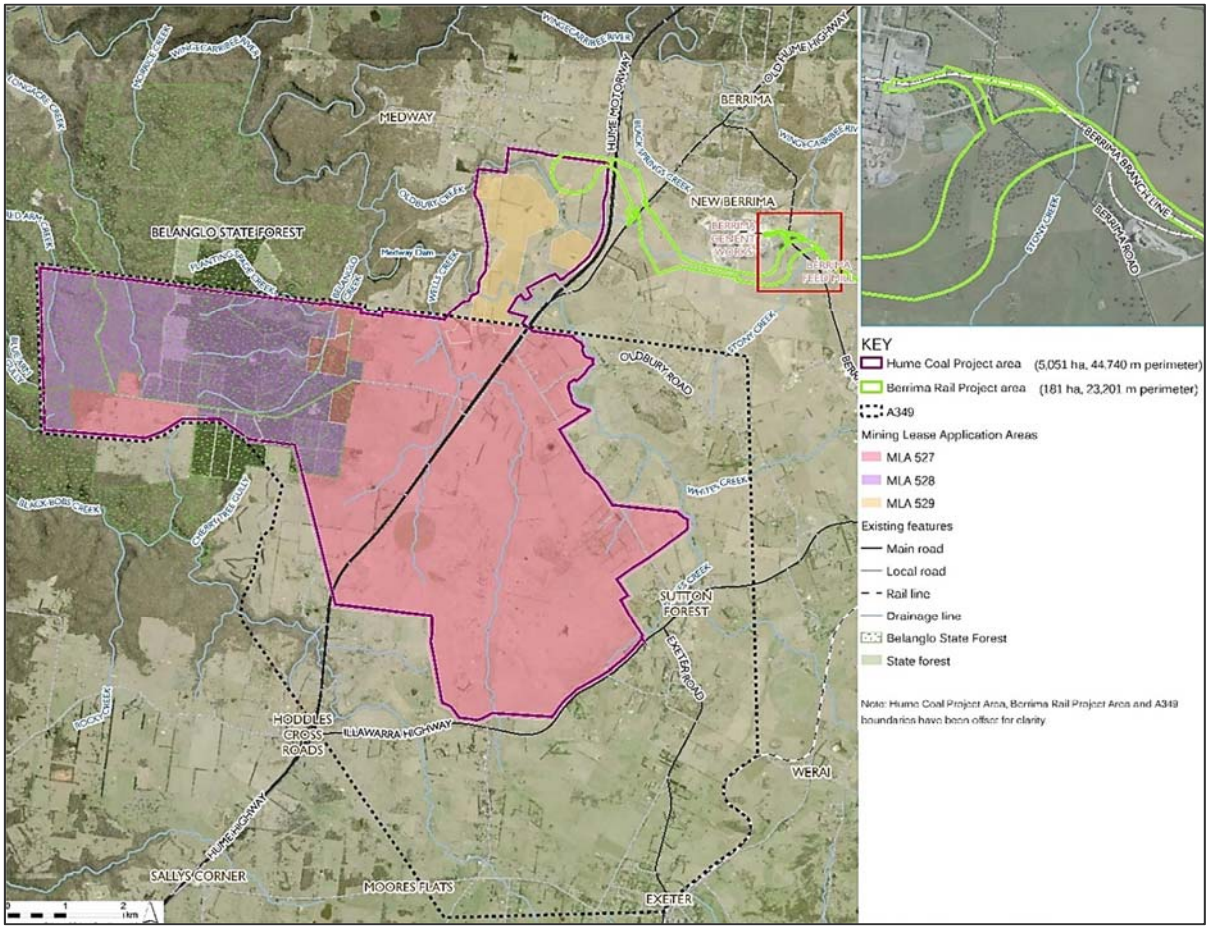

Figure 2 | Project layout

Table 1 | Main components of the project

Aspect	Description
Project Life	23 years, including 28 months of construction, 19 years of mining, and 2 years of rehabilitation with some overlap between the construction and operational phases.
Mining Project Area	Approximately 5,051 ha within the Wingecarribee local government area, comprising 5,039 ha of freehold land and 12 ha of the Crown Land.
Mining Method	Underground mining operation using the pine feather technique (see **section 6.3** of this report).
Key Infrastructure	Surface infrastructure area would include the coal preparation plant (CPP), run-of-mine (ROM) and product coal stockpiles, coal reject handling infrastructure and a temporary (emergency) reject stockpile: • over-land conveyors, rail load out facilities and rail loop; • up to three ventilation shafts; • surface and groundwater management facilities, including storages, pipelines and pumps; • on-site accommodation facility for up to 400 non-local construction employees only; and • administration, ancillary facilities, communications and power lines.
Target Coal Seam	Wongawilli Seam, in the Permian Illawarra Coal Measures at depths of approximately 70 m to 180 m (about 55% coking and 45% thermal coal).
Coal Extraction	Estimated 50 Mt of recoverable ROM coal at a rate of up to 3.5 Mtpa (approximately 39 Mt of saleable coal over lifetime of the project).
Coal Processing	On-site processing in the CPP.
Coal Reject and Waste Management	• Rejects: processed and stored in the temporary surface emplacements within the mine site during operations with the option to reprocess these rejects before pumping them back underground to partially fill the mined-out voids. • Excavated rock: used to fill the surface infrastructure area and mine rehabilitation at the end of the project life.
Water	• Groundwater: total take of 2,093 ML a year for the mining project. Produced mine water would be stored underground behind 'bulkheads' (see **section 6.2** of this report). • Surface water: on-site storage of 730 ML in the primary water dam (PWD) to contain the site and contaminated water across project life
Traffic and Transport	• Approximately 200 car parking spaces on the mine site during construction for the accommodation village and 176 car parking spaces during operations. • Construction traffic: daily movements of up to 222 light and 132 heavy vehicles. • Operational traffic: daily movements of up to 358 light and 20 heavy vehicles. • Up to 8 train movements each day (4 in each direction) to the Port Kembla Coal Terminal.
Rail and Roadworks	• Rail: construction of a new 7.6 km rail spur and loop connected to the existing Berrima Branch Line Branch Line, a railway bridge over the Old Hume Highway and a rail maintenance siding. • Road: new access to the mine site from Mereworth Road for all vehicles, upgrades to intersections in the local area, and construction of minor internal roads.
Biodiversity Offsets	The project requires a total of 107 ecosystem credits and 626 species credits to offset the project's clearing of 10.3 ha of native vegetation.
Heritage	• Aboriginal: 206 sites within the Hume Coal Project area (direct impact on 20 sites); and 11 sites within the Berrima Rail Project area (direct impact on 8 sites). • Historic: 8 historic items within project area, a portion of one of the listed items on the *Wingecarribee Local Environmental Plan* would be affected.
Agricultural Land	• No Biophysical Strategic Agricultural Land (BSAL) is present within the project area.
Rehabilitation	The project site would be progressively rehabilitated, and 177 ha of the disturbed land would be changed to a Land and Soil Capability (LSC) Class 6 land use.
Hours of Operation	• Construction: Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm and no work on Sundays or public holidays (except for limited minor works, works required by utility providers or affecting traffic flow, which would occur 24 hours a day, 7 days a week). • Operation: 24 hours a day, seven days a week.
Employment	• Construction: approximately 415 full-time positions. • Operation: up to 300 full-time positions, most of which are expected to be filled from Wingecarribee Shire and other surrounding areas.
Capital Investment Value	$533,328,391, comprising $498,044,957 for the Hume Coal Project, and $35,283,434 for the Berrima Rail Project.

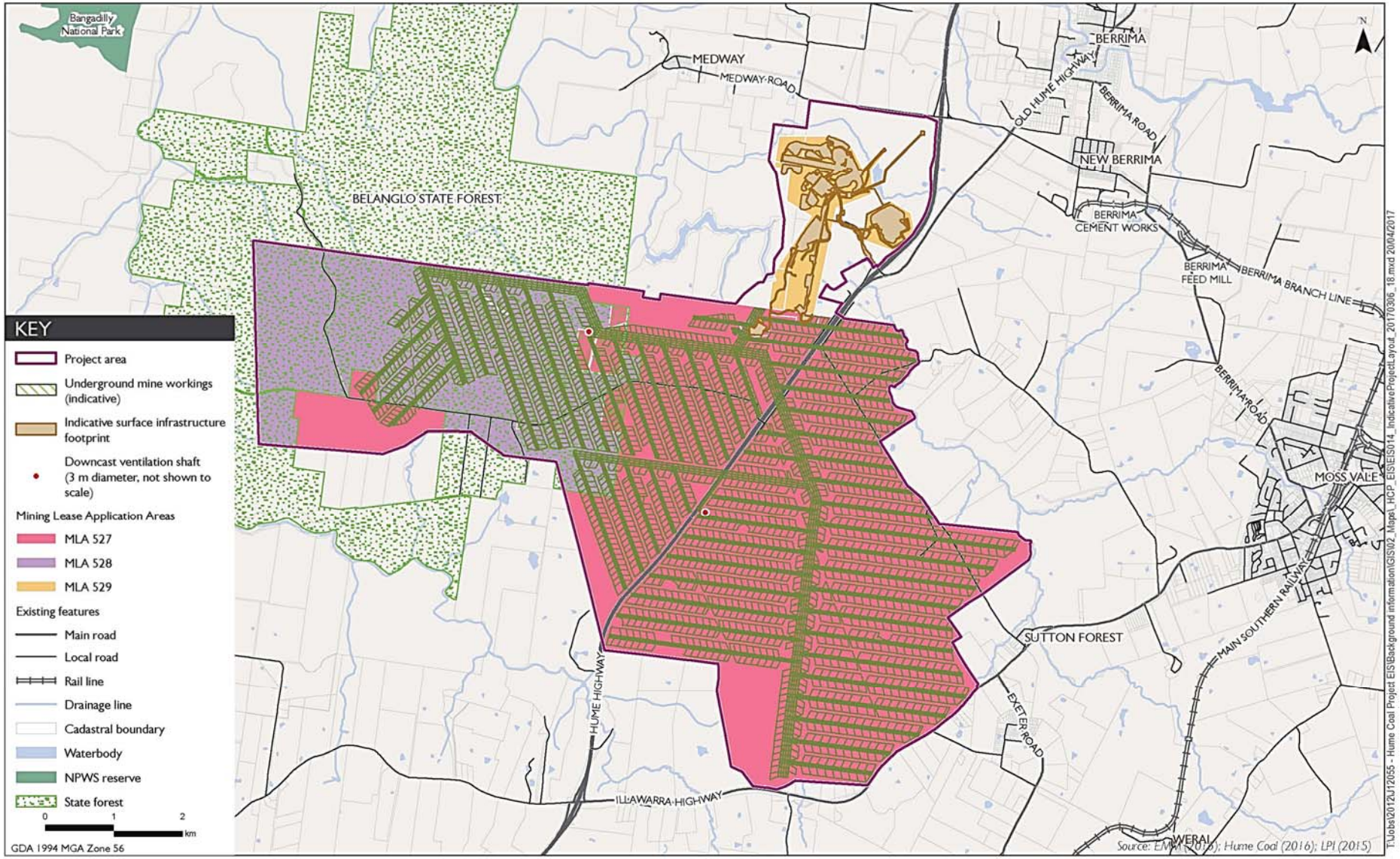

Figure 3 | Indicative layout of the Hume Coal Project

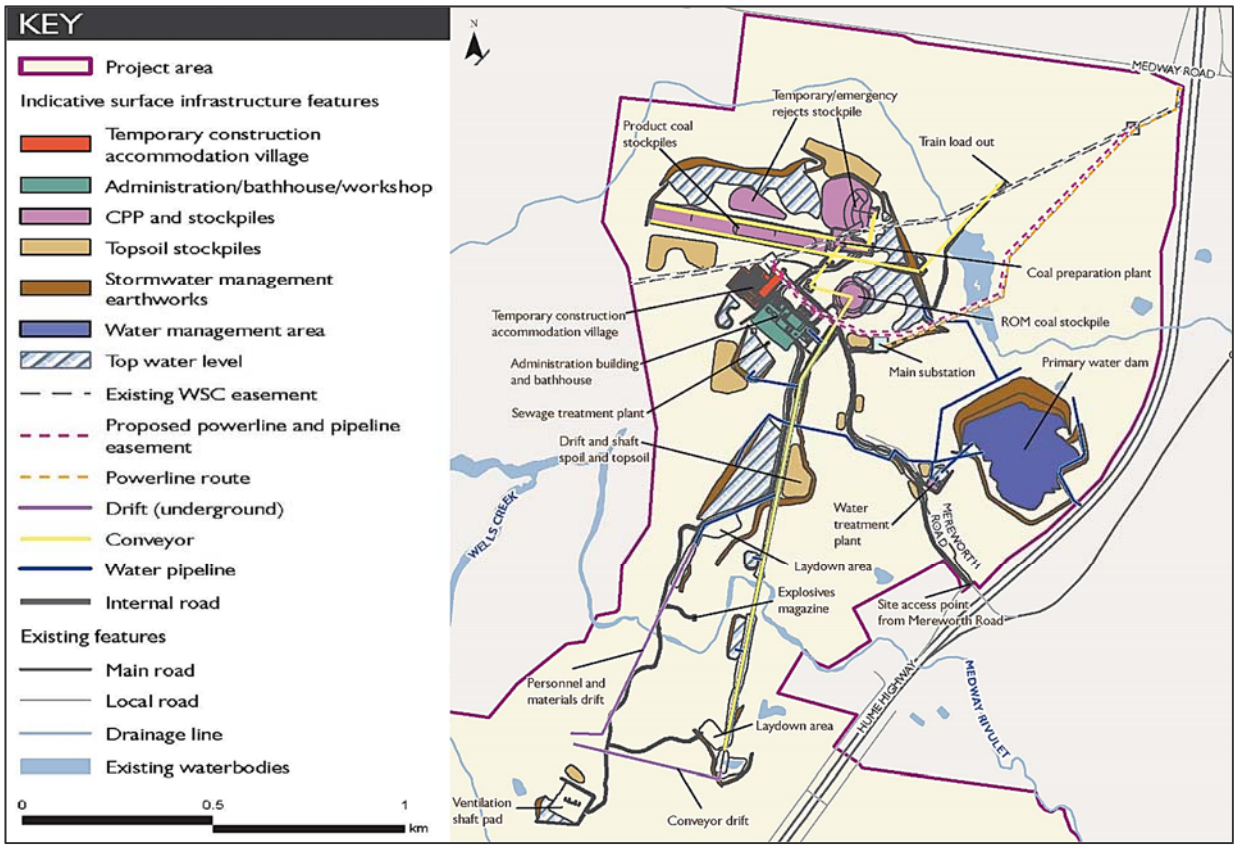

Figure 4 | Hume Coal Project indicative surface infrastructure layout

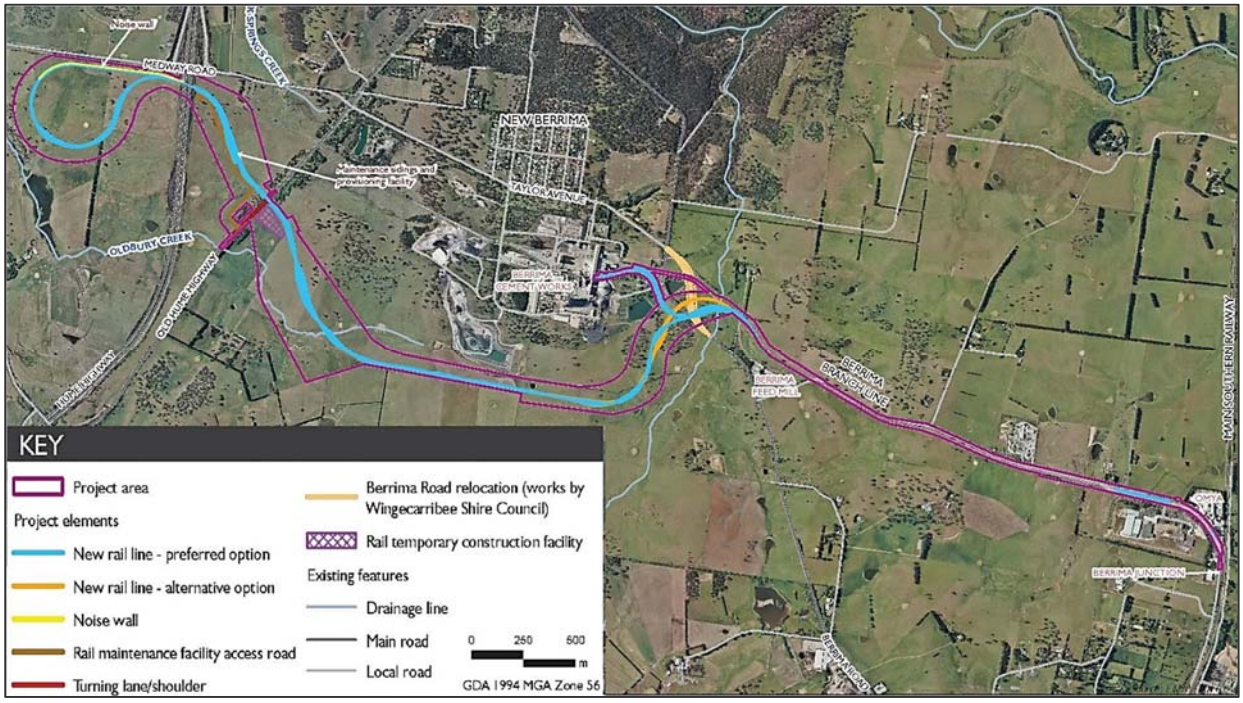

Figure 5 | Berrima Rail Project indicative layout

3. Strategic Context

3.1 Local and Regional Setting

The project area and its surrounds are characterised by low, rolling hills with predominantly rural-residential and small-scale agricultural land uses. This includes scattered rural residences, livestock grazing and various rural businesses (e.g. vineyards, olive plantations and horticulture).

The land is largely cleared for agricultural purposes and mainly comprises pastured fields, interspersed with small-scale cropping and remnant native vegetation. The soils are relatively fertile, however detailed soil assessments concluded that there is no Biophysical Strategic Agricultural Land (BSAL) within the project area.

There are various industrial land uses to the east of the project area, around New Berrima and Moss Vale. Most of these industrial land uses are within an area known as the Moss Vale Enterprise Corridor, which is zoned as industrial. It includes the Berrima Cement Works, the Berrima Feed Mill and the Dux hot water plant.

There is a range of infrastructure in the vicinity of the project that would allow the transportation of coal to Port Kembla for export or domestic users. Both the Hume Highway and the Main Southern Railway, which are the main transport routes between Sydney and Canberra, traverse the project area.

There is a long history of coal mining in the Southern Highlands region, including the Berrima Colliery, the Loch Catherine Mine, the Southern Colliery and numerous older, pre-mechanisation mine workings. However, the historical coal mining was generally small in scale and mostly ceased between 50 and 150 years ago. The main exception to that is the Berrima Colliery, which ceased operations in 2013.

The project site is located within a broader area that is renowned for its historical and heritage significance. There are three State-listed heritage items in the vicinity of the project (Oldbury Farm, Golden Vale and Hillview), eight locally-listed heritage items in the project area, and the National Trust of Australia has identified a significant cultural landscape conservation area for Berrima, Sutton Forest and Exeter (see **Figure 6**).

Figure 6 | Local and regional heritage features
(clockwise from top left: National Trust landscape conservation area, Oldbury Farm, Golden Vale homestead, Mereworth House)

3.2 Environmental Setting

The topography of the project area and its surrounds typically comprises rolling hills with elevations between 550 m to 735 m. There are some steeper slopes and gorges in the west of the project area within the Belanglo State Forest. Aside from the forest, there are only limited areas of remnant native vegetation, which are mostly associated with creeks, as well as scattered paddock trees in some areas.

The project area is located within the upper reaches of Sydney's drinking water catchment, and there are numerous watercourses in and around the proposed mining area, including Medway Rivulet, Black Bobs Creek and Oldbury Creek (see **Figure 7**).

The project is at the southern end of the Southern Coalfield, which is one of five major coalfields in NSW, and is the only coalfield that is a source of high-quality coking coal for steel production. There is an estimated recoverable coal resource of 50 million tonnes within the targeted Wongawilli coal seam.

The Wongawilli coal seam in this area is relatively shallow at depths of 70 to 180 m. While the seam is typically 10 m thick in the Southern Coalfield, the seam has been eroded in the project area and ranges from completely missing to 8.5 m thick.

There are three key layers overlying the Wongawilli coal seam – the Wianamatta Shale, the Hawkesbury Sandstone and an interburden layer of shale (directly above the coal seam). A profile of the typical local geology is provided in **Figure 8**.

The local geology is different within the project area to the rest of the Southern Coalfield, which generally features a layer of sedimentary rock, known as the Narrabeen Group directly above the Wongawilli coal seam. In this area, the Narrabeen Group has been eroded out of the sequence, which creates a unique situation where the Hawkesbury Sandstone is very close, or adjacent, to the coal seam.

The Hawkesbury Sandstone is a major groundwater aquifer that contains most of the groundwater storage volume in the Southern Coalfield. Within this area of the Southern Coalfield, the water quality is generally fresh, and the yields are relatively high. Given the high quality and yields, there are a large number of bores in this area, with 363 private bores within 9 km of the project.

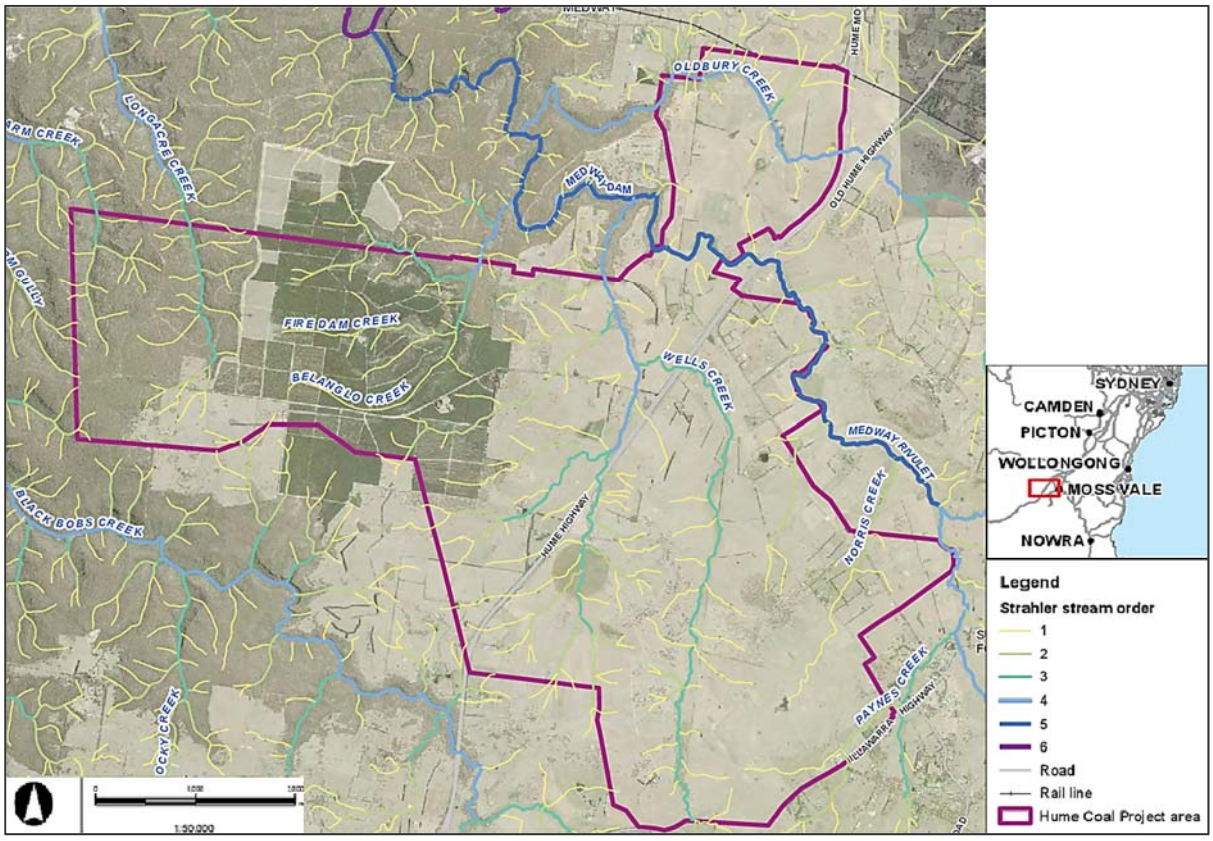

Figure 7 | Watercourses within the project area

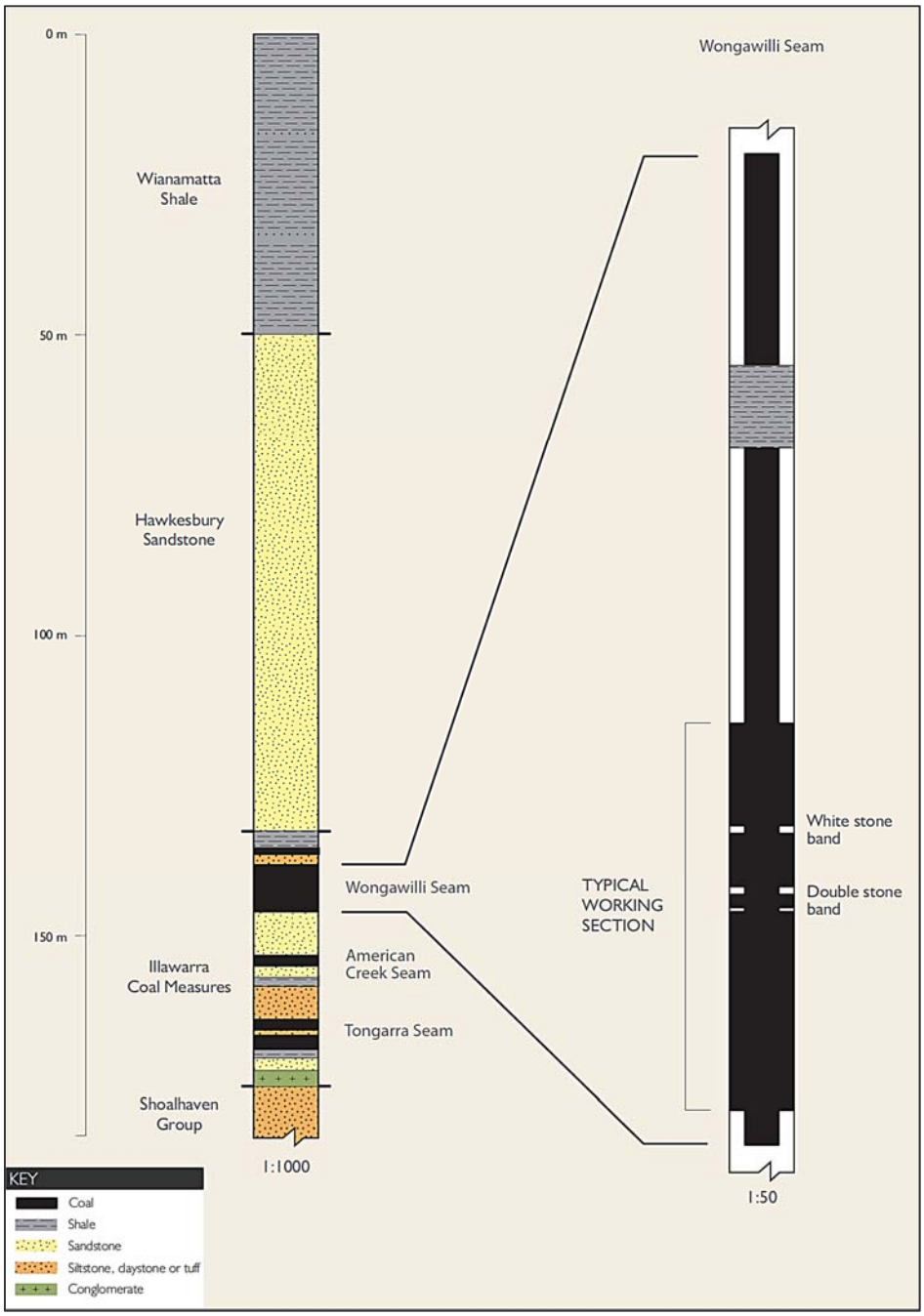

Figure 8 | Typical stratigraphy in the project area

3.3 Population and Land Ownership

There are over 47,000 people in the Wingecarribee Shire Council local government area.

The main regional centres in the vicinity of the project are Moss Vale, Bowral and Mittagong, which are located between 3 and 15 km to the east and north east of the project.

There are two villages (Sutton Forest and Exeter) located within the project area, and three other villages (Medway, New Berrima and Berrima) in nearby areas.

The project area covers approximately 5,051 ha, which includes:

- 1,253 ha of land held by the Applicant;
- 2,402 ha of land held by other private landowners;
- 1,296 ha of Belanglo State Forest; and
- 97 ha of Crown and other government-controlled land.

As the Hume Coal Project is located in a predominantly semi-rural area, there are several privately-owned properties in the project area or in close proximity to the proposed surface facilities (see **Figure 9**), including many properties that use groundwater for agricultural purposes and have registered bores.

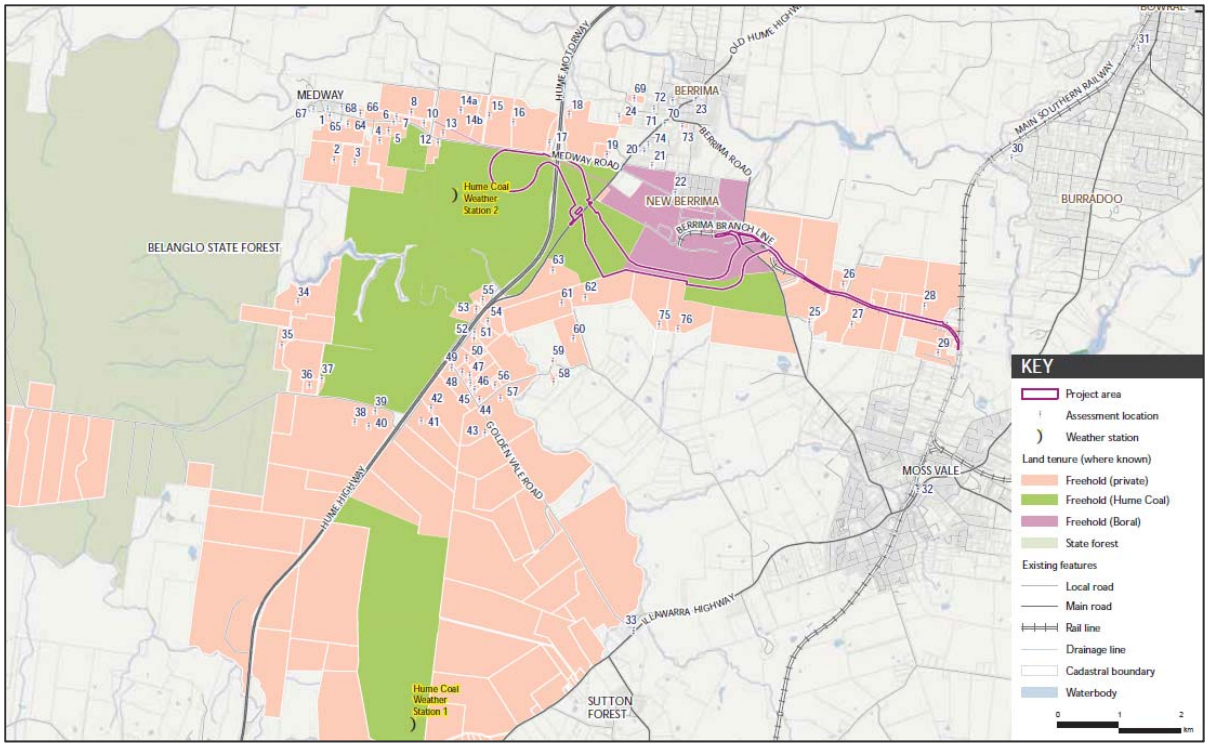

Figure 9 | Land ownership within the project site

3.4 History of the Project

The project area has long been identified as a prospective location for a coal mine proposal. Exploratory drilling first occurred in the 1950s and an exploration licence was issued by the government in 1985.

Over the last two decades, there has been growing community opposition to a new coal mine in this part of the Southern Highlands.

The key events leading up to the project are summarised in **Table 2**.

Table 2 | Timeline of events relevant to the proposal

Date	Event
1950s – 1980s	Various exploration drilling within the Exploration Licence A349 area
1985	Exploration Licence A349 was formally granted on 23 September 1985 to the Bellambi Coal Company and Austen & Butta
2001	Anglo Coal acquired Exploration Licence A349
2010	POSCO and Cockatoo Coal Limited formed a joint venture under the name Hume Coal Pty Limited and acquired Authorisation 349 (A349) from Anglo Coal and began an exploration program in May 2011.
2013	POSCO acquired Cockatoo Coal's 30% stake in Hume Coal.
August 2015	Secretary's Environmental Assessment Requirements issued
April 2016	Site Verification Certificate issued
March 2017	Development Applications SSD 7171 and SSD 7172 lodged
March – June 2017	EIS exhibited
June 2018	Responses to submissions submitted

4. Statutory Context

4.1 State Significant Development

The Hume Coal Project is declared to be State Significant Development under section 4.36 of the EP&A Act as it is "*development for the purposes of mining that is coal or mineral sands mining*", which is specified in clause 5(1) of Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011* (the SRD SEPP).

The Berrima Rail Project is also declared to be State Significant Development under section 4.36 of the EP&A Act as it is "*a mining related works*" for "*transporting any mineral*", which is specified in clause 5(3) of Schedule 1 of the SRD SEPP.

The Minister for Planning is the consent authority for State Significant Development projects. However, under section 4.5(a) of the EP&A Act and clause 8A of the SRD SEPP, the Independent Planning Commission must determine the development applications as there were more than 25 submissions objecting to the projects.

4.2 Site Verification Certificate

Clause 50A of the *Environmental Planning and Assessment Regulation* 2000 requires development applications relating to mining development (within the meaning of Part 4AA of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*) (the Mining SEPP) to be accompanied by either a gateway certificate or a site verification certificate that certifies that the land on which the activity is to be carried out is not Biophysical Strategic Agricultural Land (BSAL).

The Applicant lodged an application for a site verification certificate with the Department on 17 August 2015 for the proposed Hume Coal Project, in accordance with the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (the Interim Protocol). The Department issued a site verification certificate (SVC) on 22 April 2016, confirming that no BSAL is present in the proposed Hume Coal Project area.

4.3 Permissibility

The project site is located in the Wingecarribee local government area. Under the *Wingecarribee Local Environmental Plan 2010* , the Hume Coal Project includes land zoned as:

- E2 – Environmental Conservation;
- E3 – Environmental Management;
- RU2 – Rural Landscape;
- RU3 – Forestry; and
- SP2 – Infrastructure.

The majority of the Hume Coal Project is zoned as E3 – Environmental Management (approximately 70%). There is also a large area zoned as RU3 Forestry in the western portion of the site (approximately 26%) and a smaller area in the southwestern portion that is zoned RU2 – Rural Landscape (approximately 3%). There are two even smaller areas zoned as SP2 – Infrastructure (approximately 1%) and E2 - Environmental Conservation (less than 1%).

Under the LEP, mining development is prohibited in all of these land zones. While clause 7(1)(a) of the Mining SEPP permits 'underground mining' to be carried out on any land, it is only allowed subject to development consent. The Mining SEPP sets out a range of 'matters for consideration' that the consent authority must consider in determining whether development consent should be granted for underground mining.

In particular, clause 12 of the Mining SEPP requires the consent authority to consider whether the project is compatible with other land uses, including "*existing, approved and likely preferred land uses*". In that regard, the zoning provisions of the LEP are relevant to the extent that they influence the existing, approved and likely preferred land uses in the project area and its surrounds.

The Department considers that the project is not necessarily incompatible with the existing or likely land uses in RU3 or SP2. However, the objectives of the E2 and E3 zone are aimed at protecting existing historic, ecological, cultural and aesthetic values. Similarly, the RU2 zoning is focussed on maintaining the "*rural landscape character*" and "*encouraging sustainable primary industry*".

Importantly, both the E3 and RU2 zones include non-mandatory objectives, which reflects that there are specific characteristics of the existing land uses that Council would like to protect. Based on the limited list of permitted land uses and the non-mandatory objectives in both zones, the Department is concerned that a new coal mine may not be compatible with the *"existing, approved and likely preferred land uses"* of these zones.

The Berrima Rail Project includes land zoned as:

- IN1 – General Industrial;
- IN3 – Heavy Industrial;
- RU2 – Rural Landscape;
- SP2 – Infrastructure;
- E2 – Environmental Conservation; and
- E3 – Environmental Management.

Under the LEP, the proposed rail works are permissible in the IN1 and IN3 zones but prohibited in the RU2, SP2, E2 and E3 zones. However, under clause 7(1)(b) of the Mining SEPP, development for the purpose of 'mining' (which includes "*transportation of materials extracted*") may be carried out on land:

- where development for the purposes of agriculture or industry may be carried out (i.e. both the RU2 and E3 zoned land); or
- on land that is the subject of a mining lease (i.e. the E2 zoned land).

Consequently, the proposed rail works are permissible in the land zoned RU2, E2 and E3, however it is prohibited under both the LEP and the Mining SEPP on the land zoned SP2. While the consent authority has the power to override a partial prohibition for State Significant Development, it must assess the planning merits of such a decision.

4.4 Mandatory Matters for Consideration

Section 4.15 of the EP&A Act outlines the matters that a consent authority must take into consideration when determining development applications.

These matters can be summarised as:

- any submissions made in accordance with this Act or the regulations;
- the environmental, social and economic impacts of the development;
- the suitability of the site for the development; and
- the provisions of environmental planning instruments (EPIs), including draft instruments, development control plans, planning agreements, and the EP&A Regulations;
- the public interest, including the objects of the Act which include encouraging Ecologically Sustainable Development (ESD).

The key EPIs include:

- *Wingecarribee Local Environmental Plan 2010;*
- *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007;*
- *State Environmental Planning Policy (State and Regional Development) 2011;*
- *State Environmental Planning Policy No.33 – Hazardous and Offensive Development;*
- *State Environmental Planning Policy No.44 – Koala Habitat Protection;*
- *State Environmental Planning Policy No.55 – Remediation of Land;*
- *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011; and*
- *State Environmental Planning Policy (Infrastructure) 2007.*

The Department has considered all of these matters in its assessment of the project.

4.5 Integrated and Other NSW Approvals

Under section 4.41 of the EP&A Act, a number of approvals are integrated into the State Significant Development assessment process and consequently are not required to be separately obtained for the project. These include:

- various approvals relating to heritage required under the *National Parks and Wildlife Act 1974* and the *Heritage Act 1997*; and
- certain water approvals under the *Water Management Act 2000*.

Under section 4.42 of the EP&A Act, a number of other approvals are required, but must be substantially consistent with any development consent for the project. These include:

- a mining lease under the *Mining Act 1992*;
- an environment protection licence under the *Protection of the Environment Operations Act 1997*; and
- consent under section 138 of the Roads Act 1993 for the upgrade and re-alignment of public roads and networks.

The Applicant would also require other approvals for the project which are not integrated into the State Significant Development assessment process, including:

- approval under the *Crown Lands Act 1989* for any works on Crown land;
- approvals under the *Roads Act 1993* from Wingecarribee Shire Council (as the responsible roads authority) to permanently close roads within the project area;
- permit under section 60 of the *Forestry Act 2012* to authorise the use of Belanglo State Forest for non-forestry purposes;
- notification under the *Work Health and Safety (Mines) Act 2013* for high risk activities;
- approval for prescribed dams under the *Dams Safety Act 1978*; and
- certain water licences under the *Water Act 1912* and the *Water Management Act 2000*.

4.6 Independent Planning Commission

On 4 December 2018, the Minister for Planning asked the Commission to hold a public hearing into the project. The terms of reference for the Commission hearing are set out in the following table.

Table 3: Commission's terms of reference

Request to the Independent Planning Commission – Hume Coal Project and Berrima Rail Project
1. Conduct a public hearing into the carrying out of the Hume Coal Project and associated Berrima Rail Project, and: (a) consider the following information: - the EIS for the projects; - all submissions received on the projects; - any relevant expert advice; and - any other relevant information; (b) assess the merits of the Hume Coal Project and Berrima Rail Project as a whole having regard to all relevant NSW Government policies, and paying particular attention to the: - impacts on surface water and groundwater resources, including on private bores; - social and economic impacts of the projects on the locality and region; and - suitability of the site; and (c) prepare a report summarising the actions taken by the Commission in conducting the public hearing and outlining the Commission's findings on the projects, including any recommendations.
2. Hold the public hearing as soon as practicable after the Department of Planning and Environment provides its preliminary assessment report to the Commission.
3. Submit its report on the public hearing to the Department of Planning and Environment within 8 weeks of holding the public hearing, unless otherwise agreed with the Planning Secretary.

4.7 Commonwealth Approvals

Under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), an action that will, or is likely to, have a significant impact on 'matters of national environmental significance' requires approval of the Commonwealth Minister for the Environment.

In late 2015, the Commonwealth determined that the Hume Coal Project was likely to have a significant impact on 'matters of national environmental significance', including 'listed threatened species and communities' and a 'water resource in relation to a large coal mining development'. However, the Commonwealth determined that the Berrima Rail project would not require Commonwealth approval.

5. Engagement

5.1 Exhibition

Under clause 9 of Schedule 1 of the EP&A Act, the Department is required to publicly exhibit the EIS for the project for at least 28 days. After accepting the development applications and EIS for the project, the Department:

- advertised the exhibition of the EIS in the *The Australian* on 30 March 2017 and the *Southern Highlands News* on 31 March 2017;
- exhibited the documents from 30 March 2017 – 30 June 2017 (i.e. 92 days) at:
  - the Department's Information Centre in Sydney;
  - Wingecarribee Shire Council, and Moss Vale, Bowral and Mittagong libraries; and
  - the Nature Conservation Council;
- notified all landowners within the project area, local special interest groups, Aboriginal groups, relevant electricity supply and transmission authorities of the exhibition by letter; and
- notified relevant Government agencies of the exhibition by email.

5.2 Department's Engagement

During the assessment process, the Department met with Hume Coal on a number of occasions to discuss various aspects of the project and the assessment process. The Department also undertook extensive consultation with Government agencies and community stakeholders, including a number of site visits and community meetings prior to the lodgement of the development applications, during the exhibition period and during the assessment process. The meetings with the community and agencies are listed in **Table 4**.

Table 4 | Summary of Department's community engagement

Date	Description	Attendees
12/04/2017	Site visit and project briefing	Department, Hume Coal and Government agencies
12/04/2017	Project briefing	Department, Wingecarribee Shire Council
12/04/2017	Project briefings	Department, NSW Police Force, NSW Health
26/04/2017	Project briefings	Department, Battle for Berrima, Coal Free Southern Highlands, Berrima Residents Association
26/04/2017	Site visit to Berrima and surrounds	Department
26-27/04/2017	Community information session	Department, general public
15/06/2017	Project briefing	Department, Southern Highlands Greens
26/06/2017	Site visit to Medway Road	Department, Medway Road residents
26/06/2017	Site visit to Berrima and surrounds	Department, Battle for Berrima
14/11/2017	Site visit to Medway Road	Department, Medway Road Residents
21/08/2018	Geology and groundwater	Department, Coal Free Southern Highlands
31/08/2018	Economic impacts	Department, Coal Free Southern Highlands
4/10/2018	Groundwater impacts	Department, Coal Free Southern Highlands

5.3 Summary of Submissions

During the exhibition period, the Department received a total of 12,666 submissions on the project, which comprised 7,389 submissions on the Hume Coal Project and 5,277 submissions on the Berrima Rail Project. Of the 12,666 submissions, the Department received 13 submissions from government agencies, 59 from special interest groups (or businesses) and 12,595 from the general public.

A summary of the submissions is provided in **Table 5**, and a full copy of the submissions is provided in **Appendix B**. A detailed analysis of the submissions is also provided in **section 5**.

Table 5 | Summary submissions on the proposal during exhibition

Submitters	Number	Category
Government Agency	**13**	**1 Object, 1 Support, 11 Comment**
• Wingecarribee Shire Council • Australian Rail Track Corporation (ARTC) • Department of Primary Industries (DPI), including: - Department of Industry – Water (DoI Water) - DPI Lands - DPI Fisheries - DPI Agriculture • Division of Resources and Geoscience (DRG) • Environment Protection Authority (EPA) • Forestry Corporation of NSW (FCNSW) • Heritage Division of the Office of Environment and Heritage (OEH) • NSW Health, South Western Sydney Local Health District (SWSLHD) • Office of Environment & Heritage (OEH) • Roads and Maritime Services (RMS) • Subsidence Advisory NSW (SA) • Transport for NSW (TNSW) • WaterNSW (WNSW)		
Special Interest Groups/Organisations	**23**	**21 Object, 2 Support**
• 350 Australia • Aurora Southern Highlands Steiner School • Australian Garden History Society - Southern Highlands Branch • Australian Stock Horse Society - Moss Vale Branch • Battle for Berrima Inc • Berrima District Acclimatisation Society • Berrima Residents Association • Coal Free Southern Highlands • Climate Action Now Wingecarribee • Exeter Village Association • Farmers for Climate Action • Groundswell Gloucester • Institute for Energy Economics and Financial Analysis • Lock the Gate Alliance • National Trust – Southern Highlands Branch • Nature Conservation Council of NSW • Quit Coal • Southern Highlands Food and Wine Association • Southern Highland Greens • The Australia Institute • The National Trust of Australia		Object
• Regional Development Australia - Southern Inland • The United Mine Workers South Western District (CFEMU)		Support
Community	**12,631**	**12,191 Object, 434 Support, 6 Comment**
• Individual	1,354	929 Object, 419 Support, 6 Comment
• Form Letter	11,241	11,241 Object
• Local Business	36	21 Object, 15 Support
TOTAL	**12,666**	**12,212 Object, 436 Support, 18 Comment**

5.4 Key Issues – Government Agencies

Wingecarribee Shire Council (the Council) objected to the project and noted that it has a policy against any coal mining in its local government area. Council considers the impacts of the project to be unacceptable, particularly in relation to its impacts on amenity, tourism, water resources, heritage and cultural landscape, biodiversity, traffic and transport, and community cohesion.

While none of the other government agencies objected to the project, several agencies have residual concerns about the potential impacts of the project.

A summary of the issues raised by government agencies is provided below, with a focus on key residual issues.

The **Department of Industry, Water Division (DoI Water)** raised concerns about the "*unprecedented*" number of bores that would be adversely affected by the project and questioned whether the proposed 'make good' strategy is "*logistically viable*". DoI Water also raised residual concerns about some technical aspects of the groundwater model, which are discussed in **section 6.2** of this report.

WaterNSW raised residual concerns about the Applicant's assessment of the impacts of the project against the neutral or beneficial effect test (NorBE), particularly in relation to a lack of mass balance analysis for Medway Rivulet. It also raised concern about a lack of detailed information on geological structures, including the nature and type of faults and the classification of dykes and diatremes. WaterNSW recommended the imposition of strict performance criteria including a 'negligible reduction' in both surface water flow and water quality.

The **Environmental Protection Authority (EPA)** noted that the assessment of potential water impacts is largely reliant on complex water modelling and recommended various conditions to address any residual uncertainties. In particular, EPA recommended strict performance criteria that would ensure there is no discharge of water from the primary water dam (PWD) into local creeks.

The **Heritage Council of NSW** raised some residual concerns about the level of heritage assessment undertaken, particularly in relation to historical archaeology and the 'Berrima, Sutton Forest and Exeter Cultural Landscape'. It recommended that additional detailed assessments should be undertaken by suitably qualified heritage consultants. The Heritage Council also recommended a number of conditions about the protection of listed items, and the ongoing management and monitoring of heritage items.

The Department's **Resources Regulator** noted that the mining method is untested and has residual concerns about mine worker safety. It confirmed that the mining method represents secondary extraction, which means that the proposed mining is subject to the High Risk Activity notification process, which is discussed in **section 6.3**.

The Department's **Division of Resources and Geoscience (DRG)** did not raise any residual concerns, however it acknowledged that the pine-feather mining method has not been tested in Australia and deferred to the Department's independent experts on the potential subsidence effects and other mine design impacts.

Subsidence Advisory NSW noted the predicted worst-case subsidence predictions and considered that subsidence is unlikely to result in any impacts to surface infrastructure.

The **Office of Environment and Heritage (OEH)** commented that the project had been largely designed to avoid biodiversity and Aboriginal cultural heritage impacts. Further, it noted its appreciation that the Applicant has undertaken early assessment of Aboriginal heritage impacts, including test excavations.

The **Department of Primary Industries Fisheries (DPI Fisheries)** made a number of recommendations about the requirements for a water management plan and associated monitoring program, particularly in relation to monitoring and mitigation of impacts to riparian vegetation.

The **Department of Primary Industries Agriculture (DPI Agriculture)** raised no concerns and recommended that all land should be rehabilitated to a pre-mining state.

Forestry Corporation of NSW noted that the development of a ventilation shaft is in the Belanglo State Forest and is allowed under a permit for occupation.

Roads and Maritime Services (RMS) recommended that a traffic management plan, which includes details of upgrades to Mereworth Road, key transport routes and swept path analysis should be submitted prior to determination. It also noted that additional intersection modelling should be submitted for review by RMS.

Transport for NSW (TfNSW) initially raised a number of minor concerns that have been addressed in the Response to Submissions. **South Western Sydney Local Health District (NSW Health)** have no residual concerns.

5.5 Submissions – General Public

The key issues raised in submissions from the general public included:

- groundwater drawdown on private bores;
- potential contamination of groundwater aquifers;
- potential discharge of mine water to the surrounding catchment;
- compatibility with other land uses in the local area;
- the economic viability of the mine;
- potential tourism impacts; and
- potential heritage impacts, particularly on Berrima.

The Department has reviewed the geographical locations of the community submissions and notes that 5,300 of the total community submissions were received from addresses within the Wingecarribee Shire local government area (see **Table 6**). The majority of these (5,099) were received from addresses within postcodes that are within or adjacent to the project area (i.e. postcodes 2575-2579).

Importantly, of the 5,099 submissions from the surrounding postcodes, the vast majority were objections to the project, i.e. 4,930 objections or approximately 97%.

Table 6 | Geographical distribution of community submissions

Location	Submissions	Proportion of total community submissions	Objections	Proportion of objections
Wingecarribee local government area (**'Surrounding postcodes'** i.e. 2575-2579)	5,300 (5,099)	42.1% (40.5%)	5,131 (4,930)	96.8% (96.7%)
Surrounding local government areas (Wollondilly, Wollongong, Kiama, Shellharbour, Shoalhaven, Goulburn-Mulwaree, Upper Lachlan)	987	7.8%	911	92.3%
Greater Metropolitan Sydney	4,489	35.6%	4,389	97.8%
Rest of NSW	564	4.5%	529	93.8%
Other states and international	905	7.2%	860	95%
Unknown	350	2.8%	349	100%

The Department acknowledges that a large proportion of the objections were essentially 'form letters' by the general public (i.e. 11,241 of the total 12,212 objections). While it is not unusual for the Department to receive a large number of form letters on coal mining projects, it is relevant in this instance that a large number of these (4,233) were sent by people in surrounding postcodes and all were objecting to the project.

Aside from the form letters, the project has also attracted a very large number of 'unique' objections from the local region, i.e. 719 objections from the Wingecarribee Shire local government area, including 707 objections from surrounding postcodes.

5.6 Submissions – Special Interest Groups

The Department received a total of 23 submissions from special interest groups, including 21 objections and 2 in support of the project.

At least two special interest groups have been formed in the local community specifically to oppose the project (and coal mining in the area), including **Battle for Berrima** and **Coal Free Southern Highlands**. The Battle for Berrima group has approximately 400 members and Coal Free Southern Highlands has approximately 250 members.

Both groups have spent a considerable amount of time organising community information days and other events, including a protest at the NSW Parliament House that attracted 150 people in Sydney.

In addition, Coal Free Southern Highlands commissioned 11 expert reports on the EIS that covered a wide range of technical matters, including groundwater, geology and economics. These groups have also provided detailed comments on the Response to Submissions, including an additional two expert reports on groundwater.

Coal Free Southern Highlands strongly objects to the proposal and highlighted the number of water users in the vicinity of the mine that would experience serious impacts and questioned the Applicant's ability to make good on those impacts. It also questioned the geological assumptions made in the groundwater model and raised concerns about the storage of mine water and coal waste in underground workings.

Battle for Berrima also strongly objects to the project and was principally concerned about impacts on the social fabric of Berrima Township. The submission was accompanied by an independent Statement of Heritage Impact.

There were two special interest group submissions that supported the project – **Regional Development Australia** and the **United Mine Workers – South Western District** – which both commented on the potential economic and employment benefits of the project to the locality and the region.

The issues raised by the other **19 special interest group** objections are largely similar to the issues raised in submissions from the general public, Coal Free Southern Highlands and Battle for Berrima.

A copy of all of the special interest group submissions is provided in **Appendix B**.

5.7 Response to Submissions

In July 2018, the Applicant provided a detailed Response to Submissions document (see **Appendix D**). The Applicant also provided an additional report to the Department in October 2018 on the project's economic benefits, which is provided in **Appendix E**.

The Applicant undertook additional supplementary studies and provided additional information in the Response to Submissions in response to key issues raised in submissions, including:

- a revised water impact assessment, which replaced the EIS water impact assessment;
- three-dimensional numerical modelling of the mine layout;
- an updated visual amenity and historic heritage impact assessment on Mereworth House and its gardens; and
- an assessment of the likely effects of the projects on local and regional tourism, and local property values.

Furthermore, the Response to Submissions described the additional engagement that the Applicant has been undertaking with the community, particularly the affected land-owners. This included holding 8 community information sessions during the exhibition period and a number of meetings with the government agencies during the Response to Submissions preparation period to discuss agency submissions on the project's EIS.

The Response to Submissions was made publicly available on the Department's website and provided to key Government agencies for comment. The agency and special interest group submissions in response to that are provided in **Appendix F**.

6. Assessment

6.1 Introduction

The Department acknowledges that there is a valuable coal resource available within the project area, and that the extraction of this coal would lead to economic benefits.

The Department also acknowledges that the Applicant has taken a number of steps to avoid and/or mitigate the potential impacts of the project on the environment and the community. Further, the Applicant has made considerable efforts to respond to the concerns raised by government agencies and the community throughout the development assessment process.

Notwithstanding, the Department considers that the project would result in significant impacts on a highly productive groundwater aquifer, including drawdown impacts on a large number of bores in the vicinity of the project. There are also fundamental challenges in 'making good' on these impacts (see **section 6.2**).

Further, the Department considers that the combination of an untested mining method and an unconventional method of impounding large quantities of mine water may result in serious operational safety risks, which may lead to unacceptable surface water impacts and a significant reduction in economic benefits (see **section 6.3**).

In addition, while there is a valuable coal resource in the project area, the Department notes that there is considerable disagreement between economic experts as to the quantum of economic benefits and even the Applicant's estimate of the economic benefits is relatively low in comparison to many other coal mining projects across NSW (see **section 6.4**).

The Department has also undertaken a comprehensive assessment of the full range of other potential impacts, including economics, noise, vibration, air quality, greenhouse gas emissions, traffic, biodiversity, heritage, agriculture and rehabilitation.

The Department accepts that the majority of the other potential impacts are likely to be able to be managed, mitigated and/or offset to achieve an acceptable level of environmental performance, subject to the provision of additional information or via suitable conditions of consent. A summary of these issues is provided in **section 6.5**.

6.2 Groundwater

6.2.1 Introduction

The Hume Coal Project involves the extraction of a relatively shallow coal seam in an area that contains productive groundwater aquifers and a large number of groundwater users.

The key issue raised in community submissions is the impacts on the highly productive Hawkesbury Sandstone aquifer, particularly through drawdown impacts on surrounding water users. In addition, the reliability and accuracy of the groundwater modelling has been criticised.

Further, while the proposed 'make good' measures may be feasible from a strictly technical standpoint, the Department is concerned about the suitability and practicality of this approach given the scale of the impacts.

6.2.2 Independent Review

Given the technical complexities involved, the Department commissioned an independent expert (Mr Hugh Middlemis) to provide advice on the groundwater impacts of the project. Mr Middlemis has provided:

- advice on the groundwater assessment in the EIS, dated 6 December 2017; and
- advice on the groundwater assessment in the Response to Submissions, dated 16 October 2018.

At various stages, the Department has also sought expert advice from the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC), DoI Water, WaterNSW and EPA, and reviewed submissions from a range of other water experts that were commissioned by the Coal Free Southern Highlands group.

There are now at least 10 groundwater experts that have provided input or comments on the groundwater impact assessment process and/or groundwater model, including:

- Applicant:
  - Dr Noel Merrick
  - Dr Frans Kalf
  - Liz Webb
- Government:
  - Hugh Middlemis
  - IESC
  - DoI Water hydrogeologists
  - WaterNSW hydrogeologists
- Community:
  - Dr Steven Pells
  - Doug Anderson
  - Chris Jewell
  - John Lea.

6.2.3 Background

Groundwater inflows and drawdown

All underground mines have some level of impact on groundwater resources as the extraction of the coal seam leads to depressurisation and fracturing of the overlying strata, which can affect overlying aquifers. The groundwater inflows from overlying aquifers into an underground mine can affect important groundwater aquifers and cause 'drawdown' of water bores that surround the mine.

Local context

In this region, the Hawkesbury Sandstone is the main groundwater aquifer. It is considered to be a 'highly productive aquifer' under the NSW *Aquifer Interference Policy* and it contains generally fresh water with high yields. There are approximately 363 bores within 9 km of the project.

The Hawkesbury Sandstone is the main rock layer between the coal seam and the surface. The Hawkesbury Sandstone and the coal seam is only separated by a thin layer (between 0.1 to 4 m) of shale, which has been referred to as the 'interburden layer'.

The thickness (or even presence) of the interburden layer is an important factor in the predicted levels of groundwater drawdown and has been the subject of much debate.

Policy context

The NSW government regulates mining-related groundwater issues in two key ways:

1. any impacts on 'beneficial' groundwater aquifers must be assessed under the *Aquifer Interference Policy*, and
2. the 'take' of water from groundwater aquifers through groundwater inflows must be licensed under the *Water Management Act 2000* and associated *Water Sharing Plans*.

The *Aquifer Interference Policy* establishes rules for "*highly productive groundwater sources*", which includes the Hawkesbury Sandstone for this project. It states that any "*predicted pressure decline*" of more than 2 m is considered to be more than a "*minimal impact*" and requires "*appropriate studies to demonstrate that the decline will not prevent the long-term viability of the water supply works unless make good provisions apply.*"

The Hume Coal Project significantly exceeds the 'minimal impact' threshold, and whether this is an acceptable impact on this highly productive groundwater aquifer is the key issue in the Department's assessment.

While there is no specific guidance on how an impact can or should be 'made good' in the legislation or the *Aquifer Interference Policy*, these issues are generally dealt with via agreements between the mining company and the affected landowners, and then supported by development consent conditions.

For example, the Department regularly includes a 'compensatory water supply' condition in mining consents, which requires the company to compensate other water users for mining impacts on water supply. However, the inclusion of such conditions is only a contingency measure to manage unexpected impacts that might occur (i.e. greater than originally predicted) and the Department has rarely needed to enforce these conditions.

Importantly, the Department has never been in a situation where: (a) there are such a large number of predicted impacts on private bores; and (b) the consent conditions would be the only means of ensuring that landowners' water supply is protected. Ordinarily, there are very few predicted impacts and it is expected that the mining company would come to agreement with any affected landowners prior to determination.

The licensing of groundwater resources under the *Water Management Act* is regulated by DoI Water and is largely separate from the development assessment process under the EP&A Act. However, the Department considers advice from DoI Water on whether a project is likely to have any problems acquiring the necessary water licences within the relevant Water Sharing Plan. This consideration is material to whether the development can actually proceed.

6.2.4 Methodology

Introduction

The Department usually provides only a brief commentary on the methodology used for each area of impact assessment before addressing the particular assessment issues. However, the groundwater issues for this project are very complex and difficult to model. This has resulted in a range of residual areas of concern.

The key residual concerns are the:

- 'class' of the groundwater model;
- characterisation of the local geology; and
- uncertainty and sensitivity analyses.

Class of the groundwater model

The groundwater model in the EIS was criticised by DoI Water and in various community submissions as not meeting the requirements of a Class 2 or Class 3 model under the *Australian Groundwater Modelling Guidelines* (the Modelling Guidelines), which would mean it is not fit for impact prediction purposes.

The Department's independent expert, Mr Middlemis, noted that the groundwater report in the original EIS was confusing and criticised it for not providing "*sufficient clarity, leading to potential misinterpretations of the model setup and/or performance*". He made a number of recommendations aimed at improving the model and its ability to accurately make impact predictions (see **Appendix C**).

The initial groundwater impact assessment has been substantially revised as a result of the feedback received during the exhibition period. There is general agreement among the relevant groundwater experts that the revised groundwater model is a significant improvement on the initial model.

A number of relevant experts (DoI Water, UNSW's Doug Anderson and PSM's Dr Steven Pells) still do not consider that the model is Class 2 as there are specific aspects of the model that only meet the Class 2 criteria.

Mr Middlemis noted that the commentary in the Modelling Guidelines is somewhat misleading as some sections indicate that a model must 'pass' all the specific criteria in order to meet a given class of model. However, he warns against "*cherry-picking one guideline comment rather than considering all the attributes*".

Mr Middlemis has undertaken a detailed assessment of the model against the Modelling Guidelines, and has concluded it is Class 2 (i.e. fit for purpose), even if there are individual aspects of the model that do not necessarily meet the criteria in the Modelling Guidelines (see **Appendix G**).

Local geological data

The characterisation and understanding of the local geology has been a key criticism of the Applicant's groundwater model. The issues that have been raised about the geological data are:

- the characterisation of the interburden layer in terms of its thickness and presence across the project area;
- the characterisation of Hawkesbury Sandstone as a homogenous layer with uniform hydraulic conductivity across its entire thickness;
- the calibration of the geological data against historical Berrima Colliery data; and
- a lack of drilling samples and/or consideration of available data from historical drill holes.

The characterisation of the Hawkesbury Sandstone and the interburden layer is particularly important as they can significantly influence the model's prediction of groundwater inflows and associated drawdown impacts.

The Department notes that both of its independent experts on mine design raised concern about the lack of local geological data, particularly in relation to the presence and nature of geological structures (see **section 6.3**).

The Department also notes that the Applicant has recently advised the Department that it has gathered additional bore data, which may reduce the predicted impacts in the model. While the Department accepts that additional local data would improve the accuracy and reliability of the model predictions, this data has not yet been provided.

Uncertainty and sensitivity analyses

A final aspect of the methodology that has raised concerns is the level of uncertainty and sensitivity analyses. No comprehensive uncertainty analysis was undertaken for the EIS, which was criticised by all the relevant experts, including Mr Middlemis, DoI Water and the community group's experts.

However, the revised modelling included a Monte Carlo uncertainty analysis, which is a statistical analysis that uses random sampling to generate simulated data. In addition, sensitivity analyses were undertaken into other aspects of the groundwater model, including climate scenarios and watercourse flows.

The Department acknowledges that the Applicant has made considerable efforts to strengthen the uncertainty and sensitivity analyses in its groundwater impact assessment.

While Dr Pells and Mr Anderson have raised residual concerns about the uncertainty analysis, Mr Middlemis states that the Applicant's "*combination of uncertainty and sensitivity analysis, in consultation with the regulator, is consistent with the latest best practice*".

Summary – methodology

The Department acknowledges that groundwater modelling involves a fundamental level of uncertainty and that a model's prediction of impacts can never be entirely accurate, especially in relation to large scale coal mining projects that operate over decades. There is often disagreement between experts on technical aspects of modelling methodology.

In this instance, the Department recognises that there are some limitations to the model, particularly in relation to the level of local geological data that has been gathered. Notwithstanding, the Department considers that the revised groundwater model provides a range of predictions that can be used to make a reasonable assessment of the potential impacts.

However, given the various residual uncertainties, the Department has adopted a precautionary approach and considers that the revised model's more conservative estimates should be used.

6.2.5 Assessment

Introduction

The Department acknowledges that the project has been designed to minimise fracturing and reduce connectivity between the coal seam and the overlying aquifers. However, the targeted coal seam is relatively shallow and located close to a highly productive groundwater aquifer.

Consequently, there would still be a substantial volume of groundwater inflows into the mine workings. Given the Hume Coal Project is located in a rural-residential area that contains a large number of productive bores, there are likely to be significant drawdown impacts on groundwater bores surrounding the project.

Predicted Drawdown

There are various ways to assess the probability of drawdown and the main documents for the EIS and Response to Submissions adopt the 67th percentile to make these predictions. This means that there is a 33% chance that the actual drawdown impacts would be greater than the predictions.

Given there is a range of residual uncertainties about the groundwater model, the Department considers that a more conservative range of predictions should be used to assess groundwater impacts.

In that regard, the revised groundwater impact assessment (by Dr Noel Merrick) has also included some predictions that are based on a 90th percentile (i.e. there is only a 10% chance that the actual drawdown would be greater than the predictions). However, not all of the relevant 90th percentile have been provided.

The Department has summarised the predicted drawdown impacts on privately owned bores in **Table 7**, including both the 67th percentile and 90th percentile predictions (where available). A map of the privately-owned bores that are predicted to experience a drawdown of greater than 2 m is provided in **Figure 10**.

Table 7 | Summary of predicted drawdown impacts on privately owned bores

	67th percentile		90th percentile
	EIS	Response to Submissions	
Number of bores with greater than 2 m of drawdown	93	94	118
Maximum drawdown range	2-80 m	2-47 m	N/A
Median maximum drawdown	12 m	6 m	N/A
Number of landholders	71	72	72
Average time for bores to recover	23 years	20 years	N/A
Range of times for bores to recover	72 years	76 years	N/A

Note: where the Applicant has not yet provided the information, it is marked as 'N/A' (not available).

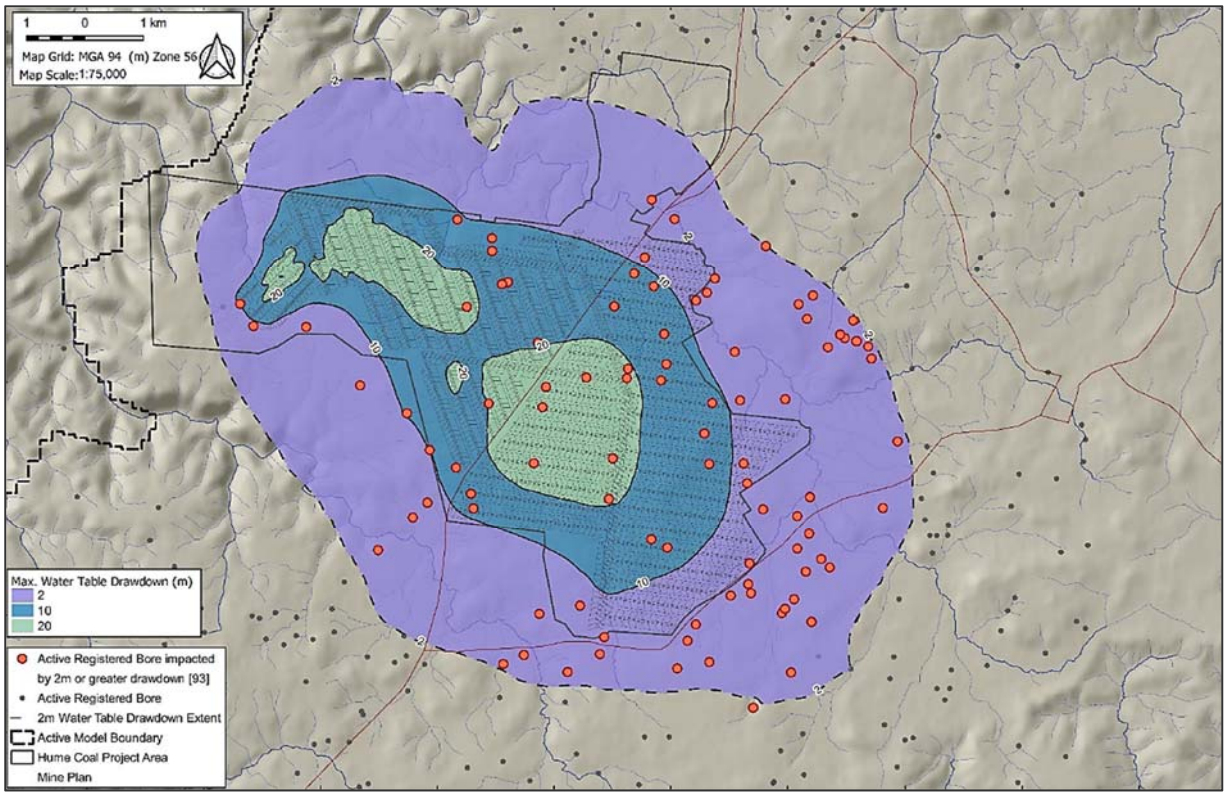

Figure 10 | Bores affected by 2 m or greater drawdown (at the 67th percentile)

While the *Aquifer Interference Policy* defines more than a 'minimal impact' as over 2 m, there are a substantial number of bores with predicted drawdown much greater than that (e.g. 54 bores with more than 5 m). **Table 8** summarises the number of the affected bores per depth of impact (at the 67th percentile).

Table 8 | Summary of affected privately owned bores per depth of impact (67th percentile)

Depth of Drawdown Impact (m)	Number of Bores	% of the Total Number of Bores
0 – 5	40	42
5 – 10	21	22
10 – 20	23	26
20 +	10	10

Consideration of drawdown impacts

Based on the range of modelling results provided to date, the precise level of impacts to the surrounding bores is not entirely certain, and the predicted impacts vary across the different probability ranges. However, it is clear that the level of drawdown impacts is very significant across all the predictions.

The predicted drawdown impacts are significant in a number of respects, including the:

- area of impact, which extends more than 10 km from north to south and east to west;
- number of bores affected, which ranges from 94 to 118;
- number of different landholders (up to 72);
- level of drawdown within the affected bores (decreases of up to 47 m); and
- duration of the impacts (up to 76 years until recovery).

Even the less conservative predictions would amount to the most significant impacts on groundwater drawdown for any mining project that has been assessed in NSW. This has been confirmed by the relevant expert agency, DoI Water, which stated in its latest advice that "*the current prediction of 2 m or greater draw down on 94 privately owned bores is unprecedented in similar projects*".

The key reason that the project is predicted to have such significant impacts on bores is due to the unique set of factors that only apply to the Hume Coal Project, including:

- it is located in an area that contains high quality groundwater aquifers that can produce high yields for beneficial uses;
- the local geology means that the proposal would involve extracting a coal seam at a shallow depth where the seam is located very close (or adjacent) to a highly productive aquifer (the Hawkesbury Sandstone); and
- it is located in a semi-rural area with a comparatively high density of properties (that are not owned by, or associated with, the Applicant), including many properties that have registered bores.

Given the fundamental nature of these factors (i.e. a combination of hydrology, geology and land use), there are very limited options to avoid or minimise the drawdown impacts.

The Department notes that the Applicant has sought to minimise inflows by proposing to deliberately transfer the 'produced' mine water back into the mine workings for storage, which is intended to restore hydrostatic pressure more quickly. However, this has not prevented drawdown impacts and the Department also has a range of concerns about this method of mine water storage (see **section 6.3**).

In the absence of options to avoid or minimise the groundwater drawdown, the only remaining option is to mitigate or compensate for any impacts via 'make good arrangements'.

Proposed make good strategy

The Department, DoI Water and numerous public submissions raised concerns at the EIS stage that the Applicant had not provided adequate information about its proposed strategy to 'make good' on the predicted drawdown of the registered bores surrounding the project.

Consequently, the Applicant included a standalone 'Make Good Strategy' in the Response to Submissions. In broad terms, the Make Good Strategy includes:

- a 'preliminary make good assessment' that establishes an in-principle approach to implementing make good arrangements as the project progresses; and
- a 'make good process' that considers the nature of individual make good arrangements and potential dispute resolution options.

The 'preliminary make good assessment' has provided an indication of the options that would be required for each of the 94 bores that are predicted experience an impact (based on the 67th percentile probability), which is summarised in **Table 9** and depicted in **Figure 11**.

Table 9 | Summary of 'preliminary make good assessment'

Make good option	Number of bores	Maximum drawdown predicted (m) (average)	Years where drawdown is greater than 2 m (average)
Increased costs	31	3	28
Deepen pump	33	11	48
Replace bore	15	11	43
Alternative water supply	15	18	51
All	94 (Total)	11 (average)	43 (average)

Technical feasibility of make good

The Department's independent groundwater expert, Mr Middlemis, has provided advice on whether the four proposed make good options are feasible from a technical standpoint. Mr Middlemis stated that "*all these arrangements are reasonable in principle*" but noted that his advice is "*is constrained to technical issues regarding borehole workovers or re-drilling, and whether access to alternative groundwater supplies is feasible*".

While DoI Water also did not raise any major concerns about the technical feasibility of the proposed options, it highlighted the difficulties associated with replacing bores. It noted that the "*viability of providing an alternate water supply for irrigation activities has not been confirmed with 15 irrigation bores identified as requiring replacement*". The Applicant has also acknowledged that it may not be "*physically possible to deepen (i.e. within the existing bore) for many bores for various reasons*".

While the Department agrees that the options of deepening or replacing bores may present challenges, the Department generally accepts that the Applicant's proposed make good options are technically feasible.

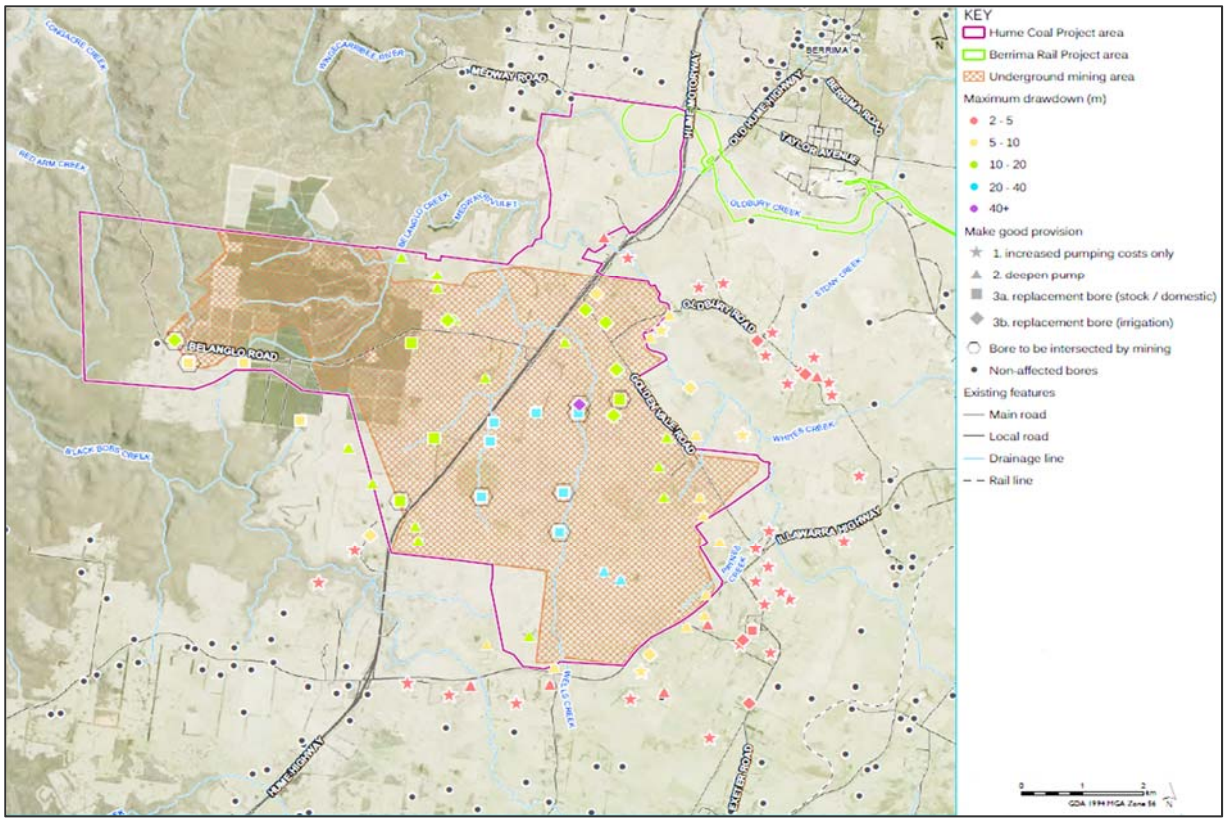

Figure 11 | Project drawdown and proposed 'make good' provisions

Suitability and practicality of make good

The *Aquifer Interference Policy* expressly contemplates the possible scenario where there are "*no suitable or practical mitigation or prevention options and therefore the proponent may be asked to avoid impacts by modifying the proposed activity*".

In this case, the Department considers that there are a number of important reasons that mean the provision of make good arrangements for up to 118 bores is not suitable or practical.

Firstly, there would be a substantial level of disruption to the community through a difficult, ongoing process of negotiating and implementing make good arrangements. The disruption would be particularly significant on this local community given the nature of the existing land uses. The majority of the affected landowners are located in an area with rural-residential and small-scale agricultural land uses, many of which rely on access to the highly productive groundwater aquifer.

Secondly, there is likely to be considerable disagreement between the Applicant and the landowners about both the actual drawdown impacts and the proposed make good options. The selection of a particular make good option may be technically preferable, however it may not align with the landowner's preference, taking into account the potential disturbance required, the physical or visual impacts, or the existing land uses and intended purpose of the bore.

Thirdly, the process is likely to rely heavily on dispute resolution to resolve various disagreements between the Applicant and the landowner. Any dispute resolution process of this nature and on this scale would inevitably involve substantial legal costs for the Applicant, the Department and, importantly, individual landowners. It is reasonably foreseeable that the Department would find itself in a position of managing an extremely large number of ongoing disputes throughout the life of the proposed mine life and even beyond that.

Finally, each of the above issues are likely to result in extensive time delays, which may interfere with the landowners' use of their bores or even disrupt the proposed sequencing of mining. It is likely that each of the make good arrangements would take a long time to be negotiated and many would end up in lengthy dispute resolution processes. These unavoidable delays would undermine the effectiveness of the entire make good process and create residual ongoing disruption and uncertainty in the community.

6.2.6 Licensing

The project area is mainly located within the Upper Nepean and Upstream Warragamba Water Source, and the Medway Rivulet management zone with smaller sections located within the Lower Wingecarribee River management zone.

In the Response to Submissions, the Applicant has assessed its licence requirement based on the predicted groundwater inflows at the 67th percentile probability.

As discussed previously, the Department and DoI Water consider that a more conservative range of predictions should be used due to a variety of residual uncertainties that exist in the modelling.

The Response to Submissions provides an outline of the groundwater inflows and the associated availability of water licences, which is summarised in **Table 10**.

Table 10 | Summary of predicted inflows and licence requirements

Groundwater Water source	Management zone	Total volume required for project (ML/year)		Outstanding volume still required (ML/year)		Total available trading pool (ML/year)
		67th percentile	90th percentile	67th percentile	90th percentile	
Sydney Basin Nepean	Nepean Zone 1	2,059	N/A	150	N/A	12,553
	Nepean Zone 2	8	N/A	3	N/A	50,000
Sydney Basin South	Sydney Basin South	7	N/A	0	N/A	69,892
Upper Nepean and Upstream Warragamba	Medway Rivulet	19	N/A	0	N/A	127
Total		2,093	2,336	123	366	132,572

Note: where the Applicant has not yet provided the information, it is marked as 'N/A' (not available).

The Department has included the conservative 90th percentile predictions in **Table 10** (where available), which shows that groundwater inflows would be 2,336 ML (i.e. an additional 243 ML) and the outstanding volume required to be secured would be 366 ML. That means there is a substantially higher number of water licence entitlements that would be required than currently predicted.

The Applicant has already secured 1,909 ML of water licences, which equates to approximately 82% of the required water licences based on the 90th percentile predictions. While there appears to be sufficient licences available on the market, the Department and DoI Water have minor residual concerns about the increased outstanding volume (i.e. 366 ML) and consider that the Applicant should further assess its ability to acquire the necessary licences.

6.2.7 Summary

The key assessment issue for this project is the impacts on an important and highly productive groundwater aquifer, particularly in relation to drawdown impacts on privately held bores surrounding the project.

While there is general agreement that the revised groundwater model is a significant improvement on the initial model, there are a range of residual uncertainties that mean the Department should adopt a precautionary approach based on the most conservative impact predictions.

Regardless of any uncertainty, even the less conservative predictions would amount to the most significant impacts on groundwater drawdown for any mining project that has been assessed in NSW. There are a set of fundamentally unique factors about the environmental context that limit opportunities to further minimise the impacts.

The Applicant has proposed a strategy to 'make good' on the predicted drawdown impacts. The proposed make good process would inevitably result in a substantial amount of disruption to the community and a large number of difficult dispute resolutions on complex issues.

While the proposed measures may be technically feasible, the Department does not consider that make good arrangements are suitable or practical for the scale of impacts from this project.

6.3 Mine Design

6.3.1 Introduction

The Applicant has proposed a relatively unknown mining method ('pine feather') and an unconventional approach to mine water management. A number of concerns have been raised about this in both agency and community submissions, particularly in relation to the reliability of the geotechnical modelling.

The Department acknowledges that the Applicant has selected this mining method in an attempt to limit subsidence-related impacts on sensitive features at the surface, particularly in comparison to the longwall mining that is used in other parts of the Southern Coalfield.

However, the Department has significant concerns about the combination of 'pine feather' mining and the impoundment of groundwater inflows within the mine workings. The Department considers that there are a range of safety risks that may lead to environmental impacts on surface and groundwater resources, and potentially reduced economic benefits.

6.3.2 Independent Review Process

The Department notes that the issues relating to mine design, geotechnical modelling and safety are extremely complex. Consequently, the Department has relied on advice from its two independent experts throughout the development assessment process. This has included an iterative process of independent review and consultation with the Applicant's experts.

Initial advice on the EIS

A key finding of the advice from both experts was that the Applicant had not provided an adequate geotechnical model, particularly for the purposes of estimating pillar loads and stability.

The EIS utilised an upper extreme loading model for some types of coal pillars and a lower extreme model in the case of web pillars. Professor Canbulat stated that this resulted in "*the predicted likelihood of web pillar failure instability falling somewhere within a range of <0.00001% to 50%*", which was considered "*obviously too wide a range for assessing reliability and stability*".

Both of the Department's independent expert reports recommended that the Applicant prepare a three-dimensional (3D) numerical geotechnical model. These reports are provided in **Appendix C**.

Joint expert meeting

In order to facilitate an open discussion and better understanding of the key issues between the various experts, the Department organised a joint expert meeting on 28 March 2018. The Department commissioned Emeritus Professor Ted Brown, a highly regarded mining engineer from Queensland, to independently chair the meeting.

The following experts attended the meeting:

- Emeritus Professor Jim Galvin (on behalf of the Department);
- Professor Ismet Canbulat (Department);
- Professor Bruce Hebblewhite (Applicant);
- Dr Russell Frith (Applicant); and
- Mr Alex Pauza (Applicant).

At the joint expert meeting, the Applicant's experts noted that they had recently undertaken a 3D numerical modelling exercise as recommended by the Department's experts. The Applicant presented the preliminary findings of the new model and noted that the details would be provided in the Response to Submissions.

While the experts all agreed that the Applicant's general approach to 3D numerical modelling and its choice of experts were appropriate in the circumstances, there were still a range of residual issues in contention, particularly in relation to pillar loading and potential safety risks.

Supplementary advice on the Response to Submissions

The Applicant submitted its Response to Submissions in June 2018 and also provided a separate response to the Department's independent expert reports that specifically addressed issues raised in their initial reports and provided further details about the new 3D geotechnical model. The Applicant later submitted peer review reports prepared by Professor Bruce Hebblewhite in August 2018. These documents are provided in **Appendix E**.

The Department then sought advice from its independent experts, which was provided in October 2018 (see **Appendix G**). The residual issues raised in their supplementary advice is discussed in detail below.

6.3.3 Background

There are two aspects of the Hume Coal Project that are unlike most other mining projects in NSW and therefore require careful consideration: (a) the 'pine feather' mining technique; and (b) the impoundment of mine water behind bulkheads throughout mining operations.

Consideration of other mining methods

The Department understands that the Applicant undertook a rigorous approach to considering the most appropriate mining on the site.

In summary, that consideration process involved:

- immediately ruling out open-cut mining due to the required stripping ratio and the environmental impacts resulting from substantial surface disturbance; and
- a 'pre-feasibility' study of various underground mining methods, including:
  - longwall mining, which was not considered appropriate for the site due to the likely impacts on sensitive surface features, including numerous State-listed heritage items;
  - 'mini-wall' mining (i.e. panels less than 100 m in width), which was considered inappropriate due to the likely subsidence impacts on groundwater resources from increased fracturing of the Hawkesbury Sandstone above the coal seam;
  - 'first workings' only, which was considered unviable due to the low coal extraction rate; and
  - 'pine feather' mining (described as "*first workings with slender pillar system*"), which was considered appropriate due to the reduced subsidence impacts, its 'flexibility' and the availability of automated/remote mining options.

The Department acknowledges that the Applicant carefully considered a range of alternative mining methods and recognises that the most impactful mining methods (i.e. open-cut or longwall) were avoided.

What is the proposed 'pine feather' mining method?

There has been considerable confusion from various stakeholders about the proposed 'pine feather' mining method as it is not a mining method that has been used in NSW or Australia before.

The 'pine feather' mining method can be described in a simplified way that comprises three key elements:

- the 'trunk' – development of underground main roadways (or 'mains') with a typical width of 29.5 m;
- the 'limbs' – development of gateroads off the mains, which would be driven at angles to the mains, with a typical width of 16 m; and
- the 'leaves' – extraction of a series of narrow, parallel drives (or 'plunges') off the outside edges of the gate roads, which would be angled at 70 degrees to the gateroads, with a width of 4 m.

The development of mains and gateroads (i.e. the 'trunk and limbs') is an essential part of all underground mining, known as 'first workings', and both are supported by wide pillars to ensure stability and prevent any subsidence at the surface.

However, an important aspect of the 'pine feather' mining method is the use of a variety of other types of pillars (see **Figure 12**), including:

- 'inter-panel pillars' (typically 50 m width), which are located parallel between the gateroads;
- 'intra-panel pillars' (typically 22.8 m width), which are located between a group of plunges; and
- 'web pillars' (typically 6 m width), which are located between each individual plunge.

The stability of each of these types of pillars and the overlying strata is fundamental to determining the safety of the operations and potential subsidence at the surface.

Where has pine feather mining been used?

The Applicant has drawn parallels between the proposed pine feather mining method and other conventional methods, including 'bord and pillar' and 'highwall' mining. However, the Applicant has also acknowledged that "*to its knowledge, there is no previous experience of driving 120m long, narrow drives by remote control means in an underground coal mine*".

In his initial advice, Professor Canbulat noted that "*the proposed web pillar sizes are also unique as the reviewer is unaware of any recent pillar design study that systematically utilised such narrow web pillars for long-term stability*".

There are clear differences between the pine feather mining method and the other analogous methods, i.e. bord and pillar, and highwall mining.

In relation to bord and pillar mining, Professor Galvin noted that the web pillars are fundamentally different as "*firstly they contain no cut-throughs and, secondly, the widths of the in-panel pillars (or web pillars, being 3.5 to 6 m, Table 1) are significantly less than standard practice for the given mining depths*".

In relation to highwall mining, Professor Galvin noted "*two significant differences*", including:

- the proposed plunges are driven from an underground gateroad of around 5.5 m of width as opposed to an above ground bench of around 50-100 m of width; and
- the plunges are at 70-degree angles from the mains as opposed to right angles, which "*places a greater reliance on operator skill in forming the plunge at the correct separation distance from the previous plunge and in not breaking up the floor strata under the screwing action of the caterpillar tracks of the continuous miner*".

In summary, the proposed pine feather mining method is unique to NSW and Australia. While it has some similarities to underground bord and pillar mining and above-ground highwall mining, there are some significant differences to each of these methods. The proposed mining method relies on a range of pillars, and the stability of these pillars is a fundamental consideration in assessing potential impacts.

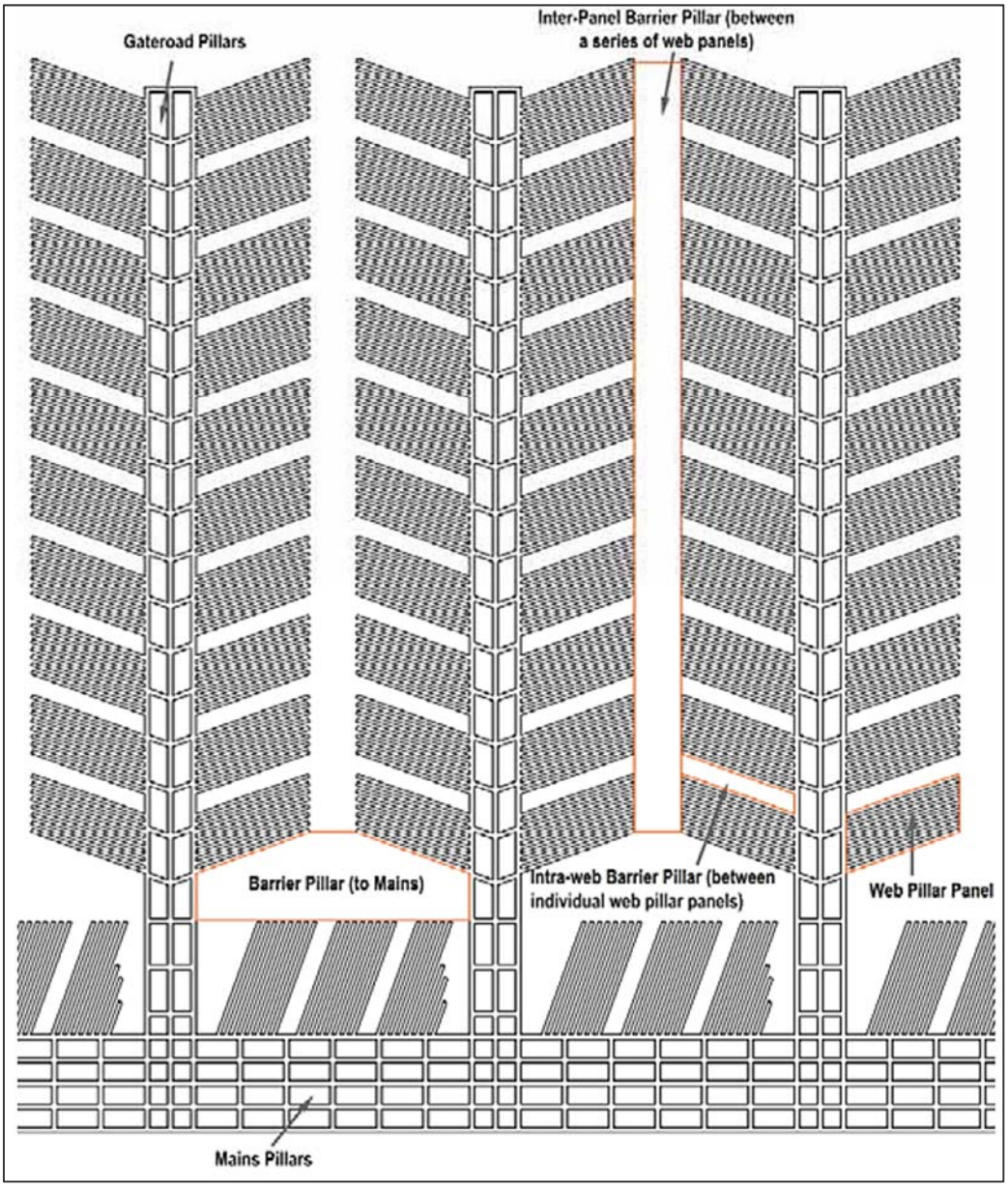

Figure 12 | Pillar types in the 'pine feather' mining method

What is the proposed impoundment of water?

All underground mines experience groundwater inflows as coal is extracted from the seam and the management of this 'mine water' is a fundamental aspect of this type of mining. The removal of water from the mine workings ('dewatering') to the surface for re-use, treatment and/or discharge is the conventional method of managing the mine water to minimise seepage and ensure worker safety.

The Hume Coal Project includes various dams at the surface for managing water, including a Primary Water Dam (PWD) to store mine water that has been 'dewatered' from the underground mine workings. However, a unique aspect of the Hume Coal Project involves the deliberate transfer of the mine water from the surface back into the mine workings for storage behind bulkheads during operations.

The Department understands that the purpose of this underground storage is two-fold. Firstly, it is designed to allow for hydrostatic pressure to restore more quickly in order to reduce drawdown impacts and increase the groundwater recovery rate. Secondly, it is aimed at ensuring that the mine is not required to treat or discharge mine water at the surface, given its location within Sydney's drinking water catchment.

Where has the proposed impoundment of water been used?

In his initial advice, Professor Galvin stated the proposed impoundment of water was "*novel as far as I know*". His supplementary advice also noted that "*two subtle but significant aspects*" of the project are that "*firstly, water is being deliberately put into the mine from the surface, rather than accumulating naturally in the mine, and secondly, it is planned to store the introduced water in all sections of the mine whereas typically water is impounded only certain areas of a mine*".

The Applicant has disputed the uniqueness of this approach to managing mine water and noted that bulkheads have been used to store water in various mines in Australia. It also referred to several international guidelines (e.g. from the US and the UK) that exist on the selection and construction of bulkheads.

The Department agrees that bulkheads are used in other Australian mines and that mine water can be stored in underground workings. However, impoundment of water behind bulkheads at NSW mines like Ulan only occurs in limited areas of the workings and is not the primary method of managing mine water.

To that point, the Applicant has even noted in its response that "*most of the bulkheads currently installed in the industry are an afterthought, and these bulkheads need to be engineered around an existing site, in order to solve a problem that has come to light*".

Further, the Department does not consider that the existence of international guidelines necessarily demonstrates that the use of bulkheads for impounding water is common, or that it is appropriate for this project. Indeed, the US guidelines are clear in the opening paragraphs that "*bulkhead failures can cause catastrophic flooding*" and that failure could lead to "*significant loss of life or property and possible damage to the environment*".

Based on expert advice, the Department considers that the proposed method of impounding water throughout the mine is unconventional, particularly in the Australian context.

6.3.4 Methodology

Introduction

As discussed in **section 6.2**, the Department usually provides only a brief commentary on the methodology used for each area of impact assessment before addressing the particular assessment issues. However, the issues relating to this project's mine design present complex technical challenges that have resulted in a substantial amount of disagreement between the relevant experts, particularly in relation to the geotechnical model.

Consequently, it is important to first address the key residual issues with the geotechnical model before assessing its predictions or associated potential impacts. There are also residual concerns about the adequacy of the baseline geological data and the level of risk assessment that has been undertaken.

Any areas of uncertainty or disagreement on the methodology underpinning the mine design and assessment of geotechnical issues are relevant to the subsequent assessment of potential impacts.

Geotechnical model

All of the relevant mining experts agree that the additional expert that undertook the 3D numerical geotechnical model (Dr Keith Heasley) has relevant expertise for the task and that the 3D model has vastly improved the reliability of the predictions of pillar loading and stability. However, the Department's independent experts have raised a number of areas of uncertainty about the revised geotechnical model, including the model's use of the 'Mark-Bienawski formula' and the use of 'elastic-plastic constitutive law'.

The Mark-Bienawski formula has been used in the Applicant's revised geotechnical model to calculate pillar strength. Professor Galvin stated that a "*range of queries arise*" about the use of this formula, particularly as the formula is not based on a minimum pillar width-to-height ratio and may over-predict the strength of pillars, i.e. "*17% to 40 % higher than alternative mainstream formulae*".

In relation to the pillar constitutive law, Professor Galvin states that there are a "*number of queries*" associated with use of an elastic-plastic constitutive law, which means that the model may not be physically realistic as "*the pillars cannot spall or yield and, instead, continue to sustain peak load indefinitely*" (Galvin supp advice p iv). In that regard, Professor Canbulat recommended "*strain-softening elements with lower residual strength properties*" should be incorporated into the model "*to estimate the subsidence magnitudes at varying depths*".

Professor Galvin has stated that the geotechnical "*situation is surprisingly complex to model"* and noted that "*the reliability of the outcomes is likely to be critical to the project assessment*". The Department cannot definitively determine whether the uncertainties about the geotechnical model would have material consequences to the assessment of potential impacts, however there are clearly outstanding questions about the reliability of the model.

Lack of geological data

A key concern raised in the submissions from the community is that the Applicant has not provided an adequate level of baseline geological data and that the model has relied too heavily on the now-closed Berrima Colliery.

Similar issues were also raised by Professor Galvin in his initial advice to the Department, where it was noted that some of the plans in the EIS were "*devoid of basic information that would normally be shown on such plans … in particular, they do not show fault throw and displacement direction and dyke thickness*".

The Applicant has responded that "*mines do not typically present detailed geological information on conceptual mine designs in the planning and assessment phase of a project*" and attached examples of other coal mining projects, including Wallarah, Bulli Seam Operations and Airly.

The Department acknowledges that the level of geological data that is acceptable may vary across different projects, but notes that the three projects that the Applicant used as examples involved more conventional mining methods (i.e. longwall or bord and pillar mining). Further, each of those projects were subject to comprehensive independent reviews by the then Planning Assessment Commission, which carefully considered the level of geological data provided.

Professor Galvin has also acknowledged that detailed geological information is not necessarily provided at this stage, but noted "*that the Hume Coal Project is not typical of other mine designs*" and "*its safe and successful execution may be quite dependent on the presence, nature and density of geological structure*".

Professor Canbulat also criticised the level of geological data used in the most recent 3D numerical model, stating that "*only 25 strain-gauged elastic modules tests were conducted on Hawkesbury Sandstone*", which is "*insufficient for the purposes of making conclusions and decisions*".

In relation to the use of Berrima Colliery data, Professor Galvin has stated that "*it would be unwise to apply the Berrima Colliery case study to the Hume Coal Project without, firstly, more robustly validating the data and, secondly, should the data prove to be reliable, carefully assessing if the associated mining circumstances apply to the Hume Coal project*".

Professor Canbulat also questioned the Berrima Colliery data in the revised geotechnical model and noted that "*no details of the Berrima Colliery back analysis were presented in Dr Heasley's report*". In particular, he noted that it was not clear if the values quoted from Berrima Colliery were from a single panel or an entire series of panels, which is important as "*readings from a single, isolated panel may produce subsidence magnitudes significantly lower than from a series of panels*".

Risk assessment

Another key concern raised by the Department's independent experts about the Applicant's mine design methodology is the level of risk assessment undertaken. In his initial advice, Professor Galvin stated that "*many of the matters raised in this report could reasonably be expected to have been evaluated by the mine owner(s) in a risk assessment of the mining concept prior to deciding to lodge a Development Application*".

The Applicant responded that it "*had previously undertaken risk assessment workshops for both the mining concept, and the use of bulkheads to contain water in mine panels … [and] the workshops were initially undertaken over a period of four days and were attended by experienced mining professionals*". However, the Applicant has not provided detailed information about this risk assessment work or how it has informed the mine design.

Further, the Department again draws attention to the unique nature of the proposed mining method and the impoundment of water, and considers that this warrants special consideration of risks. In that regard, Professor Galvin noted that there are *"a number of hazards that are not typical in underground mining and, therefore, need careful consideration at the conceptual stage to provide confidence to DPE that the hazards can be effectively managed and, importantly, that contingencies are available if the mining system does not perform as planned*" .

One of the reasons that may explain the relative lack of detail on risk assessment is that the Applicant had erroneously assumed that the proposed mining method would be considered 'first workings'. There are numerous references in the EIS to the mining method as "*only first workings*" and "*a low impact first workings mining system*" .

In its latest advice, the Resources Regulator has confirmed that the proposed pine feather mining method is not only first workings but rather a "*variation of the Wongawilli pillar extraction method and as such is secondary extraction*". Under Work Health and Safety legislation, as the web pillars are less than 1/10th depth or 10 m, they would be non-conforming pillars and are classified as a 'High Risk Activity'.

As Professor Galvin noted, the Resources Regulator therefore "*has the power to prevent the formation of a pillar … if the regulator considers that it presents a serious risk to health or safety of a person*" .

Summary – methodology

The Department has made considerable efforts to resolve disagreements between the relevant experts about the methodology underpinning the mine design and geotechnical model. However, there are residual uncertainties about the geotechnical model, the adequacy of the baseline data and level of risk assessment undertaken.

These uncertainties may influence the reliability and accuracy of predictions about pillar stability and other geotechnical issues, and are therefore relevant to the Department's assessment of the potential impacts of the project. Where necessary, the Department has taken these concerns into account and adopted a precautionary approach to its assessment.

6.3.5 Assessment

Introduction

The proposed pine feather mining method was largely selected to minimise subsidence levels and associated impacts to surface features. The Department acknowledges that subsidence is not the key issue for this project.

However, the unique nature of the project's mine design presents a range of potential hazards and safety risks, including:

- risks associated with pillar stability issues; and
- risks associated with water impoundment issues (or a combination of both).

While hazards and safety risks are ordinarily dealt with at a later stage under Work Health and Safety legislation, the Department is concerned that this unique set of risks may lead to environmental and economic impacts that must be assessed during the development assessment process.

Subsidence

At the joint expert meeting, the experts agreed in-principle that subsidence is likely to be negligible to minor, and is not the key assessment issue. This position has generally been confirmed in the supplementary advice from both of the Department's independent experts, however both experts have noted there are some residual uncertainties.

For example, Professor Galvin stated that "*although I require clarification on a number of aspects of the recent numerical modelling … I remain of the opinion that in the absence of adverse geological conditions, surface subsidence is unlikely to seriously impact on subsurface and surface features.*"

Similarly, Professor Canbulat also retains some concern that "*when the pillars are in an inelastic state the calculations may under-estimate subsidence magnitudes*". However, he also stated that "*it is my opinion that even if the proposed web-pillars fail, the expected subsidence would be relatively low*" .

Notwithstanding some minor residual uncertainties about pillar stability and associated subsidence, the Department considers that it is unlikely that subsidence would cause any significant impacts to surface features.

Pillar stability risks

Pillar stability remains a major concern in relation to safety risks underground. The main reason it is an issue with this project is because the proposed pine feather mining method relies on narrow 'web pillars' (with very small width-to-height ratios) remaining stable in the long-term.

There is a risk that these narrow web pillars may yield or fail, both on an individual basis or in a series of pillars. The independent experts have advised that pillar failure (whether gradual of sudden) can be a direct risk to worker health and safety, particularly due to roof falls and ground falls.

The risk safety issues would be increased in areas of geological structures (e.g. faults, dykes and joints) due to their potential impacts on pillar stability. Professor Galvin has stated that "*the nature of the mine layout for the Hume Coal Project is such that it is almost inevitable that cleats and joints will be sub-parallel to pillar sides in some parts of the mine, creating conditions conducive to rib spall (and, therefore, reductions in pillar width and strength*".

The Applicant has proposed various response measures and controls for managing geological structures in an operational sense, however Professor Galvin noted that "*until experience is gained with them, it is difficult to form a view as to how effective some of these controls may prove to be.*"

There are also a number of other potential hazards that are directly or indirectly associated with pillar stability issues, including:

- Ventilation issues – the development of long plunges with narrow web pillars creates the potential for 'blackdamp' to develop i.e. an oxygen-deficient atmosphere. Professor Galvin noted that "*strata instability can present an additional hazard as it has the potential to push a plug of irrespirable atmosphere out of drive and into a workplace*".

- Trap and salvage of equipment – a common issue that can occur with the narrow panels and pillars in highwall mining is the mining equipment becoming trapped, which often requires difficult and hazardous retrieval efforts. Professor Canbulat raised this as a concern in the pine feather method and referred to US research, which found that underground recovery of mining equipment at highwall operations is "*arguably the most hazardous and essentially requires the setup of a small underground coal mining operation*".

- Off-line cutting – another relatively common issue with driving narrow panels in highwall mining is inaccurate drivage of the mining equipment. This can result in significant differences between the actual widths and heights of pillars compared to the designed values, which may affect pillar and roof stability. Professor Canbulat stated that an "*in-depth study into the degree of potential off-line cutting and its impact on the proposed layout is highly recommended*". The Applicant responded with details about field trials, which Professor Galvin noted "*is encouraging but does not address the potential for the direction of the plunges to be off line to start with*".

As a general comment on the pillar stability issues, Professor Galvin stated that the nature and extent of web pillar loading and yielding would influence the "*likelihood of some of the more critical hazards materialising, the magnitude of the consequences should they materialise, controls for eliminating or mitigating them, and emergency responses and contingencies*". Further, he stated that "*this concern is yet to be resolved despite the numerical modelling undertaken to date*".

Ultimately, the Department considers that the issue of pillar stability has not been adequately resolved by the 3D numerical modelling, and that there are significant residual risks to worker health and safety.

Impoundment of water

In their initial advice, both of the Department's independent experts raised concerns about the potential for impounded water to flow or seep into the mine workings during operations. This is particularly a concern if water is impounded behind a bulkhead 'up-dip' of the current mine workings.

Professor Galvin stated that "*if the workings behind the bulkhead are relatively level and extensive, or up dip, a large volume of water could be released over a very short period of time if the bulkhead or the strata surround it failed*". Professor Canbulat noted that "*in the past there have been a number of bulkhead failures due to piping through rib coal or leakages and hydrostatic pressure build-up, resulting in strata failure around bulkheads"*.

The Applicant provided a response to the experts' comments, which explained that:

- most of the panels have been designed to be down-dip from the mains, rather than up-dip;
- the mine design includes separation distances between panels to ensure that it would not operate in a "*inrush control zone*" under Work Health and Safety legislation; and
- the proposed 'tapered plug' style of bulkhead design is less likely to fail than other options.

However, importantly, there are still sections of the proposed mine plan that would require storage of mine water behind bulkheads that are either up-dip or level to the mine workings.

Further, the combination of pillar stability and water impoundment risks is a problem that is unique to this project. It is a very complex problem that does not fall neatly into the expertise of either mining engineers or groundwater specialists, and the unique combination of risks is not adequately addressed in either the geotechnical model or the groundwater model.

Notwithstanding the potential expertise gap, the Department's independent experts in both mine design and groundwater have provided comments that emphasise the importance of properly assessing the issue and note that there is not currently sufficient information available for that.

In his latest advice, Professor Canbulat noted that "*pumping large volumes of water from flooded workings could be a significant problem if there is no storage space; adding pillar failures to this problem can be a significant challenge*". He also stated that "*this needs to be further assessed*".

Professor Galvin noted that the impoundment of water "*can be expected to increase the risk profile associated with water at the mine*". He also stated that "*the assessment of the EIS would be aided if it was supported by a geological plan and a mining plan showing the panel extraction and the sequence and timing of the filling of panels with coal reject and water*".

The Department's independent groundwater expert, Mr Middlemis, noted that he made enquiries with the Applicant's experts and stated "*a map and schedule of the impoundment volumes was not provided to groundwater modellers*". Mr Middlemis noted that this is only a "*minor limitation*" for the purposes of understanding groundwater inflows, but that "*there are also potential implications for mining safety and bulkhead integrity*".

Further, Mr Middlemis stated that these issues "*would become very important considerations if the distribution and schedule of impoundment showed that there are areas/occasions where there is water impounded behind bulkheads that are also up-dip from actively worked panels*".

In summary, based on the advice of its independent experts, the Department considers that:

- there are inherent risks in the proposed impoundment of large quantities of mine water behind bulkheads during the operation of the mine;
- these risks are exacerbated by various other risks associated with pillar stability and the combination of these risks has not been adequately assessed; and
- there are a range of residual uncertainties, particularly in relation to the timing of the proposed impoundment of water.

While the Department acknowledges that these issues could be dealt with by the Resources Regulator in accordance with Work Health and Safety legislation, the Department is concerned that these residual risks may lead to environmental or economic impacts that must be considered under the EP&A Act.

Environmental Impacts

The project has been uniquely designed to limit the volume of mine water that is handled at the surface throughout the mine life (by impounding it underground). In that regard, the revised modelling predicts that there is sufficient storage for all surplus water generated by the project without the need to release water into local creeks.

However, the Department is concerned that the various safety risks associated with pillar stability and water impoundment may result in the need to transfer additional mine water from underground to the surface. This is particularly the case as the Resources Regulator has classified the mining method as a 'High Risk Activity' and may choose to prevent certain hazardous activities from occurring underground.

An increase in the amount of mine water at the surface due to safety risks has not been accounted for, or assessed, and may have significant environmental impacts.

The potential need to treat and discharge mine water at the surface was a major concern raised by EPA, WaterNSW, OEH and numerous community submissions. EPA and WaterNSW have both recommended that if the project is approved, it must be subject to strict performance criteria restricting mine water discharges.

The project currently includes one surface dam that can hold up to 730 ML of mine water (the Primary Water Dam or PWD) and it is predicted to have a maximum water level of 664 ML, however this only a leaves a 66 ML buffer before its capacity is reached. That is only a small buffer relative to the average daily groundwater inflows, which are predicted to reach 5.9 ML per day (or 6.4 ML per day with a 90th percentile prediction). In a worst-case scenario, the PWD would only provide approximately 10-11 days of mine water storage.

If the mine water cannot be stored underground or in surface dams, it would ultimately need to be discharged at the surface. While the EIS mentions a water treatment plant as "*provisional infrastructure*" and the potential discharge of treated water to Oldbury Creek, the Response to Submissions confirms that neither of these aspects are included in the project, and neither have been assessed.

The discharge of untreated mine water may cause significant adverse impacts on the receiving environment given the quality of the mine water. This is particularly problematic as the project is located within Sydney's drinking water catchment, which means it must comply with the 'neutral or beneficial effect' (NorBE) test.

In recent times, the NSW Government has worked hard to prevent or reduce the impacts of mine water discharges on surface water, particularly within Sydney's drinking water catchment. For example, the 2015 development consent for Springvale coal mine near Lithgow included strict conditions that have led to the development of a $100 million desalination plant. This water treatment plant will treat mine water to a quality that is near to freshwater and will be linked into a 'closed circuit' of existing dams, which means that there will ultimately be 'nil discharge' from the Springvale coal mine.

If the project was amended to include a water treatment plant and surface water discharges, that would be a significant amendment to the existing Hume Coal Project. It would require a detailed assessment of the impacts associated with the construction and operation of such infrastructure, and the water quality of the discharges. Further, even if the mine water could be treated to meet appropriate water quality parameters, the quantity of water discharges would also require careful consideration as that may affect water quality in the receiving environment.

In summary, the Department considers that the wide variety of safety risks associated with pillar stability and water impoundment (including its classification as a 'High Risk Activityy') may lead to the transfer of additional mine water to the surface. This would require significant amendments to the existing project and a substantial amount of additional assessment.

While there are a range of residual uncertainties about this issue, the Department considers that any discharge of mine water (whether treated or untreated) may result in significant impacts on surface water, particularly given the project's location within the drinking water catchment.

Economic Impacts

The uncertainties associated with the proposed mining method and the potential safety risks may also result in reduced economic benefits.

The unconventional nature of the proposed mining method and the proposed impoundment of water brings into question the Applicant's suggestion that the mining method is flexible. Professor Galvin has noted that "*in comparison to conventional bord and pillar mining, the proposed mining method is constrained in its flexibility to deal with geological structure other than by leaving coal unmined*".

The Department notes that the proposed mining method is not designed in a way to allow unmined areas to be mined at a later date, which is often an option with conventional mining methods (e.g. longwall or bord and pillar mining). In fact, the Applicant has accepted that improved knowledge in the future "*may necessitate variations to the conceptual mine plan, such as leaving blocks of coal behind as barriers to flow between mapped and inferred faults and mining voids, should it be determined that the faults are likely to act as flow conduits*".

The loss of coal associated with avoiding geological structures or other risks would therefore reduce the total amount of coal extracted. This would, in turn, reduce the royalties payable to the state of NSW and reduce the overall economic benefits of the project.

The Department notes that the coal extraction rate for the proposed pine feather mining method is already very low compared to most conventional mining methods. Professor Galvin has stated that even a mine design based on conventional bord and pillar mining "*would result in a marginally higher resource recovery and coal pillars with substantially higher factors of safety*".

6.3.6 Summary

The mine design issues for this project are very complex. Based on independent expert advice, the Department considers that neither the pine feather mining method nor the specific type of water impoundment has ever been used in NSW or Australia.

Notwithstanding the Department's considerable efforts to resolve disagreements between experts, there is a substantial degree of residual uncertainty about the mine design and the geotechnical model. In that context, the Department must adopt a precautionary approach to its assessment.

The unconventional pine feather mining method was largely selected to minimise subsidence levels and associated impacts to surface features. While there are some residual uncertainties that require further consideration, the Department acknowledges that subsidence is not a key assessment issue.

However, the combination of an untested mining method and an unconventional method of impounding large quantities of mine water may result in serious operational safety risks. The Resources Regulator has advised that the proposed mining would be subject to the High Risk Activity notification process. The safety risks are exacerbated by uncertainties about the local geology and the level of risk assessment undertaken to date.

The Department considers that the various safety risks may lead to the transfer of additional mine water to the surface and a need to discharge into local watercourses. While the Applicant has not assessed this issue or proposed a water treatment plant, the Department considers that any discharge of mine water (whether treated or untreated) may result in sgnificant impacts on surface water.

Further, there is a risk that the operational safety issues associated with the untested mine design may result in an unexpected sterilisation of additional coal, which may significantly reduce the economic benefits of the project.

6.4 Economic

6.4.1 Introduction

The Department accepts that there is a valuable coal resource available within the project area, including a total coal resource size of up to 50 million tonnes.

The Department acknowledges that the extraction of this coal would lead to economic benefits, particularly through royalties payable to the state of NSW and through the creation of jobs. If the project reached its predicted employment capacity, it would create up to 300 jobs.

However, the Department considers that there is residual uncertainty about the likely quantum of economic benefits. Further, the relatively low rate of production and the Applicant's intention to export coal are likely to reduce economic benefits to the State.

6.4.2 Net Economic Benefits

The Applicant's economic assessment (prepared by BAE Economics) concluded that the project would have a net present value of $373 million.

The Department's independent expert, Mr Andrew Tessler of BIS Oxford Economics, has estimated the net economic benefits at approximately $127 million.

One of the key points of difference is the inclusion of 'employment benefits' and associated 'tax benefits', which Mr Tessler considers should not be included in the cost-benefit analysis. This is based on NSW Treasury Guidelines that make it clear that, on first principles, labour should be considered as a cost rather than a benefit. That is because it is assumed that labour is already fully employed and must be drawn away from elsewhere.

Another key point of difference is the approach taken in valuing externalities, particularly in relation to the impacts on water resources.

Mr Tessler has also considered a range of risks and uncertainties associated with the project, particularly in relation to the mine design and the difficulties associated with 'make good' provisions. For example, there is a risk that the operational safety issues may result in an unexpected sterilisation of coal.

Ultimately, Mr Tessler concluded that none of these risks or uncertainties is likely to make the project economically unviable, however he noted that "*it could substantially reduce the economic case*" for the project.

While there are differences in opinion and various residual uncertainties about the scale of the project's economic benefits, the Department considers that the project is likely to have some level of economic benefits for the state of NSW.

6.4.3 Steel Making and Power Generation

The project's targeted coal seam contains a combination of coking coal and thermal coal, with a ratio of approximately 55:45. The Department acknowledges that an additional source of coking and thermal coal would make a contribution to steel-making and power generation, respectively.

However, the Department does not consider that there is any existing shortage in coking or thermal coal that needs to be filled. The Southern Coalfield already produces up to 15 million tonnes of coking coal per year, and the state of NSW produces up to 175 million tonnes of thermal coal per year.

Blue Scope Steel in Port Kembla currently sources its coking coal from a range of different sources, including existing local coal mines at Tahmoor, Metropolitan, Appin, West Cliff and Dendrobium.

Further, given the project's relatively low annual production rate of thermal coal and the Applicant's plans to export the majority of the coal, the Department does not consider that the project would make any material difference to power generation in NSW or reduce electricity prices for consumers.

6.4.4 Summary

The Department notes that there are fundamental difficulties in efficiently recovering the coal resource for this project, particularly due to the shallow depth of the coal and the risk of environmental impacts.

Even the Applicant's estimated net economic benefits of $373 million is relatively low in comparison to many other coal mining projects in the Southern Coalfield and across NSW. The scale of these benefits needs to carefully weighed up against the potential impacts of the project on the environment and the community (see **section 7**).

6.5 Other Impacts

The Department has comprehensively assessed all of the other potential impacts of the project and has provided a summary of its consideration in **Table 11**.

Table 11 | Summary of other issues raised

Issue	Consideration	Conclusion
Noise	• Construction - There would be short-term exceedances of the highly affected noise management levels under the EPA's *Interim Construction Noise Guideline* (ICNG). - The Applicant has committed to implementing the measures listed in the ICNG to manage any exceedances. • Operation - There are predicted exceedances of project specific noise levels (PSNLs) at numerous privately-owned properties surrounding the project. - For the Hume Coal Project, there are 9 properties with predicted noise levels of 3 to 5 dB above the PSNLs, and 2 properties with predicted noise levels greater than 5 dB above PSNLs. - For the Berrima Rail Project, there is 1 property with predicted noise levels of 3 to 5 dB above the PSNL. - Under the *Voluntary Land Acquisition and Mitigation Policy* (VLAMP), exceedances of 3 to 5 dB would require mitigation and exceedances greater than 5db would require acquisition. - Sleep disturbance is predicted for maximum noise events due to train pass-by-arrival on the rail loop at 3 privately-owned properties.	While there are a number of exceedances of the relevant PSNLs, the Department, the Department's independent expert and EPA consider that noise could be adequately managed through the following: • Include noise criteria in the conditions. • Restrict the construction hours to 7 am to 6 pm Monday to Friday, 8 am to 1 pm on Saturday, and no work on Sundays or public holidays. • Prepare and implement a Noise Management Plan. • Minimise the construction noise in accordance with the ICNG. • Provide mitigation and acquisition in accordance with the VLAMP. • Use approved class of locomotives for operation on the NSW rail network.
Vibration	• The nearest sensitive receptor is located 300 m from the construction blast activity for the Hume Coal Project. • Predicted construction blasts would comply with the relevant ANZECC air-blast and ground vibration criteria. • Vibration levels under Hume Highway would not cause structural damage. The predicted peak particle velocity is less than 0.1 mm/s, which is well below structural vibration screening criteria is 7.5 mm/s. • Vibration impacts from construction and operation of the Berrima Rail Project would be negligible.	The Department considers that blasting could be adequately managed through the following: • Include blasting criteria in accordance with ANZECC guidelines. • Restrict blasting hours to daylight hours only and no work on Sundays or public holidays. • Prepare and implement Vibration and Blast Management Plan in consultation with EPA.

Air Quality	• The air quality impact assessment considered any location within 165 km^2 of the project and included 76 selected receptors out of the identified 172. • Loaded and empty trains associated with the project would be covered to minimise fugitive dust emissions. • Predicted concentrations of particulate matter (TSP, PM_{10} and $PM_{2.5}$), gaseous emissions (NO_2 and VOCs) and dust deposition levels would be negligible at the sensitive receptors.	The Department and EPA consider that air quality could be adequately managed through the following: • Include air quality criteria in accordance with EPA's relevant guidelines. • Prepare and implement an Air Quality Management Plan, in consultation with EPA.
Greenhouse Gas (GHG) Emissions	• Total annual average scopes 1, 2 and 3 GHG emissions (excluding the end use of coal) for Hume Coal project are estimated as approximately 345.01 kt CO_2-e. Total maximum annual scopes 1 and 3 emissions for Berrima Rail Project are estimated as approximately 4.3 kt CO_2-e. • The predicted emission from Hume Coal Project for scopes 1, 2 and 3 GHG emissions represent approximately 0.27% of NSW annual GHG emissions and 0.066% of Australia's annual GHG emissions. • The predicted emission from Berrima Rail Project for scopes 1 and 3 represent 0.0033% of NSW and 0.0008% of Australia's annual emissions.	The Department considers GHG emissions would be minimal and could be managed through the implementation of all reasonable and feasible measures to minimise the release of GHG emissions.
Traffic	• During the construction and operation of the Hume Coal Project, there would be up to 378 additional daily light and heavy vehicle movements using the local road network (between 0.2% to 29% traffic increases on various roads). • During construction of the Berrima Rail Project, the peak daily movements would be 80 vehicles for the construction stage of Berrima Rail Project from Old Hume Highway (approximately 3% traffic increase). • During the operations of the Berrima Rail Project, there would be 10 heavy and 10 light vehicle movements per day, accessing the rail maintenance facility access road (approximately 1% traffic increase). • There would be additional delays of up to a 24 minutes per day at the major road level crossings between Robertson and Moss Vale, and associated safety risks within the local road network.	The Department and RMS consider that the traffic impacts would not be significant and could be managed through the following: • Include road and intersection upgrades, and maintenance requirements in the conditions. • Prepare an implement a Traffic Management Plan in consultation with Council and RMS. • Potentially require road maintenance contributions to Council.
Rail	• The maximum daily movements on the Berrima Branch Line would be 34 trains (17 in each direction). • This would be equivalent to 77% of the practical line operating capacity. • ARTC noted the performance improvements in its rail network resulting from the project.	The Department considers that any residual rail issues could be adequately managed by including the design and use of the proposed level crossings and railway bridges in the conditions.
Biodiversity	• The Department and OEH consider the project has largely been designed to avoid and minimise direct impacts of the project on biodiversity. • The Hume Coal Project would involve clearing of up to 8.3 ha of native vegetation and threatened species habitat and requires 101 ecosystem credits and 582 species (Koala, Squirrel Gilder and Southern Myotis) credits. • The Berrima Rail Project would involve clearing of up to 2 ha of native vegetation and threatened species habitat and requires 6 ecosystem credits and 44 species (Squirrel Gilder) credit.	The Department and OEH consider that the biodiversity impacts would not be significant and could be managed through the following: • Offset any impacts in accordance with *NSW Biodiversity Offsets Scheme*. • Prepare and implement a Biodiversity Management Plan in consultation with the OEH.

Heritage	• 206 Aboriginal sites were identified within the Hume Coal Project area, 20 of which would be affected by direct disturbance footprint (3 totally disturbed, 10 partially lost and 7 totally lost). • 11 Aboriginal sites were identified within the Berrima Rail Project area, 8 of which would be affected by direct disturbance footprint (6 partially lost and 2 totally lost). • 8 historic items were identified within the project area. A portion of one of the identified items that would be affected is in the Wingecarribee LEP.	The Department considers that the Aboriginal and historic heritage impacts would not be significant and could be managed through the following: • Include conditions requiring protection of all items. • Prepare and implement management plans in consultation with OEH, Council and Heritage Council.
Agriculture & Rehabilitation	• 279 ha of land would be disturbed for the project, including: - 117 ha of land (or 2% of the project area) for the mine infrastructure area; - 25 ha of land for the rail line; - 73 ha of land would be temporarily disturbed for the construction workers camp and site administration; and - 64 ha would be temporarily disturbed during the construction of the Berrima Rail Project.	The Department considers that the agricultural impacts would not be significant and could be managed through the following: • Include rehabilitation performance criteria. • Implement progressive rehabilitation where possible. • Prepare and implement a Rehabilitation Management Plan.

7. Evaluation

Introduction

Under the EP&A Act, the Department is required to undertake a 'triple-bottom' line assessment that balances the likely environmental, social and economic impacts of the project. In undertaking this assessment, the Department must also consider public submissions, the provisions of EPIs, the suitability of the site and the public interest.

This section of the report is a summary of the Department's overall evaluation of the project.

Project Design

The Department acknowledges that the Applicant has taken a number of important steps in designing the project to avoid and/or mitigate potential impacts of the project on the environment and the community, including:

- locating the proposed mine's surface infrastructure away from most sensitive receivers, adjacent to a major highway and on largely cleared land with limited native vegetation;
- locating the proposed rail works close to an existing industrial area (the Moss Vale Enterprise Corridor);
- utilising a range of existing infrastructure in the vicinity that would allow the transportation of coal for use and/or export at Port Kembla;
- selecting an unconventional mining method in an attempt to limit subsidence-related impacts on sensitive features at the surface, particularly in comparison to the longwall mining that is used in other parts of the Southern Coalfield; and
- selecting an unconventional method of mine water management that would use the storage capacity of the mine workings in an attempt to reduce groundwater inflows and prevent surface water discharges.

Strategic Context

The Department acknowledges that there are some advantages to the site as a coal mine, most notably the existence of a valuable coal resource and the presence of existing transportation infrastructure.

However, the targeted coal resource is located in a shallow seam that is inherently difficult to extract without causing adverse environmental impacts and disturbing existing land uses. The project is also located within the upper reaches of Sydney's drinking water catchment.

In addition, while coal mining plays a part in the Southern Highlands region's history and heritage, the region is now more widely known for its rural land uses, small-scale agriculture, scenic landscapes and tourism. The area surrounding the proposed coal mine features relatively dense, small-scale agricultural lots with most properties holding registered bores in order to gain access to productive groundwater aquifers.

These unique characteristics have led to an unconventional mine design that presents a range of uncertainties and safety risks, as well as the likelihood of significant impacts on water resources.

Consequently, the Department is concerned that the project site is not suitable for the development of a new coal mine.

Policy Context

The Mining SEPP is the key planning policy that regulates mining in NSW, including underground coal mines.

While the Mining SEPP is intended to make underground coal mining permissible on almost any land, it only allows underground mining "*with development consent*".

In particular, clause 12 of the Mining SEPP requires the consent authority to consider whether the project is compatible with other land uses, including "*existing, approved and likely preferred land uses*". In that regard, the zoning provisions of the LEP are relevant to the extent that they influence the existing, approved and likely preferred land uses in the project area and its surrounds.

The majority of the project is zoned as E3 Environmental Management (approximately 70%) and there is also a smaller area in the southwestern portion that is zoned RU2 Rural Landscape (approximately 3%).

Based on the limited list of permitted land uses and the non-mandatory objectives in both the E3 and RU2 zones, the Department is concerned that a new coal mine may not be compatible with the *"existing, approved and likely preferred land uses"* of these zones.

Further, under clause 10 of the Drinking Water Catchment SEPP, the consent authority must not "*grant consent to the carrying out of development*" in the drinking water catchment unless it would have a 'neutral or beneficial effect' on water quality (the 'NorBe test').

The Applicant has not undertaken an assessment of the potential surface water impacts associated with the potential need to store additional mine water above ground. Consequently, the Department considers that the project may not conform with the Drinking Water Catchment SEPP.

Submissions

The vast majority of the community has expressed its opposition to the project, particularly those in close proximity to the proposed mine site.

The Department received a total of 12,666 submissions on the project, of which 96% were objections, 3% supported the project and less than 1% provided comments. The key issues raised in objections were groundwater, and social and economic impacts.

The Department has reviewed the geographical locations of the submissions and notes that 5,099 were received from addresses within postcodes that are within or adjacent to the project area. The vast majority of these submissions were objections to the project, i.e. 4,930 objections or approximately 97%.

The Department acknowledges that the Applicant has made considerable efforts to respond to the concerns raised by government agencies and the community throughout the development assessment process, including:

- revising its entire groundwater model and undertaking comprehensive uncertainty and sensitivity analyses;
- updating its groundwater impact assessment, including the preparation of a detailed 'make good strategy';
- commissioning an international mining engineering expert to prepare a three-dimensional geotechnical model; and
- undertaking additional consultation with the community to address amenity impacts and progress potential make good arrangements.

Notwithstanding, Wingecarribee Shire Council maintains its objection to the project and has a policy against any coal mining in its local government area.

None of the other government agencies objected to the project, however several agencies have significant residual concerns about the potential impacts of the project.

While there are supporters of the project, the community engagement undertaken by the Department indicates strong and widespread opposition to the project from the local community.

Likely Impacts

The Department has undertaken a comprehensive assessment of the full range of potential impacts and considers that most could be managed, mitigated or offset to achieve an acceptable level of environmental performance.

Groundwater

However, the project is predicted to have significant impacts on a highly productive groundwater aquifer, including drawdown impacts on up to 118 privately held bores.

Regardless of any uncertainty about the modelling, the predicted drawdown impacts on this aquifer would be the most significant for any mining project that has ever been assessed in NSW.

The significant groundwater drawdown impacts are largely due to a range of project-specific factors, which means there are limited opportunities to further minimise impacts.

The Applicant has proposed a strategy to 'make good' on the predicted drawdown impacts. While the proposed make good measures (e.g. deepening pumps or replacing bores) may be feasible from a strictly technical standpoint, the Department considers that make good arrangements are not suitable or practical in this case.

Given the significant opposition to the project in the local area, the proposed make good process would inevitably result in a large number of negotiations and disputes with local landowners, unavoidable delays to the development of the project, and significant disruption to the community.

Mine Design

The unconventional pine feather mining method was largely selected to minimise subsidence and associated impacts to surface features. However, the combination of an untested mining method and an unconventional method of storing large quantities of mine water underground is likely to result in serious operational safety risks.

The Department considers that the various safety risks may lead to the transfer of additional mine water to the surface and a need to discharge into local watercourses. The Applicant has not assessed this issue or proposed a water treatment plant.

Any discharge of mine water may result in significant impacts on surface water within Sydney's drinking water catchment.

Further, there is a risk that the operational safety issues associated with the unconventional mine design may result in an unexpected sterilisation of coal, which may significantly reduce the economic benefits of the project.

Economic

While there are differences in opinion and various residual uncertainties about the scale of the project's economic benefits, the Department considers that the project is likely to have some level of economic benefits for the state of NSW.

However, the Department notes that there are fundamental difficulties in efficiently recovering the coal resource for this project, particularly due to the shallow depth of the coal and the risk of environmental impacts.

Importantly, even the Applicant's estimated net economic benefits of $373 million is relatively low in comparison to many other coal mining projects in the Southern Coalfield and across NSW.

Public Interest

The courts in NSW have held that the concept of 'ecologically sustainable development' should be taken into account in considering the public interest. The Department considers that there is a threat of serious harm to both groundwater and surface water resources, and there is currently considerable scientific uncertainty about the level of environmental damage to both.

Consequently, the 'precautionary principle' is triggered and the project as currently proposed should not be considered an 'ecologically sustainable development'.

Further, while the project is likely to have some level of economic benefits for the state of NSW, the scale of these benefits needs to carefully weighed up against the potential impacts of the project on the environment and the community.

The Department considers that the economic benefits cannot be realised without significant adverse impacts on the environment and the local community, particularly in relation to groundwater impacts. At this stage, the Department does not consider that the economic benefits outweigh the likely adverse impacts on the environment and community.

Consequently, based on the information currently available, the Department considers that the project should not be approved.

Preshaw 6/12/18

Clay Preshaw
Director
Resource and Energy Assessments

Kitto 6/12/18

David Kitto
Executive Director
Resource Assessments and Business Systems

Appendices

Appendix A: Environmental Impact Statement

Refer to the Department's website:

Hume Coal Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7172

Berrima Rail Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7171

Appendix B: Submissions

Refer to the Department's website:

Hume Coal Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7172

Berrima Rail Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7171

Appendix C: Department's Initial Independent Expert Reports

Refer to the Department's website:

Hume Coal Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7172

Berrima Rail Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7171

Appendix D: Response to Submissions

Refer to the Department's website:

Hume Coal Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7172

Berrima Rail Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7171

Appendix E: Applicant's Response to Initial Independent Expert Reports

Refer to the Department's website:

Hume Coal Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7172

Berrima Rail Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7171

Appendix F: Comments on Response to Submissions

Refer to the Department's website:

Hume Coal Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7172

Berrima Rail Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7171

Appendix G: Department's Supplementary Independent Expert Reports

Refer to the Department's website:

Hume Coal Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7172

Berrima Rail Project: http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7171