Appendix O

Rehabilitation and Closure Strategy

Hume Coal Project

Environmental Impact Statement | Appendix O | Closure and Rehabilitation Strategy

Prepared for Hume Coal Pty Limited | 7 March 2017

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Hume Coal Project

Final

Report J12055RP1 | Prepared for Hume Coal Pty Limited | 7 March 2017

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Executive Summary

This Closure and Rehabilitation Strategy (the strategy) forms part of the environmental impact statement to support a development application for the Hume Coal Project (the project); for which approval is sought under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979.*

The overarching rehabilitation objective of the project is to restore the land to its pre-mining land use at the end of its operational life; that is, an agricultural land use comprising grazing on improved pasture. Being an underground mine, disturbed areas on the surface requiring rehabilitation will be minimal, with the disturbance footprint comprising only 2.3% of the entire project area.

There will be opportunities for progressive rehabilitation of areas containing early and temporary works or facilities such as the construction accommodation village, once vacated. During operations, wherever possible disturbed areas no longer required for mining activities, such as drill pads and access tracks, will be progressively rehabilitated.

The project area has been divided into a series of primary domains, in accordance with *ESG3 Mining Operations Plan (MOP) Guidelines* (NSW Department of Trade and Investment – Division of Resources and Energy 2013). The primary domains form the basis of conceptual rehabilitation and project closure planning for this strategy. The primary domains identified across the project area are infrastructure areas; water management areas; stockpiled material; and underground mining area. All of the project primary domains have been assigned a secondary domain (post-mining land use) of "D – Rehabilitation Area – Pasture."

Preliminary completion criteria have been developed for each of the domains as part of this strategy. Rehabilitation monitoring will be undertaken throughout the mine life and post-closure (until lease relinquishment) to assess progress towards meeting this criteria. Whether rehabilitation criteria have been met depends on the trending of measurements over time compared to pre-mining or reference site conditions. The criteria will be refined and confirmed in the MOP and in the detailed closure plan as the project progresses towards closure.

Closure of the mine will involve decommissioning and removal of infrastructure and services; soil testing of potentially contaminated areas such as coal stockpile areas and hydrocarbon storage areas; and remediation or removal of any contaminated soil if required. Compacted areas will be deep ripped, contouring earthworks will be undertaken to blend disturbed surfaces into surrounding topography; and stockpiled soil applied to promote establishment of improved pasture suited to the future land use of grazing land.

As underground mining progresses, the mined out voids will be progressively sealed, enabling the progressive emplacement of rejects underground, and assisting with groundwater management by allowing water injection as well as natural recharge to occur. When mining is completed in each panel, the panel will be sealed through the installation of water-retaining rated bulkhead seals, in accordance with the requirements of *Work Health and Safety (Mines and Petroleum sites) Regulation 2014*, and *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February 2012*.

Spontaneous combustion is not expected to be a risk during operation or at closure.

There risks of subsidence related impacts occurring above the underground mine are negligible, due to the first workings mining method which retains pillars of coal to support the overlying strata. No rehabilitation activities as a result of mine subsidence impacts will therefore be required.

Post-mining, the land and soil capability class for the vast majority of the project area (ie 4,969 hectares (ha)) will remain unchanged due to the underground nature of the project and the first workings mining method, with negligible associated subsidence, to be employed. Of the 117 ha to be disturbed, 59 ha will be rehabilitated back to the original land and soil capability, as the soil profile will not be significantly altered. There will be a change to the land and soil capability class over 58 ha of land disturbed by the surface infrastructure area and water management areas. The original land class of these areas (3 ha of Class 3, 37 ha of Class 4 and 18 ha of Class 5) will change to Class 6 because the soil depth will be 0.3 m as the replaced topsoil will overlie re-profiled fill materials. However, Class 6 land will still be suitable for grazing and improved pasture, allowing the continuation of an agricultural land-use post-mining, as it is now.

Final rehabilitation and project closure requirements will ultimately be developed as part of a detailed closure plan, which will be produced within five years of closure in consideration of input from key government agencies and relevant stakeholders at the time.

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1 Introduction

1.1 Overview

Hume Coal Pty Limited (Hume Coal) is seeking State significant development consent to construct and operate an underground coal mine and associated mine infrastructure (the 'Hume Coal Project') in the Southern Coalfield of New South Wales (NSW). Hume Coal holds exploration Authorisation 349 (A349) to the west of Moss Vale, in the Wingecarribee local government area (LGA). The underground mine will be developed within part of A349 and associated surface facilities will be developed immediately north of A349. The project area and its regional and local setting are shown in Figure 1.1 and Figure 1.2.

The project has been developed following several years of technical investigations to define the mineable resource and identify and address environmental and other constraints. Low impact mining methods will be used which will have negligible subsidence impacts and thereby protect the overlying aquifer and surface features and allow existing land uses to continue at the surface. Post-mining, the mine infrastructure will be decommissioned and these areas rehabilitated to a state where they can support land uses similar to the current land uses.

Approval for the Hume Coal Project (the project) is being sought under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). An environmental impact statement (EIS) is a requirement of the approval processes. This Mine Closure and Rehabilitation Strategy forms part of the EIS.

1.2 Project description

The project involves developing and operating an underground coal mine and associated infrastructure over a total estimated project life of 23 years. Indicative mine and surface infrastructure plans are provided in Figure 1.3 and Figure 1.4. A full description of the project, as assessed in this report, is provided in Chapter 2 of the main EIS report (EMM 2017a).

In summary it involves:

- Ongoing resource definition activities, along with geotechnical and engineering testing, and other fieldwork to facilitate detailed design.
- Establishment of a temporary construction accommodation village.
- Development and operation of an underground coal mine, comprising of approximately two years of construction and 19 years of mining, followed by a closure and rehabilitation phase of up to two years, leading to a total project life of 23 years. Some coal extraction will commence during the second year of construction and hence there will be some overlap between the construction and operational phases.
- Extraction of approximately 50 million tonnes (Mt) of run-of-mine (ROM) coal from the Wongawilli Seam, at a rate of up to 3.5 million tonnes per annum (Mtpa). Low impact mining methods will be used, which will have negligible subsidence impacts.
- Following processing of ROM coal in the coal preparation plant (CPP), production of up to 3 Mtpa of metallurgical and thermal coal for sale to international and domestic markets.

- Construction and operation of associated mine infrastructure, mostly on cleared land, including:
    - one personnel and materials drift access and one conveyor drift access from the surface to the coal seam;
    - ventilation shafts, comprising one upcast ventilation shaft and fans, and up to two downcast shafts installed over the life of the mine, depending on ventilation requirements as the mine progresses;
    - a surface infrastructure area, including administration, bathhouse, washdown and workshop facilities, fuel and lubrication storage, warehouses, laydown areas, and other facilities. The surface infrastructure area will also comprise the CPP and ROM coal, product coal and emergency reject stockpiles;
    - surface and groundwater management and treatment facilities, including storages, pipelines, pumps and associated infrastructure;
    - overland conveyors;
    - rail load-out facilities;
    - a small explosives magazine;
    - ancillary facilities, including fences, access roads, car parking areas, helipad and communications infrastructure; and
    - environmental management and monitoring equipment.
- Establishment of site access from Mereworth Road, and construction of minor internal roads.
- Coal reject emplacement underground, in the mined-out voids.
- Peak workforces of approximately 414 full-time equivalent employees during construction and approximately 300 full-time equivalent employees during operations.
- Decommissioning of mine infrastructure and rehabilitating the area once mining is complete, so that it can support land uses similar to current land uses.

The project area, shown in Figure 1.2 is approximately 5,051 hectares (ha). Surface disturbance will mainly be restricted to the surface infrastructure areas shown indicatively on Figure 1.4 though will include some other areas above the underground mine, such as drill pads and access tracks. The project area generally comprises direct surface disturbance areas of up to approximately 117 ha, and an underground mining area of approximately 3,472 ha, where negligible subsidence impacts are anticipated.

A construction buffer zone will be provided around the direct disturbance areas. The buffer zone will provide an area for construction vehicle and equipment movements, minor stockpiling and equipment laydown, as well as allowing for minor realignments of surface infrastructure. Ground disturbance will generally be minor and associated with temporary vehicle tracks and sediment controls as well as minor works such as backfilled trenches associated with realignment of existing services. Notwithstanding, environmental features identified in the relevant technical assessments will be marked as avoidance zones so that activities in this area do not have an environmental impact.

Product coal will be transported by rail, primarily to Port Kembla terminal for the international market, and possibly to the domestic market depending on market demand. Rail works and use are the subject of a separate EIS and State significant development application for the Berrima Rail Project.

1.3 Project area and study area

The surface and underground mining infrastructure areas within the project area are addressed as part of this rehabilitation and closure assessment. The impact assessment focuses on the infrastructure areas within the project area as these areas will experience the greatest level of disturbance.

1.4 General site description

The project area is approximately 100 km south-west of Sydney and 4.5 km west of Moss Vale town centre in the Wingecarribee LGA (refer to Figure 1.1 and Figure 1.2). The nearest area of surface disturbance will be associated with the surface infrastructure area, which will be 7.2 km north-west of Moss Vale town centre. It is in the Southern Highlands region of NSW and the Sydney Basin Biogeographic Region.

The project area is in a semi-rural setting, with the wider region characterised by grazing properties, small-scale farm businesses, natural areas, forestry, scattered rural residences, villages and towns, industrial activities such as the Berrima Cement work and Berrima Feed Mill, and some extractive industry and major transport infrastructure such as the Hume Highway.

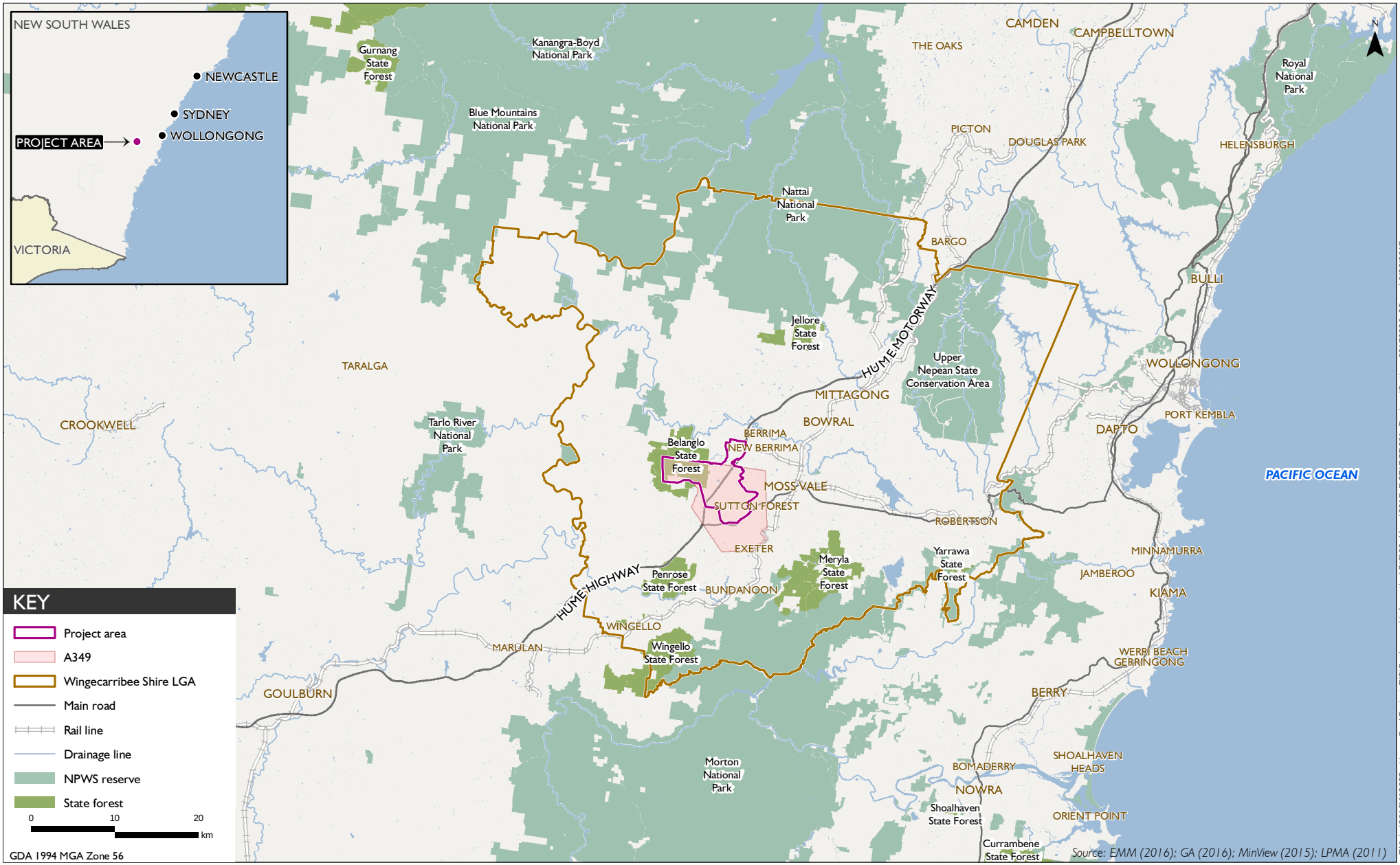
Surface infrastructure is proposed to be developed on predominately cleared land owned by Hume Coal or affiliated entities, or for which there are appropriate access agreements in place with the landowner. Over half of the remainder of the project area (principally land above the underground mining area) comprises cleared land that is, and will continue to be, used for livestock grazing and small-scale farm businesses. Belanglo State Forest covers the north-western portion of the project area and contains introduced pine forest plantations, areas of native vegetation and several creeks that flow through deep sandstone gorges. Native vegetation within the project area is largely restricted to parts of Belanglo State Forest and riparian corridors along some watercourses.

The project area is traversed by several drainage lines including Oldbury Creek, Medway Rivulet, Wells Creek, Wells Creek Tributary, Belanglo Creek and Longacre Creek, all of which ultimately discharge to the Wingecarribee River, at least 5 km downstream of the project area. The Wingecarribee River's catchment forms part of the broader Warragamba Dam and Hawkesbury-Nepean catchments. Medway Dam is also adjacent to the northern portion of the project area.

Most of the central and eastern parts of the project area have very low rolling hills with occasional elevated ridge lines. However, there are steeper slopes and deep gorges in the west in Belanglo State Forest.

Existing built features across the project area include scattered rural residences and farm improvements such as outbuildings, dams, access tracks, fences, yards and gardens, as well as infrastructure and utilities including roads, electricity lines, communications cables and water and gas pipelines. Key roads that traverse the project area are the Hume Highway and Golden Vale Road. The Illawarra Highway borders the south-east section of the project area.

Industrial and manufacturing facilities adjacent to the project area include the Berrima Cement Works and Berrima Feed Mill on the fringe of New Berrima. Berrima Colliery's mining lease (CCL 748) also adjoins the project area's northern boundary. Berrima colliery is currently not operating with production having ceased in 2013 after almost 100 years of operation. The mine is currently undergoing closure.

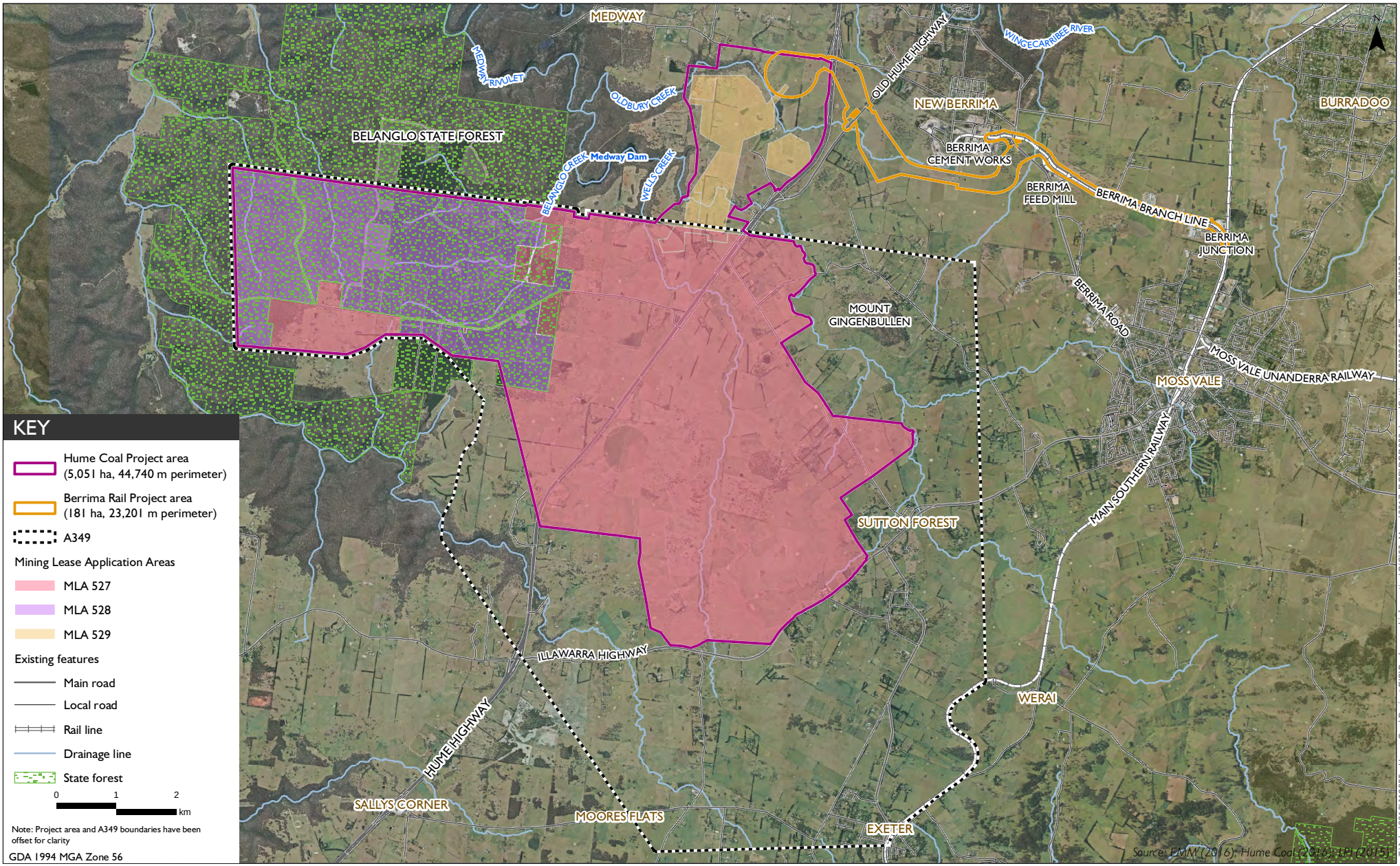


Regional context

Hume Coal Project

Closure and Rehabilitation Strategy

Figure 1.1

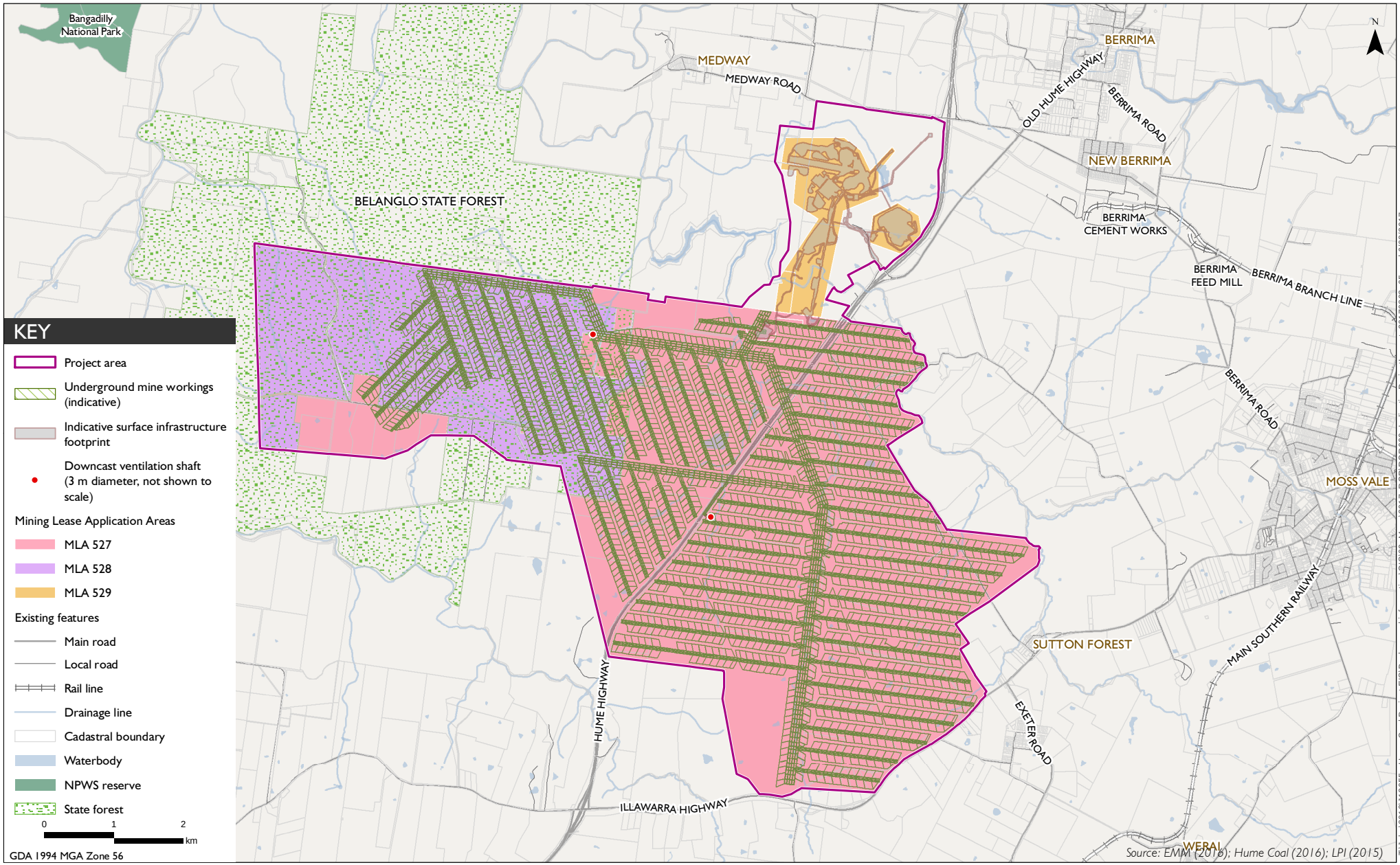


Local context

Hume Coal Project

Closure and Rehabilitation Strategy

Figure 1.2

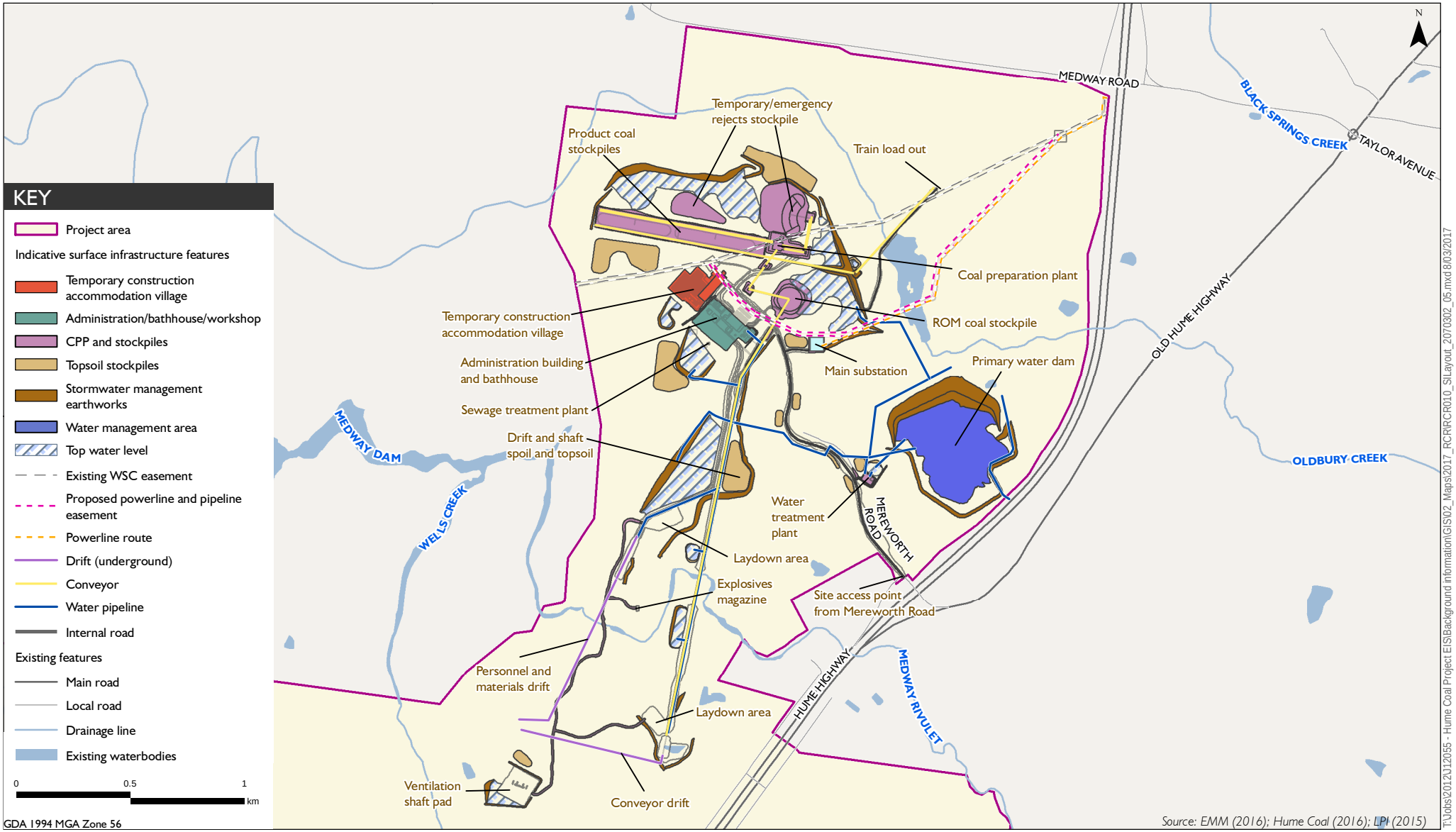


Indicative project layout

Hume Coal Project

Closure and Rehabilitation Strategy

Figure 1.3



Indicative surface infrastructure layout

Hume Coal Project
Closure and Rehabilitation Strategy

Figure 1.4

1.5 Assessment requirements

This assessment has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies, and in consultation with the relevant government agencies.

This strategy has been prepared in accordance with requirements of the Commonwealth Department of the Environment and Energy (DoEE) and NSW Department of Planning and Environment (DP&E). These were set out in the Secretary's Environmental Assessment Requirements (SEARs) for project, issued on 20 August 2015, and supplementary SEARs issued on 18 January 2016. The SEARs identify matters which must be addressed in the EIS and essentially form its terms of reference. A copy of the SEARs is attached to the EIS as Appendix B, while Table 1.1 lists the individual requirements relevant to this strategy and provides a reference to where they have been addressed.

Table 1.1 Rehabilitation and closure related Secretary's environmental assessment requirements (SEARs)

Requirement	Section addressed
The EIS must include a rehabilitation strategy, having regard to DRE's requirements (see Attachment 2)	See Table 1.2

To inform preparation of the SEARs, DP&E invited other government agencies to recommend matters for address in the EIS. These matters were taken into account by the Secretary for DP&E when preparing the SEARs. Copies of the government agencies' advice to DP&E was attached to the SEARs.

Two agencies, Department of Industry, Resources and Energy (DRE) and the Department of Primary Industries – Water (DPI Water) raised matters relevant to the rehabilitation and closure assessment. The matters raised are listed in Table 1.2 and Table 1.3 and have been taken into account in preparing this strategy, as indicated in the tables.

Table 1.2 DRE comments: standard and project-specific assessment recommendations

Recommendation	Section addressed
A statement on the interaction between the proposed mining activities and the existing environment and inclusion of a comprehensive description of the following and their impacts: - mine layout and scheduling, including maximising opportunities for progressive final rehabilitation. The final rehabilitation schedule should be mapped against key production milestones (i.e. ROM tonnes) of the mine layout sequence before being translated to indicative timeframes throughout the mine life. The mine plan should maximise opportunities for progressive rehabilitation; - mineral processing and handling, washery rejects handling and disposal management activities; - infrastructure facilities and storage requirements; and - mine closure including rehabilitation and decommissioning activities.	Section 2 Further details in Ch 2 of EIS

Table 1.2 DRE comments: standard and project-specific assessment recommendations

Recommendation		Section addressed
Impacts associated with the operational and post closure stages of the project must also be identified in detail and control management measures outlined. The identification and description of impacts must draw out those aspects of the site that may present barriers or limitations to effective rehabilitation and which may limit the mine closure potential of the land. The following are the key issues to be addressed in the EIS that are likely to have a bearing on rehabilitation and mine closure:		
-	An evaluation of current rehabilitation techniques and performance against meeting existing rehabilitation objectives and completion criteria.	Widely accepted rehabilitation techniques are proposed, as described in Section 17.7. A literature review of successful mine site rehabilitation for a grazing land use was also conducted as part of the AIS (refer to Section 7.6.5 of Appendix G)
-	An assessment and life of mine management strategy of the potential for geochemical constraints to rehabilitation, particularly associated with the management of overburden/interburden and reject material. Based on this assessment, the EIS is to document the processes that will be implemented throughout the mine life to identify and appropriately manage geochemical risks that may affect the ability to achieve sustainable rehabilitation outcomes.	Section 3.2.1 *See Water Assessment Report (Appendix E of the EIS)*
-	A life of mine tailings management strategy which is to detail measures to be implemented to avoid the exposure of potentially environmentally sensitive tailings material as well as promote geotechnical stability of the rehabilitated landform.	Section 2.2.3.iii for management of coal rejects (ie tailings) *See Ch 2.8 of EIS (Coal washing and processing)*
-	Existing and surrounding landforms (showing contours and slopes) and how similar characteristics can be incorporated into the post-mining final landform design. This should include an evaluation of how the key geomorphological characteristics evident in stable landforms within the natural landscape can be adapted to the materials and other constraints associated with the site.	Section 4.4 and Figure 4.1
-	Groundwater assessment to determine the likelihood and associated impacts of groundwater accumulating and subsequently discharging (eg acid or neutral mine drainage) from the workings post cessation of mining. This is to include a consideration of the likely controls required to prevent or mitigate against these risks as part of the closure plan for the site.	*See Ch 7 EIS, and Appendix E of EIS*
-	An assessment of the biological resources associated with the proposed disturbance area and how they can be practically salvaged for utilisation in rehabilitation (ie topsoil, seedbanks, tree hollows and logs, native seed etc.), including an evaluation of how topsoil/subsoil of suitable quality can be direct-returned for use in rehabilitation.	Section 5.2 – 5.4 (topsoil management) *See Ch 8 EIS, and Soils and Land Assessment Report (Appendix F of EIS)* See Ch 10 EIS, and Biodiversity Report (Appendix H of EIS)
-	The flora, fauna and ecological attributes of the disturbed area should be recorded and placed in a regional context.	See Ch 10 EIS, and Biodiversity Report (Appendix H of EIS)

Table 1.2 DRE comments: standard and project-specific assessment recommendations

Recommendation		Section addressed
-	An evaluation of current land capability class and associated condition. The EIS should characterise soils across the proposed area of surface disturbance and assess their value and identify opportunities and constraints for use in rehabilitation.	Section 4.6 *See Ch 8 EIS, and Soils and Land Assessment Report (Appendix F of EIS)*
-	Where an agricultural land use is proposed, the EIS should: ▪ demonstrate how Agricultural Suitability Class in the rehabilitated landscape would be returned to the existing Class/es or better. ▪ where the intended land use is likely to be grazing, the existing capacity in terms of Dry Sheep Equivalent or similar must be calculated and a timeframe from vegetation establishment be given for the return to agricultural production to at least the existing stock capacity. ▪ provide information on how soil would be developed in order to achieve the proposed stock capacity.	*See Ch 9 EIS, and Agricultural Impact Statement (Appendix of G EIS)*
-	Where an ecological land use is proposed, the EIS should demonstrate that the revegetation strategy (eg seed mix, habitat features, corridor width etc.) has been developed in consideration of the target vegetation community(s).	An ecological land use is not proposed – therefore not applicable See Ch 10 EIS, and Biodiversity Report (Appendix H of EIS)
REHABILITATION AND MINE CLOSURE DRE's role focuses on ensuring that land mined in NSW is effectively rehabilitated and returned to beneficial post mining land uses. This is undertaken by requiring mine operators to have strategies in place to ensure the rehabilitation of all mined land, and strategies in place to ensure the rehabilitation of all mined land, and strategies for an orderly transition from a mining land use to an agreed stable and beneficial post mining use. At the EIS stage, the strategies may be conceptual in nature. Each of the following aspects of rehabilitation planning should be addressed in the strategy:		
-	Post Mining Land Use – the proponent must identify and assess post-mining land use options and provide a statement of the preferred post-mining land use outcome in the EIS, including a discussion of how the final land use(s) are aligned with relevant local and regional strategic land use objectives as well as the benefits of the post-mining land to the surrounding environment, a subsequent landowner, the local community and the state of NSW.	Section 4
-	Rehabilitation Objectives and Domains - a set of project rehabilitation objectives and completion criteria that define the environmental outcomes required to achieve the final land use for each domain. The criteria must be specific, measurable, achievable, realistic and time-bound. - If necessary, objective criteria may be presented as ranges rather than finite indicator levels. Subjective criteria may also apply where a gap in technical knowledge is experienced. Further refinement of these criteria will be undertaken and included in the Rehabilitation Management Plan (RMP).	Section 4 and 6
-	Final Landform Design - a drawing at an appropriate scale with final landform contours should be provided which identifies vegetation types, habitat features, contaminated areas, drainage infrastructure, access and internal roads, fencing design and other remaining infrastructure such as sheds, dams, bores and pipelines.	Figure 4.1

Table 1.2 DRE comments: standard and project-specific assessment recommendations

Recommendation	Section addressed
- Scope of Rehabilitation and Decommissioning Activities – The EIS is to include a detailed description of the scope of decommissioning and rehabilitation activities required to meet the nominated closure objectives and completion criteria for each domain. The scope of these activities must be developed in consideration of the existing environment, identification of impacts and constraints as listed above.	Section 4.5
- Monitoring and Research - Outline the proposed monitoring programs that will be implemented to assess how rehabilitation is trending towards the nominated land use objectives and completion criteria. This should include details of the process for triggering intervention and adaptive management measures to address potential adverse results as well as continuously improve rehabilitation practices.	Section 6.3
- In addition, an outline of proposed rehabilitation research programs and trial, including objectives. This should include details of how the outcomes of research are considered as part of the ongoing review and improvement of rehabilitation practices.	
- Post-closure maintenance - Describe how post-rehabilitation areas will be actively managed and maintained in accordance with the intended land ues(s) in order to demonstrate progress towards meeting the closure objectives and completion criteria in a timely manner.	Section 5.7

Table 1.3 DPI - Water comments: standard and project-specific assessment recommendations

Recommendation	Section addressed
Landform rehabilitation (including final void management) Where significant modification to landform is proposed, the EIS must include:	
• Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems.	Section 4 *See Ch 7 EIS, and Water Assessment Report (Appendix E of EIS)*
• A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape.	Section 4
• Outline of proposed construction and restoration of topography and surface drainage features if affected by the project.	Section 4.4, 4.5
• The measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.	Section 5.7.5
• The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.	*See Ch 7 EIS, and Water Assessment Report (Appendix E of EIS)*

1.6 Other legislation, guidelines and leading practice

There is no clear directive provided within NSW legislation describing the engineered controls that underground mines must use during closure and rehabilitation. The following sections describe sections of the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014*, the *Mining Act 1992* and the *Protection of the Environment Operations Act 1997* (POEO Act) that are relevant to the closure and rehabilitation of the project and how they have been addressed within this strategy.

1.6.1 Legislation and environmental planning instruments

i Work Health and Safety (Mines and Petroleum Sites) Regulation 2014

The *Work Health and Safety (Mines and Petroleum Sites) Act* 2013 and Work *Health and Safety (Mines and Petroleum Sites) Regulation 2014* (WHS (Mines Petroleum Sites) Regulation) regulate the process of permanently sealing surface entries into underground mines. Specifically, closure and rehabilitation is addressed in the WHS (Mines Petroleum Sites) Regulation in Clause 35:

> 35 Closure, suspension or abandonment of mine or petroleum site:
>
> (1) If the operator of a mine or petroleum site closes the mine or petroleum site, the operator must, at the time of the closure, ensure so far as is reasonably practicable that the mine or petroleum site is safe, including by being secure against unauthorised entry by any person.
>
> (2) If mining activities or petroleum activities at a mine or petroleum site are suspended, the operator must ensure so far as is reasonably practicable that the mine or petroleum site is safe, including by being secure against unauthorised entry by any person during the period of suspension.
>
> (3) For the purposes of subclause (1) or (2), a mine is not secure against unauthorised entry by a person unless every shaft or outlet to the mine:
>
> (a) is permanently sealed or filled, or
>
> (b) is provided with a barrier that is properly maintained....”

The relevant provisions of the WHS (Mines Petroleum Sites) Regulation have been considered during the preparation of this strategy. As discussed further in Section 4.5.1 ii, Hume Coal will undertake the following steps prior to closing all surface entries to the underground mine:

- A risk assessment will be undertaken and used to inform the design of the seal; and
- a detailed design and installation procedure will be developed and approved by the relevant Authority, prior to it being applied.

ii Mining Act 1992

Rehabilitation and environmental performance conditions are attached to all mining leases issued under the Mining Act. The Mining Act defines rehabilitation as the "treatment or management of disturbed land or water for the purpose of establishing a safe and stable environment".

Titleholders are required to develop a Mining Operations Plan (MOP) which includes objectives and criteria for rehabilitation, rehabilitation plans, risks that need to be addressed, rehabilitation controls and methodologies, and monitoring programs. The MOP is not required at this stage of the approval (discussed in greater detail in Section 1.4.2iii), but the requirements of the MOP have been addressed in this Closure and Rehabilitation Strategy. Accordingly, rehabilitation of the project area will be carried out generally in accordance with this strategy.

iii Protection of the Environment Operations Act 1997

The POEO Act establishes the State's environmental regulatory framework and includes licensing requirements for certain activities. The objectives of the POEO Act that relate to decommissioning and rehabilitation include *...to protect, restore and enhance the environment, to reduce risks to human health and prevent degradation of the environment*.

The POEO Act objectives have been used in the preparation of this strategy, and are principally reflected in one of the overarching goals of the strategy; to minimise the risk of offsite pollution occurring from the site during and following closure, decommissioning and rehabilitation.

iv Wingecarribee Local Environmental Plan 2010

The *Wingecarribee Local Environmental Plan 2010* has outlined objectives for each land use zone in the shire. The disturbance footprint of the project, is within land zoned E3 – Environmental Management. The objectives for this zone are:

- To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values.
- To provide for a limited range of development that does not have an adverse effect on those values.
- To encourage the retention of the remaining evidence of significant historic and social values expressed in existing landscape and land use patterns.
- To minimise the proliferation of buildings and other structures in these sensitive landscape areas.
- To provide for a restricted range of development and land use activities that provide for rural settlement, sustainable agriculture, other types of economic and employment development, recreation and community amenity in identified drinking water catchment areas.
- To protect significant agricultural resources (soil, water and vegetation) in recognition of their value to Wingecarribee's longer term economic sustainability.

The objectives for the zone have been considered when identifying final land use options. Returning the land back to the pre-mining agricultural land use is consistent with the second and fifth objective of retaining a restricted range of development that provides for sustainable agriculture. Removal of all infrastructure at decommissioning is consistent with the fourth objective of minimising the proliferation of buildings.

1.6.2 Guidelines

This strategy has been prepared generally in accordance with the appropriate guidelines, policies and industry requirements, where appropriate. Guidelines and policies referenced are as follows:

- *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells* (NSW Department of Industry, Skills and Regional Development - Division of Resources and Energy, March 2016);
- *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February, 2012* (NSW Department of Trade and Investment – Division of Mine Safety, 2012);
- *ESG3 – Mining Operations Plan (MOP) Guidelines , September 2013* (NSW Department of Trade and Investment – Division of Resources and Energy, 2013);
- The *Strategic Framework for Mine Closure* (ANZMEC and MCA, 2000);
- *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth of Australia, 2006); and
- *Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth of Australia, 2006).

The relevance of each of the guidelines is discussed briefly in the following sections.

i Borehole Sealing Requirements on Land

The guideline *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells* (the drilling guideline) provides an overview of the process for rehabilitation of boreholes not licensed under the *Water Management Act 2000*.

In the event that any boreholes remain open at completion of the operational phase, Hume Coal will appropriately rehabilitate any remaining boreholes, having regard to the borehole sealing requirements in the drilling guideline.

ii Permanent Filling and Capping of Surface Entries Guidelines

The *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams* (the guideline) (NSW Department of Trade and Investment – Division of Mine Safety, 2012) provides an overview of the process for design and approval of permanent caps and seals for surface entries into underground mines. The guideline *"is designed to be used to describe the minimum requirements to safely perform the task of sealing entries to the point where they can be considered permanently sealed."*

This strategy sets out the proposed approach to permanently cap and/or seal drifts and ventilation shafts.

iii Mining Operations Plan Guidelines

The *ESG3 – Mining Operations Plan (MOP) Guidelines, September 2013* (the MOP guidelines) (NSW Department of Trade and Investment – Division of Resources and Energy 2013) provide an overview of the approval process for mining developments in NSW and provides content and formatting requirements for MOPs and Annual Reviews. The purpose of these documents is to *"ensure that all mining operations are safe, the resources are efficiently extracted, the environment is protected and rehabilitation achieves a stable and satisfactory outcome."* Specifically, the MOP must meet the content and format as set out in the MOP guidelines as well as:

- be consistent with any development consent requirements;
- be consistent with safety management plans;
- be based on objectives and outcomes developed with stakeholder involvement;
- provide sufficient detail, supported by scientific and engineering assessment and/or peer review where appropriate, to clearly demonstrate that the objectives and outcomes defined in the MOP will be met; and
- where necessary, contain an environmental assessment of any impacts associated with the implementation of the MOP, where the activities have not been previously assessed under the EP&A Act.

This strategy has been prepared to address the various requirements of the closure and rehabilitation aspects of the MOP guidelines. A MOP will be prepared and submitted to the DRE for approval following the grant of development consent for the project. An approved MOP must be in place prior to commencing any significant disturbance activities.

As noted in the MOP guidelines, a MOP is designed to fulfil the function of both a rehabilitation plan and a mine closure plan. It will document the long-term mine closure principles and outcomes whilst outlining the proposed rehabilitation activities (if any) during the MOP term (typically five years).

A MOP also forms the basis for the estimation of the security deposit imposed to ensure compliance with conditions of authorisation granted under the Mining Act. An estimate of rehabilitation cost has been prepared, and will be updated and presented in the MOP, prior to commencing operations.

iv Strategic Framework for Mine Closure

The *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia, 2000) (SFMC) was developed to promote nationally consistent mine closure management. The SFMC provides guidelines for the development of a mine closure plan to make sure that all stages of mine closure are conducted appropriately, including stakeholder engagement, development of mine closure methodology, financial planning, and implementation of mine closure. The SFMC also describes the expected standards for mine closure and relinquishment of the mine to a responsible authority. Whilst the objectives generally relate to mine closure, there are key elements that are relevant to rehabilitation of the project, in particular the allocation of appropriate resources and the establishment of rehabilitation criteria which have been included in this strategy. The main objectives of the SFMC are:

> "To enable all stakeholders to have their interests considered during the mine closure process;
>
> To ensure the process of closure occurs in an orderly, cost-effective and timely manner;
>
> To ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability;
>
> To ensure there is clear accountability, and adequate resources, for the implementation of the closure plan;
>
> To establish a set of indicators which will demonstrate the successful completion of the closure process; and
>
> To reach a point where the company has met agreed rehabilitation criteria to the satisfaction of the Responsible Authority."

v Mine Rehabilitation - Leading Practice Sustainable Development Program for the Mining Industry

The aim of *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (NSW Department of Industry, Tourism and Resources, 2006) (MR Handbook) is to provide guidelines to promote 'leading practice' sustainable mine plan and rehabilitation design, considering environmental, economic, and social aspects to support on-going sustainability of a mining development. The MR Handbook recommends procedures and mitigation measures that should be considered during mine plan and rehabilitation design, including stakeholder consultation, material and handling, water balance, final landform design, soil (topsoil and subsoil) management, vegetation and fauna habitat re-establishment and rehabilitation, and agriculture / commercial forestry suitability. The MR Handbook also provides relevant mine development case studies supporting the recommended procedures and mitigation measures. Where relevant to the project, the above principals have been addressed in this strategy.

vi Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry

The aim of *Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry* (NSW Department of Industry, Tourism and Resources, 2006) (MCC Handbook) is to provide guidelines to promote 'leading practice' sustainable mine closure and completion, minimising any long-term environmental, economic, and social impacts and resulting in a suitable final land form for an agreed land use. Specifically, the MCC Handbook provides that a progressive rehabilitation plan, which is a key principle of this strategy, should be developed for mine closure.

1.7 Adoption of leading practices

Hume Coal is committed to adopting leading practices in the planning, construction, operation, closure and rehabilitation of the project. This includes leading practice measures to avoid, minimise and/or mitigate potential environmental and social impacts. In particular, in relation to rehabilitation the leading practices adopted are:

- All coal reject material will be returned underground to partially backfill the mined-out void, rather than keeping it at the surface in a large above ground emplacement or trucking it off-site for emplacement elsewhere. This minimises the surface disturbance footprint, thereby reducing the land to be rehabilitated at closure.

- To eliminate and/or minimise impacts on surface features and water resources, Hume Coal will use an innovative non-caving coal extraction method, leaving coal pillars in place throughout the mine that are designed to provide indefinite long-term support to the overlying rock. Given this mining system is first workings only, there will be no associated subsidence impacts, and therefore the structure of the overlying groundwater system will remain intact and surface features will be protected.

1.8 Purpose and scope of this strategy

The purpose of this report is to prepare a strategy that addresses applicable regulatory requirements, standards and guidelines for the closure and rehabilitation of the project.

This strategy has been prepared recognising that, once conditions of consent are available for the project to proceed, a complete MOP will then be prepared and submitted to the DRE for approval. The MOP will be generally consistent with the commitments relating to rehabilitation and closure outlined in this strategy.

The objectives of this strategy are:

- to describe the proposed post-mining land use;

- identify potential risks and impacts which will impact on rehabilitation and closure success;

- to describe the methods for establishing stable post-mining landforms; and

- to set rehabilitation criteria and outlining the monitoring requirements that assess whether or not these criteria are being accomplished.

The rehabilitation concepts presented in this strategy should be regarded as provisional to allow for consideration of the outcomes from future rehabilitation trials and research, and other unforeseeable changes that may come about, for example via the mine closure consultation phase. Final rehabilitation and project closure requirements will ultimately be formulated in consultation with key government agencies and other relevant stakeholders.

1.9 Strategy structure

This strategy has been structured as follows:

- proposed activities (Section 2);
- rehabilitation and closure risks, and appropriate mitigation methods (Section 3);
- post-mining land use, rehabilitation goals, and rehabilitation objectives (Section 4);
- rehabilitation methods (Section 5); and
- performance indicators and completion/relinquishment criteria (refer Section 6).

2 Proposed activities

2.1 Project schedule

The project will be undertaken in three phases over approximately 23 years, as follows:

- Construction and commissioning phase – building of surface infrastructure, development of underground access and associated infrastructure (approximately 2 years);
- operational phase – coal extraction from the underground mine and associated coal product processing (approximately 19 years); and
- decommissioning and rehabilitation phase - closure and rehabilitation activities of nominally two years.

2.2 Primary domains

Primary domains (as defined in the MOP guidelines) are based on land management units within the project area, usually with a unique operational and functional purpose during operation and therefore have similar characteristics for managing environmental issues. The primary domains form the basis of conceptual rehabilitation and project closure planning for this strategy. The primary domains that have been identified for the project are:

- infrastructure area;
- water management area;
- stockpiled material; and
- underground mining area.

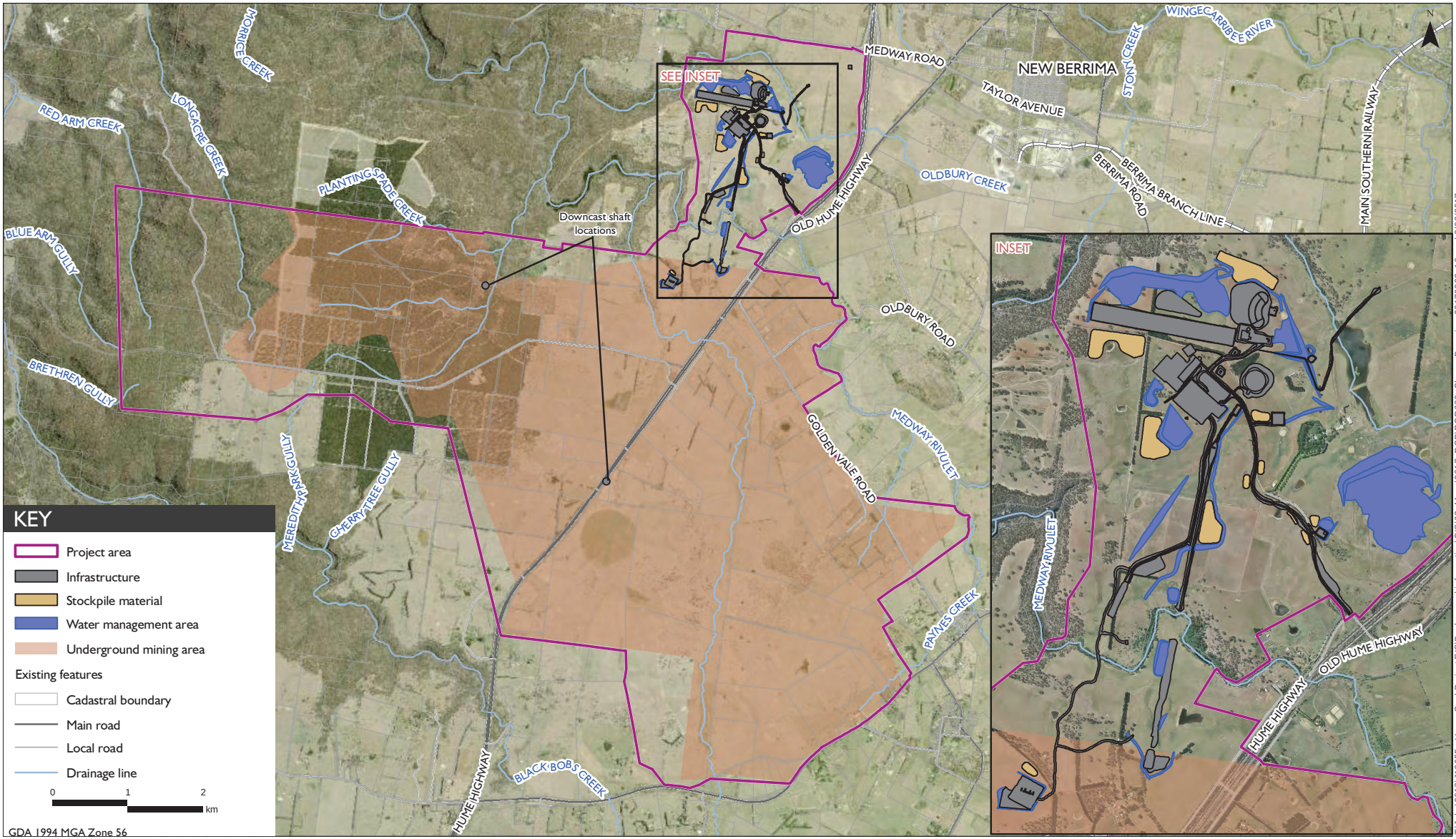
The extent of disturbance per primary domain is presented in Table 2.1 and the location is shown in Figure 2.1.

A description of the activities to be carried out in each primary domain is presented in the following sections. The decommissioning of each project element is described in Section 4.

Table 2.1 Surface Infrastructure disturbance by primary domain

Primary domain	Project element	Area (ha)
Infrastructure area	• Mining infrastructure o drifts o upcast ventilation shaft o downcast ventilation shafts o service supply holes (power, water, gravel supply) • Coal handling infrastructure o ROM overland conveyor system o product overland conveyor system o coal preparation plant o coal loading facility • General infrastructure o access roads o offices, bathhouse, carpark, workshop o temporary accommodation o temporary construction facilities o utilities (power line, water pipeline)	64
Water management area	• Primary water dam; • Stormwater basins • Sediment control dams	44
Stockpiled material	• ROM stockpile • product stockpiles • temporary coal reject stockpile • Drift spoil stockpile • topsoil stockpiles	9
Underground mining area (SMP[1])	• Minor access tracks to exploration sites and environmental monitoring equipment etc.	3,423

Notes: 1. SMP – Subsidence Management Plan as per coding for primary (operational) domains in the MOP guidelines.



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Primary domains

Hume Coal Project
Closure and Rehabilitation Strategy

Figure 2.1

EMM HUMECOAL PROJECT

2.2.1 Infrastructure area

i Mine surface infrastructure

a. Drift portals

The primary access to the underground mine will be via two drifts aligned west-northwest to east-southeast in the northern part of the project area. Underground mine access includes one drift for personnel and materials, and one conveyor drift.

b. Upcast ventilation shafts

Ventilation of the underground mine will be provided by exhaust fans. A main upcast ventilation shaft and associated fans will be installed close to the bottom of the drifts. The main ventilation shaft will be around 110 m deep and nominally 5.5 m in diameter.

c. Downcast ventilation shafts

Up to two additional downcast shafts will be installed later in the mine life if needed, pending ventilation requirements at the time. The two downcast shafts will be nominally 90 m and 140 m deep and nominally 3m in diameter. The design of the shafts may incorporate above-ground structures designed to prevent unauthorised access. The construction and access pad at the site of the downcast fans will be nominally 50 m by 50 m in size.

d. Infrastructure area

The mine surface infrastructure will be located north of the drift portals and includes the administration buildings, bathhouse, staff car park, warehouse, and laydown areas, vehicle washdown, fuel depot and lubricant storage facilities. For safety, the explosives magazine will be over 1,100 m from the fuel and other hydrocarbon storage areas of the mine infrastructure area.

ii Coal handling infrastructure

a. ROM overland conveyor system

The ROM coal will be transported from the underground mining faces along the panel conveyors and onto a trunk conveyor which will transfer the coal up the drift. Coal that has been transported up the drift will then be transferred via a covered overland conveyor system that runs from the drift portal to a ROM stockpile adjacent to the coal preparation plant (CPP).

b. CPP

The ROM coal will be taken from the ROM stockpile and processed through the CPP. The product handling area will consist of a series of conveyors and two stackers transferring coking and thermal product coal from the CPP onto the product coal stockpiles. Each product coal stream will be transferred onto a slewing and luffing stacker and stockpiled. Coal from the stockpile will be reclaimed by a portal reclaimer prior to train loadout (TLO).

c. Product coal overland conveyor system

The product coal will be transferred from the coal stockpiles at the CPP to the TLO via an overland conveyor system. Product coal is will be transported by rail to port for shipment to international markets and/or transported by rail to domestic markets.

iii General infrastructure

a. Access roads

A sealed main access road will be built from the Mereworth Road to the MIA and CPP. Other smaller roads will also be built or re-shaped.

b. Accommodation facility

The accommodation facility will be temporary for the duration of construction. The facility will contain around 400 rooms, a kitchen and dining area, laundries, gym, recreation room, first aid room, and car park. It will also have a water treatment, storage and pumping station and a sewerage treatment plant.

c. Temporary construction facilities

Temporary construction facilities will be located adjacent to the MIA and the CPP.

d. Powerline and pipeline easement

The existing Wingecarribee Shire Council (WSC) easement, containing a water supply pipeline, traverses the proposed surface infrastructure area; therefore it is to be re-aligned. The new easement will contain the re-aligned water pipeline, and the Hume Coal electricity transmission line.

2.2.2 Water management

The water management system will reuse as much mine water as possible, with it being used first to meet all demands except for potable water. If demand cannot be fully met from rainfall-runoff and the mine sump in the underground workings, supplies will be supplemented by groundwater from the sealed voids.

The overarching water management philosophy involves:

- one primary water dam (PWD) with a minimal catchment area that is used for storage and reuse of water for mine operations;
- water runoff from undisturbed catchments being diverted around the mine surface infrastructure and into natural drainage lines via diversion drains;
- water runoff from the disturbed area within the mine surface infrastructure footprint being directed to one of four stormwater basins (SB01-SB04) or four mine water dams (MWD05-MWD08) and then pumped to the PWD for use in mine operations; and
- clean water runoff into SB03 and SB04 (it has not come into contact with coal) being discharged to a local creek if rainfall meets the adopted first flush and water quality criteria. If rainfall does not exceed the adopted first flush criteria it will be transferred to the primary water dam.

2.2.3 Stockpiled material

i Drift spoil stockpile

Spoil excavated during the installation of the drift portals and shaft will be stockpiled on the surface, near to the drift portals. The stockpile will contain approximately 27,000 m^3 of drift spoil. Some of the drift spoil may be used throughout the project for building infrastructure such as roads and dam walls as required, with the remainder to be stored in the drift spoil stockpile. Upon decommissioning it will be used to fill the drifts and shafts.

ii ROM and product stockpiles

The ROM stockpile will have a capacity of around 60,000 tonnes (t). There will be two product stockpiles, one for thermal coal and one for coking coal. Product coal will be stockpiled prior to transport via overland conveyor to the rail load out bin.

iii Temporary coal reject stockpile

During the initial 12-18 months, as the project is developed, the coal reject will be stored in a temporary coal reject stockpile adjacent to the CPP until sufficient void space is available underground, and the plant is commissioned to commence underground emplacement. During this initial period, the fines will be dewatered via belt press filters prior to being combined with the course reject for “co-disposal” on the temporary coal reject stockpile. At the end of the operational phase of the project the reject on the temporary coal reject stockpile will be put back through the reject plant and pumped underground prior to sealing the surface entries to the underground mine.

iv Soil stockpiles

Soil stockpiles will be created as soil is conserved during the construction phase. The soil will be used in the decommissioning phase for rehabilitation.

2.2.4 Underground mining area

i Above ground level

The area of land overlying the underground mining area is approximately 3,500 ha. No surface disturbance will occur over this area in the commissioning or operating phases. Any infrastructure that is within this area (ie downcast fans) is addressed in the infrastructure domain. Therefore, no surface rehabilitation will be required at decommissioning with the exception of a limited number of exploration boreholes and their access tracks. This area is not predicted to be subject to subsidence (see Section 3.4).

ii Below ground level

The project strategy is to develop a mining system which effectively eliminates subsidence and hence eliminates the impact of the project on surface and subsurface water flows. It accomplishes this by using a high productivity non-caving, first workings system with a layout that utilises elements from traditional underground development layouts and long narrow plunges similar to those used in highwall mining. These panels are called plunge panels. Remaining coal pillars are designed to provide long-term stability resulting in negligible surface subsidence impacts and preservation of the hydraulic properties of the overlying groundwater systems.

a. Panel sealing

The mine design compartmentalises the underground operations into individual panels utilising the plunge panel system. This will allow progressive sealing of completed panels (compartments) and assist with groundwater management. The length of the plunge panels have been limited to minimise the time the panels are open to the ingress of ground water and hence minimise the time for the panels to re-charge from natural ground water.

When mining is completed in a panel, the panel will be sealed to allow water injection as well as natural recharge to occur. Bulkhead seals will be installed in every panel of the underground mine. Seals will be designed generally in accordance to relevant industry standards, including the UK Health and Safety Executive guideline "The design and construction of water impounding plugs in working mines".

b. Underground reject emplacement

To minimise the environmental impact of coal reject, it is proposed to return the coal reject underground to panels which will subsequently be sealed off. The coal reject will be mixed with water to a consistency which can be pumped underground in a continuous process using commercially appropriate pumping equipment.

The total volume of coal reject slurry over the life of the project represents only around 30% of the void created, depending on assumed moisture content of the mix.

Individual panels have been designed so that they are down apparent dip where possible to minimise the risk of reject material moving towards the main headings once it is emplaced. The nature of the mine design as a series of long, narrow blind headings also minimises the risk of any bulk movement of material.

2.3 Decommissioning and Rehabilitation

Decommissioning of the project will involve the following activities:

- decommissioning of the infrastructure area;
- decommissioning of services and infrastructure;
- removal of infrastructure, materials and rubbish;
- soil testing of potentially contaminated areas (ie coal stockpile areas, hydrocarbon storage areas);
- remediation or removal of any coal or AMD contaminated soil to the underground mine;
- remediation or removal of any soil contaminated with hydrocarbon or industrial chemicals at a licensed facility or on-site bioremediation; and
- soil and groundwater testing to validate benign material is present before rehabilitation programs commence.

Rehabilitation of the project will involve the following activities:

- contouring earthworks, deep ripping compacted areas, and blend disturbed surfaces into surrounding topography; and
- application of the stockpiled soil to promote establishment of improved pasture suited to agreed future land use.

Table 2.2 summarise the key aspects related to the decommissioning and closure of the primary domains. It assumes that all buildings and other infrastructure are demolished and removed despite the potential for them being used after mining (subject to the landholder's requirements and consultation with relevant stakeholders such as government agencies closer to the time of closure). It is considered likely that at least some aspects of the existing infrastructure will be used post-mining (eg roads). These options will be considered in greater detail during stakeholder engagement and development of the detailed closure plan.

Table 2.2 Decommissioning strategy by primary domain

Primary domain	Decommissioning strategy
Infrastructure area	• all surface infrastructure removed; • drifts and ventilation shafts partially backfilled and sealed to prevent access. Drift portals will be removed to below ground level; and • rehabilitated land is contoured to match the surrounding landforms.
Water management area	• water in storages to be tested to determine if water quality criteria are met, and if not, then put through treatment plant to remove any potential contamination before being returned to underground or released from the project area; • water management structures removed and area re-shaped to match surrounding topography; and • re-shaped area is ripped, soiled and seeded.
Stockpiled material	• all stockpiled coal or drift spoil materials removed and buried in underground workings; • no hazardous material or sources of contamination left within the project area; and • disturbed land is re-shaped to match the surrounding landforms, and area is ripped, soiled and seeded.
Underground mining area (SMP)	• Exploration tracks and drill holes rehabilitated.

3 Environmental and socio-economic risk management

3.1 Overview

Identifying environmental, social and economic (socio-economic) risks associated with rehabilitation and closure is essential for effective closure planning. A preliminary risk assessment has been conducted to identify and assess risks associated with closure and rehabilitation of the project. The risk assessment has had regard for *AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines. S*pecific objectives of the assessment were to identify:

- risks from closure and associated rehabilitation activities;
- risks which have the potential to adversely affect the environment;
- community and other stakeholder risks, eg economic, health and safety, etc; and
- controls required to mitigate the identified risks.

A number of potential risks were identified by the risk assessment process, which are presented in Appendix A, and discussed in the sub-sections below. Management practices have been identified and presented in this strategy to manage any residual risks after rehabilitation.

3.2 Environmental risk

3.2.1 Geochemistry

The management of the coal product stockpiles and the temporary coal rejects stockpiles will need to manage the potential for AMD during operation due to the presence of normal levels of sulphur in the coal. At closure after all coal has been sold, any residual coal materials and coal reject stored on the surface will be removed and emplaced in the underground mine.

The specific management of coal and coal reject materials is further detailed in Section 3.2.4iib below. Additional detail can be found in the report *Hydrogeochemistry assessment* (Geosyntec 2016) which is appended to the Water Assessment Report of the Hume Coal Project EIS (EMM 2017c).

i Geochemistry risk management

Coal and coal reject will be located at a number of locations within the project area during operation and at closure including:

- coal in the coal product stockpiles and coal remaining insitu in the underground mine in the barrier pillars etc; and
- coal rejects in temporary reject stockpiles and then permanently stored in the underground mine.

Drifts will be constructed to access the underground mine. Spoil from the drifts will be temporarily stockpiled nearby the drifts during operation.

The following sections describe how the potential for AMD is mitigated at the project for coal stockpiles, coal reject stockpiles and drift spoil.

a. Coal stockpiles

During operations the coal stockpiles will have been subject to standard water management and monitoring practices which should have identified if any AMD is present in water. If elevated levels are found, then alkaline materials (eg agricultural limestone) will be added to the water management infrastructure as required as required.

During construction, 300mm of soil and subsoil will be stripped from the stockpile pad areas and set aside for rehabilitation. At closure, the ground under the stockpiles will be selectively assessed for potential contamination issues against background criteria for:

- pH, electrical conductivity (EC), total dissolved solids (TDS), acidity and alkalinity;
- major anions (sulfate, chloride) and major cations (calcium, magnesium, sodium and potassium); and
- analysis of soluble metals (such as aluminium, arsenic, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination is found then the contaminated area will be appropriately remediated so that it is made suitable for the agreed future land use prior to reinstating the topsoil and subsoil that was set aside during construction.

b. Coal reject stockpiles

The majority of the coal reject will have been returned to the underground workings during operations. However, the temporary coal reject stockpiles emplaced on the surface at the start of mine life will be recovered and relocated to the underground parts of the mine during operations or during decommissioning.

To provide for the safe and efficient emplacement of coal reject underground during operations, a coal reject management plan will be developed and implemented.

During operations temporary coal reject stockpiles will be subject to standard water management and monitoring practices which will have identified if any AMD is present in runoff. If required alkaline materials (eg agricultural limestone) will be added to temporary coal reject stockpiles to maintain pH levels in the neutral pH range and to avoid any potential environmental impacts from AMD in surface runoff and/or seepage.

As per the coal stockpiles, after the coal rejects from the temporary stockpile have been removed the ground under the stockpiles will be selectively assessed against background criteria for:

- pH, EC, TDS, acidity and alkalinity;
- major anions (sulfate, chloride) and major cations (calcium, magnesium, sodium and potassium); and
- analysis of soluble metals (aluminium, arsenic, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, fluoride, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination is found then the project element will be appropriately remediated so that it is suitable for the agreed future land use prior to the replacement of stockpiled topsoil and subsoil.

c. Underground workings

During pumping of the coal reject to the underground mine workings, up to 1% limestone may be added to create excess alkalinity in backfilled coal reject. This will reduce any residual risk of impacting groundwater quality to as low as reasonably possible.

Following sealing of each panel, any remaining void will become anoxic and/or fill with water, removing the risk of oxidation of any reactive sulphide content of the coal or reject materials.

d. Drift spoil

There will be a drift spoil stockpile at the time of closure; although some drift spoil may have been used as fill material during the construction phase. This material will be used in the rehabilitation and closure phase for sealing and backfilling the drifts and ventilation shafts.

Samples that represented the proposed drift spoil materials were tested (RGS Environmental 2016) and determined that they have excess acid buffering capacity and a high factor of safety with respect to producing AMD. The excess buffering capacity is several times greater than the maximum potential acidity and has low reactive sulfide content. Therefore, the drift spoil is considered to be non-acid forming and is not expected to generate AMD; that is, surface runoff and seepage from drift spoil is likely to be pH neutral.

Static and kinetic leach tests of the proposed drift spoil indicate that trace metals and major ions are sparingly soluble in surface runoff and seepage. Dissolved concentrations of metals in surface water and seepage are therefore expected to be low and unlikely to present any significant environmental risks in the project area or for the receiving environment. Dilution effects from rainfall and natural attenuation are also likely to occur and further reduce the concentrations of soluble metals in surface runoff and seepage.

The concentrations of metals/metalloids in drift spoil samples will be low and within relevant background criteria for soils (RGS Environmental 2016), and therefore unlikely to present any environmental issues associated with revegetation and rehabilitation. Drift spoil is likely to have a low level of sodicity and therefore have a relatively low risk of being susceptible to significant dispersion and erosion (RGS Environmental 2016). Further, salinity will be low due to low levels of dissolved solids.

Based on the benign nature of the drift spoil, no special management measures are required for their handling and storage.

3.2.2 Spontaneous combustion

Spontaneous combustion is not expected to be a risk during operation or at closure. Studies have shown that there is a low risk of spontaneous combustion occurring in the targeted Wongawilli seam (Beamish 2012). Annual reporting for other mines in the area which target the same target seam, such as Dendrobium Mine and Illawarra Metallurgical Coal, also confirms no recorded spontaneous combustion events. Historically the Wongawilli seam is not known as being prone to spontaneous combustion as identified in the following coal mines in the region; Kemira, Nebo, Wongawilli, Avon, Huntley, Avondale, Yellow Rock, Meryla, Southern and Erith mines.

3.2.3 Subsidence

There is a negligible risk of subsidence-related impacts occurring above the underground mine, due to the proposed mining method which retains pillars of coal to support the overlying strata. Mine Advice (2016) has assessed the predicted maximum subsidence associated with the proposed mine method and layout and predicts that it is “imperceptible” or “negligible”. No rehabilitation activities as a result of mine subsidence impacts are expected to be required.

3.2.4 Soil

Accurate estimates of the available depths of soil, and of the required volume of soil, are needed for effective rehabilitation. The recommended stripping depths of 0.15m topsoil and 0.15m subsoil are based on results from the soil survey (EMM 2017b), which assessed soil depths found across the project area.

To successfully rehabilitate surface disturbance within the project area soil will be replaced at a general depth of approximately 0.3 m over disturbed surfaces. The area of direct disturbance is 117 ha. Therefore, around 351,000 m^3 of soil will need to be stripped. The actual volumes of soil available will only become definitely known when detailed stripping plans are being prepared. If any topsoil shortages emerge, due to factors like unanticipated shallowness or waterlogging, additional subsoil will be stripped in an adjacent area.

i Soil risk management

The following sections describe how Hume Coal will manage the potential risks of soil loss in the project area either from inefficient handling or from erosion.

a. Soil losses

To mitigate the risks of insufficient soil being available, soil requirements will be accurately determined before construction works commence. An inventory of stripped and stockpiled soil will be prepared, and any additional soil requirements identified. Hume Coal will preferentially strip topsoil however subsoil will be stripped and used for rehabilitation if a short fall in the available inventory is identified. These requirements are further addressed in the proposed rehabilitation management strategy (Section 4).

b. Erosion and sediment control

Erosion results in loss of soil from the landscape and a subsequent deterioration in the productive capacity of the land and in the capacity of the land to perform ecosystem functions. The potential for soils to erode determines the applicability of management measures and whether the soils are appropriate for use in rehabilitation activities. Erosion of soil may take place after the soil has been spread on rehabilitated areas. The design of the re-shaped landforms will need to take into account soil erosion and sediment control to prevent impacts to waterways, as well as impacts to the rehabilitation itself.

The rehabilitated land contours will be designed to minimise receiving environment impacts from erosion and sediment runoff. The re-shaped land will be spread with soil and seeded to quickly establish a vegetation cover which will minimise erosion and runoff. Wherever possible the rehabilitated land will be close to the original landform characteristics, which were generally gentle slopes and rolling hills. An erosion and sediment control plan will be implemented during operations and will be maintained during rehabilitation.

3.2.5 Noise and dust

Air quality and noise management plans will be implemented during operations and will be updated to include the rehabilitation phase of the project prior to rehabilitation activities commencing. These management plans will be designed to achieve compliance with licence limits during decommissioning and rehabilitation activities.

3.2.6 Weeds

The presence of weed species has the potential to have an impact on revegetation outcomes. Additionally, weed species within the surrounding land has the potential to impact on the success of rehabilitated areas. Weed management will therefore be a critical component of rehabilitation activities.

Weeds will be managed through a series of control measures, including:

- if machinery to be used for rehabilitation is brought to the site from another project, and if there is a risk of weed seeds having been transported on the machinery, it will be hosed down in an approved wash down area before entry to the project area;
- herbicide spraying or scalping weeds from soil stockpiles prior to re-spreading;
- rehabilitation inspections to identify potential weed infestations; and
- identifying and spraying existing weed populations together with ongoing weed spraying over the life of the project.

Weed control programs will be implemented according to industry best management practice for the weed species present, if required.

3.2.7 Hydrocarbons, chemicals and wastes

Despite designs that prevent or contain spills, there is a low residual risk that land within the surface infrastructure area could be contaminated during de-commissioning (eg from hydrocarbon spills, storage of fuel and chemicals, refuelling activities, sewage, etc).

To manage any potential contamination sources, waste management practices in accordance with the site Environmental Management System will continue to be implemented during rehabilitation. For example:

- hydrocarbons at the project will be stored in bunded areas designed in accordance with the relevant Australian Standards;
- waste products that are removed from the project will be appropriately disposed of at licensed facilities; and
- sewage generated post-decommissioning will be minimal (ie after the on-site sewerage treatment facility is removed). Any such waste (eg portable toilets) will be transported off site for appropriate disposal at a licensed facility by a licensed waste contractor.

There is a low risk that hydrocarbon spills may also occur during soil spreading associated with rehabilitation (eg a burst hydraulic hose), but the impact would be isolated and spill-clean-up procedures would mitigate any potential impacts.

3.2.8 Bushfire

To prevent or manage bushfire risks, the site bushfire management plan will continue to be implemented. A hot work permit system will be used during rehabilitation works which will take into account the risk factors for bush fires.

3.3 Socio-economic impacts

Community consultation has been, and will continue to be, key to project planning and understanding the project's potential impacts on the local community. Relevant stakeholders will be engaged in the closure planning and implementation process, including in the development of a detailed closure plan as the project progresses towards completion. The closure plan will address socio-economic impacts at closure.

4 Post-mining land use and rehabilitation objectives

4.1 Land use options following closure

Land uses on properties surrounding the project area primarily comprise agricultural, native vegetation and/or conservation. Other land uses on land near the project area include the Berrima Cement Works, Berrima Colliery (which is closing), Berrima Feedmill, residential development at New Berrima and Medway, water infrastructure (Medway Dam and water filtration plant), forestry, and transport infrastructure (Hume Highway and Illawarra Highway). Considerations for final land uses have taken into account the current land uses in and surrounding the project area, infrastructure to be developed by the project, and the proximity of the project to existing agricultural industry, residences and general local infrastructure. The surrounding land use on the properties will continue to be farming, during the construction and operational phases of the project.

Final land uses considered include:

1. **Industrial development:** Given the proposed status as a mining operation, some form of industrial development could be developed; however, the infrastructure area is currently used for agricultural purposes and it is considered best practice to return the land to a similar land use and capability to that pre-mining. The demand for industrial land would also have to be considered in light of the availability of other land in the region already zoned for industrial purposes. This industrial development use has thus been removed from further consideration.

2. **Conservation:** Regionally, with the exception of the Belanglo State Forest, much of the land is cleared for agricultural purposes. The area to be disturbed (around 117 ha for surface infrastructure) is a relatively small area, and developing a conservation area isolated from the Belanglo State Forest is likely to be of little conservation value. Further, an objective of the rehabilitation strategy is to return the land to a similar land use and capability to that which existed pre-mining. This conservation use has thus been removed from further consideration.

3. **Tourism:** On the closure of the mine, it is unlikely to be of any interest to tourists travelling in the general region and the availability of other examples of mining in the region preclude this tourism option from further consideration.

Based on the above assessment, it is considered that establishment of conditions that have grazing value (on improved pastures) is the preferred land use option.

As noted above, a detailed closure plan will be developed within five years of closure, which will confirm the most appropriate land use option in consideration of input from all relevant stakeholders at the time.

4.2 Rehabilitation goals

The overriding goal for this strategy is to return disturbed land to a condition that is stable, and supports the proposed post-mining land use which is grazing with improved pasture. The surface disturbance area is within existing farmland, and it is proposed that the rehabilitated land will be incorporated back into the operating farm. Specifically, the rehabilitation goals are:

- restoration of a safe and stable landform;

- reinstate soil profile and function and create landforms that are compatible with surrounding topography; and
- the re-shaped landform permits land uses of grazing with improved pasture.

4.3 Rehabilitation objectives

Rehabilitation objectives have been further defined. Each primary domain requires specific management objectives to achieve the final land use outcome due to distinct features associated with the operational land use.

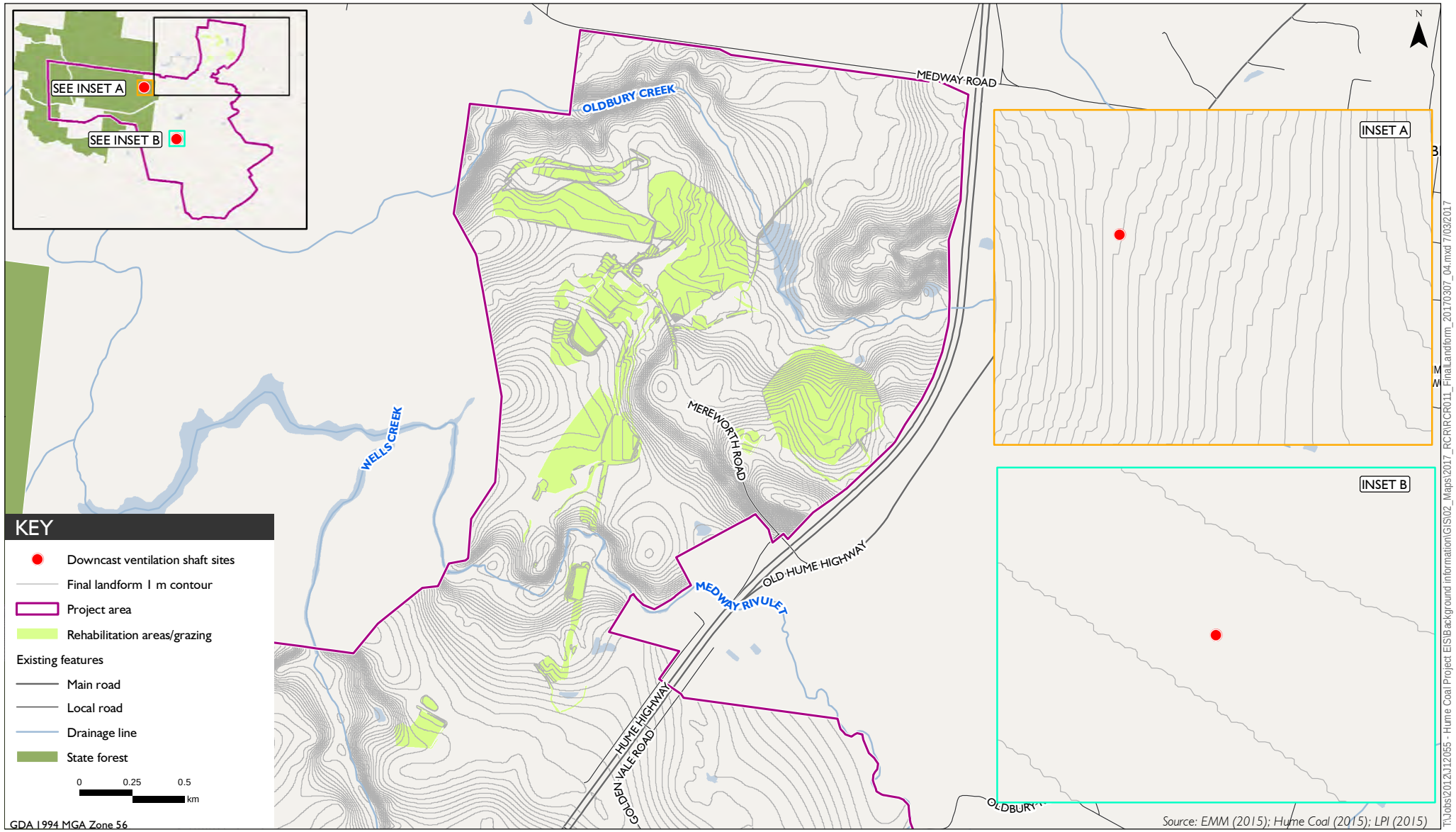
- All infrastructure that is not to be used as part of the future intended land use, is removed so that the site is safe, free from hazardous materials, and will not pose a threat of environmental harm.
- There is no residual contamination of soil or water on site that is incompatible with the intended land use or that poses a threat of environmental harm.
- Underground workings are sealed and present no safety risks for humans and animals now and in the long-term.
- The rehabilitated land is suitable for the planned land use and is compatible with the surrounding landscape.
- The rehabilitated land is stable, and does not present a risk of environmental harm downstream of the site or a safety risk to the public/ stock/ native fauna.
- Returned soil on the rehabilitated land is able to support the planned land use.
- Vegetation establishment is adequate and able to support the desired land use. The rehabilitated land is sustainable for the long term and only requires maintenance that is consistent with the final land use.
- Runoff water quality is similar to, or better than, the pre-disturbance runoff water quality.
- Ground level and surface stability is not impacted by the presence of the underground workings.

4.4 Conceptual post-mining landform design

Areas disturbed for the construction of the infrastructure area and other ground disturbances including soil stockpiles footprints and access roads will generally be the subject of superficial disturbance. Consequently, the objective for these primary domains will be to reinstate the pre-mining contours and drainage. Figure 4.1 shows the conceptual rehabilitated landform.

The water management structures and drainage diversion bunds and embankments will be re-shaped so that they do not permanently hold water, and wherever possible the topography of the land will be re-instated.

The other most significant variation in the post-mining landform compared to pre-mining conditions will be the areas that have been cut and filled to create flat areas (ie coal stockpiles). However, as addressed below, these landforms will be re-shaped to be compatible with the surrounding landscape.



Conceptual final landform

Hume Coal Project
Closure and Rehabilitation Strategy

Figure 4.1

4.5 Primary domain rehabilitation intent

The following sub-sections describe the rehabilitation concepts relevant to each primary domain. The concepts presented may be refined in the MOP and subsequently over the life of the project in consultation with relevant government agencies and key stakeholders. The MOP will provide a more detailed description of the proposed measures for each primary domain provided below.

4.5.1 Infrastructure area

i General

The following description of the rehabilitated landform and rehabilitation concepts apply to the project elements as follows:

- surface infrastructure area including buildings, access roads, accommodation facility, powerline and pipeline easement;
- coal handling infrastructure; and
- ROM overland conveyor system.

Following decommissioning, dismantling and/or demolishing of infrastructure (including the removal of all concrete footings and services to 1 m below ground level), the disturbed areas will be cleared of any remaining coal. After any remaining coal is removed, the ground surface will be selectively assessed against background criteria for:

- pH, EC, TDS, acidity and alkalinity;
- major anions (sulfate, chloride) and major cations (calcium, magnesium, sodium and potassium; and
- analysis of soluble metals (aluminium, arsenic, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, fluoride, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination is found then the area will be appropriately remediated so that it is suitable for the agreed future land use.

Once disturbed areas are deemed to be free of construction materials and/or contaminants, they will be deep ripped (where required) to ameliorate the effects of compaction as a result of operational activities. The area will then be sp read with approximately 0.1-0.3 m of soil and treated with ameliorants, if necessary. Revegetation will be primarily by direct seeding of improved pasture species.

General overland flow management for each disturbed area will require a coordinated response in terms of final landforms and flow direction. A rehabilitation objective is to maintain overland flow to minimise disturbance. This will be achieved by:

- re-shaping the area as required to return it to its pre-mining topography, where practicable;
- deep ripping any compacted surfaces to minimise the effects of compaction and maximise infiltration following rainfall; and
- installing diversion banks/channels (where necessary) to safely convey overland flow.

ii Drifts

The following strategy has been developed with consideration of relevant parts of the WHS (Mines and petroleum sites) Regulation and *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February, 2012*. A final strategy will be developed prior to closure of the project in consultation with all relevant stakeholders.

At closure the following activities will be undertaken to backfill and seal the drifts:

- Any structures or plant and equipment within the drift containing oils or greases will be removed or drained.
- Pipes and conveyor structure will be removed from the part of the drift to be filled with material, if it is safe to do so.
- A substantial bulk head that has been designed and certified by a suitably qualified engineer will be constructed in a location that is deeper than at least 30m of cover, and located within the part of the drift that is excavated in rock, with a septum of solid rock above the drift of at least 15 m.
- The remainder of the drift, including the cut and cover section will be filled with material either excavated from the drift originally, or otherwise determined to be geochemically benign and suitable as fill.
- The concrete floor and arch sections will be removed to a depth of at least 1m below final ground level.
- The remaining fill material will be placed and compacted and covered with top soil at least 300mm deep.

The potential for environmental harm will be limited as follows:

- the geochemistry of the drift spoil has been assessed and it is NAF and therefore there will not be an on-going potential for AMD;
- there is a very low likelihood of gas building up due to the fact the coal seam has very low measured gas contents. Nonetheless, if gas is assessed to be a potential risk prior to sealing the underground mine, the bulkhead will be designed accordingly; and
- the drift spoil will be placed and shaped in a way that limits the potential for rainfall infiltration and the accumulation of water in the backfilled drifts.

After sealing and backfilling the top sections of the drifts, landforms will be re-shaped to a similar angle to pre-mining. Once the area has been re-shaped, soil will be applied approximately 0.3 m thick, and will be seeded with improved pasture species.

The location of the drifts may be durably marked with a plaque or similar device, subject to the outcomes of a risk assessment as part of preparation of the detailed closure plan within five years of closure.

iii Ventilation shafts

The following strategy has been developed with due regard for the WHS (Mines and petroleum sites) Regulation and *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February, 2012*. A detailed strategy will be developed prior to closure of the project in consultation with all relevant stakeholders.

The ventilation shafts will require rehabilitation at closure to limit the potential for access. At closure infrastructure associated with the ventilation shafts and their services such as electricity lines will be removed. In the case of buried services they will be excavated to a depth of 1 m below ground level where they will be cut and the excavation backfilled.

A retaining structure (such as a seal or solid plug) will be designed and constructed in the connecting roadways at the base of each ventilation shaft to prevent backfill from flowing into any unfilled voids. Once the retaining structures have been built the ventilation shafts will be filled with drift spoil or other suitable borrow material.

At the ground surface a suitably designed and engineer certified concrete plug will be used to permanently seal the top of the ventilation shafts. The concrete plug will be keyed into the ventilation shaft collar, which will be designed and constructed so that it is founded on hard rock, and is of appropriate geometry to allow the final plug to be permanently keyed in place by the use of pockets, wedge shape or other mechanical system.

Where practicable the shaft collars/plugs will remain uncovered, and the location of the shafts durably marked with a plaque or similar device displaying sealing details.

4.5.2 Water management

i Panel sealing for groundwater management

The underground mine will be compartmentalised to allow progressive sealing of completed panels and assist with groundwater management.

When mining is completed in a panel, the panel will be sealed with bulkheads to allow groundwater recharge to begin to occur.

ii Surface water management structures

Water management structures (primary water dam, stormwater dams, sediment dams) and associated infrastructure (pipes, pumps, discharge points, sediment control dams and diversion drains) will be rehabilitated once no longer required. Decommissioning and rehabilitation will include:

- any remaining water in storages will be tested to determine if water quality criteria are met, and if not, then treated to remove any contaminants before discharging, or pumped into the underground voids;
- pushing down the dam walls and re-shaping the area generally consistent with the surface of the surrounding land as practicable;

- deep ripping the compacted base of the dams to facilitate infiltration and minimise the potential effects of compaction; and

- spreading soil and seeding.

4.5.3 Stockpiled material

No stockpiled material (drift spoil, soil, coal or coal reject) will remain on the ground surface after rehabilitation is completed. The following sections described how these stockpile areas will be rehabilitated.

i Drift and shaft spoil stockpile

Stockpiled drift and shaft spoil will be returned to the underground mine during closure of the project to seal the drifts and ventilation shafts. Once the spoil is removed the ground surface will be deep ripped to remove compaction. Stockpiled soil will be returned and the area will be seeded with improved pasture species.

The drift spoil has been assessed and has been found to be NAF with sparingly soluble constituents (RGS Environmental 2016). To make sure that no contamination remains, the land under the stockpiles will be selectively assessed for potential contaminants.

If any contamination is found then the area will be appropriately remediated so that it is suitable for the agreed future land use. Once the area is deemed to be free of contaminants, it will be rehabilitated as described above.

ii ROM and coal product stockpile

At decommissioning any residual coal will be removed from the ROM coal pad and coal product stockpile, and if there is no commercial value it will be returned to the underground workings. The risk of AMD is considered very low from these stockpiles (RGS Environmental 2016). The area will be selectively tested for potential contaminants.

Once the area is free of contaminants, it will be deep ripped to remove compaction, soil will be applied 0.1-0.3 m thick, and the area will be seeded with improved pasture species.

iii Coal reject stockpiles

The temporary coal reject stockpile will be removed during rehabilitation of the project. The addition of an alkaline material (eg agricultural limestone) will be added to control/neutralise any acidity that could potentially be generated from these materials if required.

Rehabilitation will be as per the coal stockpiles.

iv Soil stockpiles

Soil stockpiles will be used for rehabilitating the rest of the site. After stockpiled soil removal, the compacted subsoil will be ripped (if needed) and topsoil replaced (if needed) and seeded.

4.5.4 Underground mining area

The underground mine will remain predominately as voids after rehabilitation with the exception of about 30% which will be backfilled with coal rejects. Groundwater will be managed progressively through the mine life by the installation of bulkheads and upon closure, entry to the underground mine will be managed by sealing and partial backfilling the drifts and shafts, as described in Section 4.4.1.

As there will be negligible subsidence, no rehabilitation will need to be carried out to manage subsidence impacts.

Piezometer sites will be rehabilitated once they are no longer required for groundwater monitoring.

If drill pads from exploration remain at the time of closure then they will be rehabilitated with regard for *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells*.

4.6 Post-mining land and soil capability

An assessment of the LSC classes for the project was conducted (EMM 2017).

Soil depth will be shallower in the rehabilitated post-mining land because not all soil is suitable for use in rehabilitation. Therefore there will be less soil available resulting in shallower soil depths by comparion to the pre-mining land. Table 4.1 is taken from the LSC assessment scheme guideline, and shows how the depth of soil is translated into a LSC.

Table 4.1 Shallow soils and rockiness LSC class assessment table[1] (OEH 2012)

Rocky outcrop (% coverage)	Soil depth (m)	LSC class
<30 (localised)	>1	2
	0.75 -<1	3
	0.5 - <0.75	4
	0.25 - <0.5	6
	0 - <0.25	7

Notes: 1.only relevant portion of table shown.

2. depths presented in m – modified from original.

Table 4.2 describes the type of disturbance and rehabilitation required for each of the surface infrastructure types. The table also describes the reason for the change in land class.

It should be noted that in Table 4.2 that fill will be sourced mostly from the excavation of the initial drift workings and will therefore be a mixture of soil and rock.

From the *Australian Soil Classification* and SALIS there are three factors that may come into effect regarding the definition of soil depth in the LSC assessment scheme guideline:

- depth to a hardpan in the mining landscape (ie land which has been compacted by heavy machinery, noting that the impact of compaction can be overcome by deep ripping);
- depth to rock (ie vegetation cannot grow in rock because of low plant available water capacity and inherent fertility); and
- most importantly the presence of a C horizon (ie the layer of soil above bedrock, which is defined as weathered rock or a mixture of weathered rock and newly developed soil in the *Australian Soil Classification*).

In the rehabilitated land, areas that are likely to be underlain by rocky fill are equivalent to having a C horizon of weathered rock, so only the returned topsoil is counted as the overall soil depth.

Some surface infrastructure may be underlain by subsoil however, the depth of soil may also be constrained by chemical inhibition such as high salinity. Salt is highly water soluble and mobile and there is some potential that it may become concentrated overtime creating a chemical inhibition layer. The assessment shown in Table 4.2 conservatively assumes that salt has been built up under infrastructure. If it is found after rehabilitation that subsoil is not constrained by chemical inhibition then the overall soil depth may increase from the conservative assumptions given in Table 4.2 resulting in a higher capability LSC class.

Table 4.2 Reasons for LSC changes in the post mining land

Surface infrastructure	Disturbance and rehabilitation type	Justification for post-mining LSC
Drift portals, ventilation shafts	Portal and shafts excavated into rock deep underground – rehabilitation involves replacing fill materials and overlaying with 0.3m topsoil.	LSC class 6, based on replaced soil depth of 0.3m (fill material is not equivalent to natural soil profile).
Dam walls	Dam walls constructed with fill material – rehabilitation involves re-profiling of fill material to match surrounding contours and overlaying 0.3m topsoil.	LSC class 6, based on replaced soil depth of 0.3m (fill material is not equivalent to natural soil profile).
Excavated sediment dams	Dams constructed by excavating material – rehabilitation involves filling with excavated material or fill removed from dam walls or roadways, and overlaying 0.3m topsoil.	LSC class 6, based on replaced soil depth of 0.3m (fill material is not equivalent to natural soil profile).
Waterbody areas	Dam areas of natural contours which held water for extended periods of time – rehabilitation involves return of topsoil.	LSC class 6, based on the assumption that the subsoil which has been saturated for extended periods has effectively become a Hydrosol soil.
Soil stockpiles	Topsoil stockpiles placed on natural land contours, only topsoil disturbed – rehabilitation involves spreading of topsoil over underlying subsoil.	LSC class the same as the pre-mining LSC, as the soil profile depth is now the same, and all other factors are still the same.
Temporary accommodation and construction facilities	Buildings placed on natural land contours, only topsoil disturbed – rehabilitation involves spreading of topsoil over underlying subsoil.	LSC class the same as the pre-mining LSC, as the soil profile depth is now the same, and all other factors are still the same.

Table 4.2 Reasons for LSC changes in the post mining land

Surface infrastructure	Disturbance and rehabilitation type	Justification for post-mining LSC
Overland conveyor system	Conveyor footings placed on natural land contours, only topsoil disturbed – rehabilitation involves spreading of topsoil over underlying subsoil.	LSC class the same as the pre-mining LSC, as the soil profile depth is now the same, and all other factors are still the same.
Minor tracks and roads (no cut and fill)	Roads or tracks built on existing land surface, topsoil removed, road base materials placed over the top. Rehabilitation involves the removal of road base and return of topsoil.	LSC class the same as the pre-mining LSC, as the soil profile depth is now the same, and all other factors are still the same.
Constructed roadways and infrastructure areas	Roads and infrastructure areas created by cut and fill of existing land surface. Rehabilitation involves re-profiling the fill material to match surrounding contours and overlaying 0.3m topsoil.	LSC class 6, based on replaced soil depth of 0.3m.
Underground mine area	No surface disturbance, negligible subsidence – no rehabilitation.	No change to LSC class.

Class 6 land will still be suitable for grazing and improved pasture. The LSC guideline says in relation to Class 6 land:

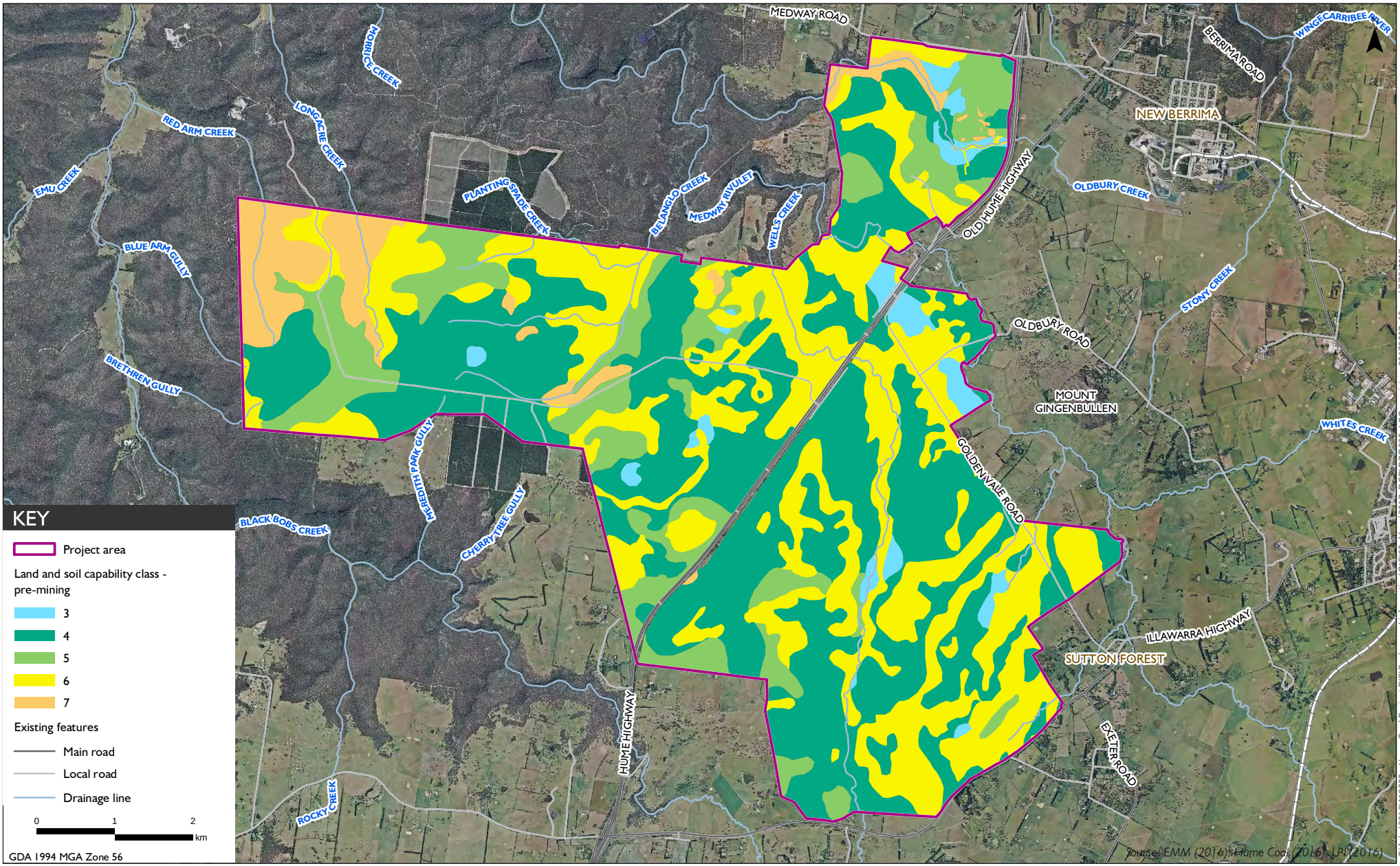
> "...This land requires careful management to maintain good ground cover (maintaining grass or cover taller than 8 cm is a guide). Grazing pressures need to be lower than those used on Class 4 and 5 land. Rotational grazing systems with adequate recovery time for plant regrowth are essential. It is important to minimise soil disturbance, retain perennial ground cover and maintain high organic matter levels...."

Therefore grazing will still be an option for land beneath the infrastructure area and water management areas, even with a lower LSC class compared to pre-mining.

Table 4.3 shows the pre- and post-mining area changes for each LSC class found on land that makes up the project. Figure 4.2 show the pre- mining LSC and Figure 4.3 show the post- mining LSC classes. Of the 117 ha to be disturbed, 59 ha will be rehabilitated back to the original land and soil capability, as the soil profile will not be significantly altered. There will be a change to the land and soil capability class over 58 ha of land disturbed by the surface infrastructure area and water management areas. The original land class of these areas (3 ha of Class 3, 37 ha of Class 4 and 18 ha of Class 5) will change to Class 6 because the soil depth will be 0.3 m as the replaced topsoil will overlie re-profiled fill materials. However, Class 6 land will still be suitable for grazing and improved pasture, allowing the continuation of an agricultural land-use post-mining, as it is now.

Table 4.3 LSC class pre- and post-mining

LSC Class	Capability	Pre-mining LSC (ha)	Post-mining LSC (ha)	Amount lost or gained (+/- ha)	% change
LSC of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)					
1	Extremely high	-	-		
2	Very high	-	-		
3	High	144	141	-3	-2%
LSC of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)					
4	Moderate	2221	2184	-37	-2%
5	Moderate-low	704	686	-18	-3%
LSC for a limited set of land uses (grazing, forestry and nature conservation)					
6	Low	1641	1699	+58	+4%
LSC generally incapable of agricultural land use (selective forestry and nature conservation)					
7	Very low	300	300		
8	Extremely low	-	-		
None	Waterbodies, Hume Highway, etc	41	41		

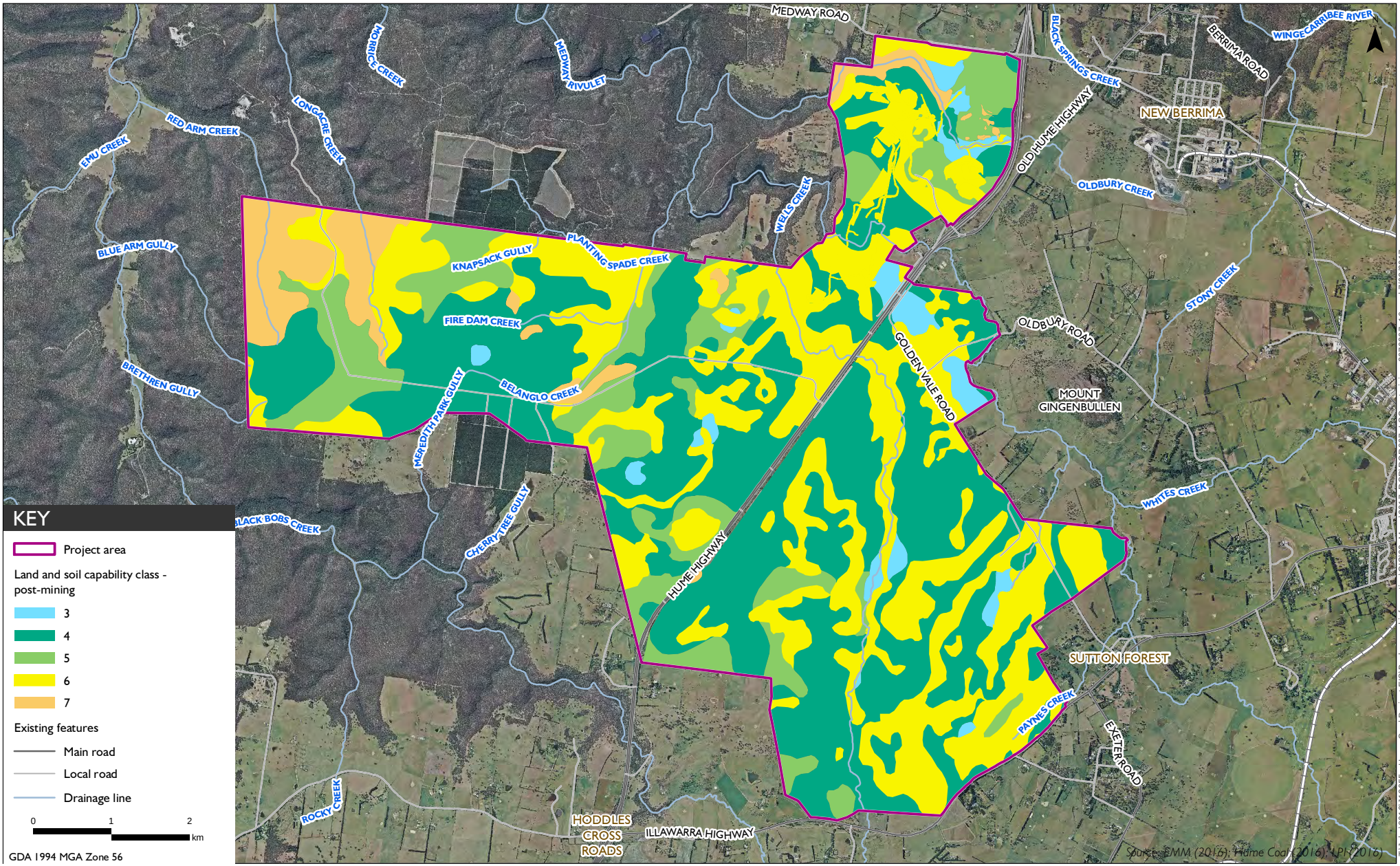


Land and soil capability classes- pre-mining

Hume Coal Project

Closure and Rehabilitation Strategy

Figure 4.2



Land and soil capability classes – post-mining

Hume Coal Project

Closure and Rehabilitation Strategy

Figure 4.3

5 Rehabilitation methods for closure

5.1 Progressive rehabilitation

Rehabilitation of areas containing early and temporary works or facilities will occur progressively. In particular, once the construction accommodation village is vacated and pipeline and powerlines relocated, the affected areas will be rehabilitated.

There is limited opportunity for any other progressive rehabilitation as almost the entire surface infrastructure will remain for the duration of the project.

Areas that can be rehabilitated progressively are:

- temporary construction facilities;
- accommodation facility;
- powerline and pipeline easement; and
- exploration drill pads and access tracks.

5.2 Soil stripping procedure

The topsoil stripping procedure will be designed to maximise the salvage of suitable topsoils and subsoils. These measures will be consistent with leading practice and incorporate the full range of reasonable and feasible mitigation methods for soil stripping.

The procedure for topsoil stripping will include the following soil handling measures that will minimise soil degradation (in terms of nutrients and micro-organisms present) and compaction, thus retaining its value for plant growth.

- The area to be stripped will be clearly defined on the ground, avoiding any waterlogged or similarly constrained areas. The target depths of topsoil and subsoil to be stripped for each location will be clearly communicated to machinery operators and supervisors.
- A combination of suitable earthworks equipment will be used for stripping and placing soils in stockpiles. Machinery circuits will be located to minimise compaction of the stockpiled soil.
- All machinery brought onto the site for soil stripping will have to comply with any weed management and biosecurity protocols established for the site.
- Where the soil surface of the soil stockpile footprint is to be disturbed by the creation of topsoil stockpiles (ie vegetation removal, tracks, turning circles, etc), a nominal 0.1m topsoil only (not subsoil) will be stripped before stockpiles are developed.
- The surface infrastructure area does not contain significant areas of native vegetation or trees, but any trees present will be cleared and grubbed prior to topsoil salvage.

- Topsoil and subsoil will be stripped to the required depths as nominated in this assessment and then stockpiled. Subsoil will be stripped and stockpiled separately where identified as suitable. Depending on compaction and recovery rates, deep ripping may be required to maximise topsoil recovery. Where soils are shallower, topsoil and subsoils will be stripped and stockpiled together.

- Handling and rehandling of stripped topsoil will be minimised as far as practicable by progressively stripping vegetation and soil only as needed for development activities.

- Soil stripping in very wet conditions will be avoided if practicable, because of the risk of compaction, nutrient deterioration and less volume of suitable materials being available. However, when possible, soils will be stripped when they are slightly moisture conditioned and this will assist in their removal and retain their structure.

- To avoid dust hazards, stripping of soil during particularly dry conditions will be avoided where possible.

5.3 Soil stockpile management

Soil stockpile management procedures will be designed to minimise degradation of soil characteristics that are favourable for plant growth. These measures are consistent with leading practices and incorporate all reasonable and feasible mitigation methods.

The following management practices will generally be adopted:

- Stockpiles will be located at an appropriate distance from water courses and dams (so they are not washed away).

- Where practical, topsoil and subsoil will be stockpiled separately. Where this is not possible, combined topsoil and subsoil stockpiles will still be built to the specifications for topsoil stockpiles.

- Topsoil stockpiles will be designed and constructed to a height generally no greater than 3 m in order to limit anaerobic conditions being generated within the stockpile and to minimise deterioration of nutrients, soil biota and seed banks.

- Soil stockpiles will have a slope grade of 1V:4H or less to limit erosion potential.

- Subsoil stockpiles can be designed over 3 m in height; however the slope grade needs to be considered for erosion control and should still be 1V:4H or less.

- The surface of the soil stockpiles should be left in a 'rough' condition to help promote water infiltration and minimise erosion via runoff. If required, sediment controls will be installed downstream of stockpile areas to collect any runoff.

- Overland water flow onto or across stockpile sites will be kept to a practical minimum and will not be concentrated to the extent that it causes visible soil erosion.

- Stockpiles will be seeded with an appropriate pasture grass mixture to stabilise the surface, restrict dust generation, minimise erosion and weed growth.

- The location will be marked on site maps to identify the stockpiles so that they are protected from future disturbance.

- The stockpile locations will be surveyed and data recorded about the soil types and volumes present.
- The establishment of weeds on the stockpiles will be monitored and control programs implemented as required.
- Short-term stockpiles created during construction will be managed under the Construction Environmental Management Plan.

5.4 Soil reinstatement

Upon decommissioning of the infrastructure area and other hardstand areas at closure, compacted areas will be ripped to break up hard layers and provide a favourable root zone. Soil will be applied to landforms once they are re-shaped and drainage works are complete. This may include contour or diversion banks with stable discharge points if required to manage runoff.

The topsoil application procedure will essentially be the reverse of the stripping procedure. It will be designed to minimise any degradation of soil physical and chemical characteristics. Generally, all soils will be applied with a thickness of approximately 0.3 m to provide sufficient depth for ripping and plant growth. If subsoil is stripped separately to the topsoil, the subsoil will need to be spread at approximately 0.15 m depth and then topsoil spread over the top at approximately 0.15m depth to create an overall depth of approximately 0.3 m.

The following measures are designed to minimise the loss of soil during respread on rehabilitated areas and promote successful vegetation establishment:

- A soil balance plan will be prepared before the topsoil is spread, which shows the depths and volume of soils to be reapplied in particular areas. The plan will take account of the relative erodibility of the soils, with more erodible material being placed on flatter areas to minimise the potential for erosion.
- After the area to be rehabilitated has been re-profiled and/or deep ripped, the subsoil will be spread onto the site, followed by the topsoil (or all at once if not stripped and stored separately).
- Soil will be respread in even layers at a thickness appropriate for the land capability of the area to be rehabilitated.
- Soils will be lightly scarified on the contour to encourage rainfall infiltration and minimise run-off.
- As soon as practicable after respreading, pasture grasses will be seeded.

5.5 Drainage and erosion control

Re-shaped surfaces will be stabilised as soon as practicable to reduce potential wind erosion and subsequent dust.

All rehabilitation areas will require stabilisation to protect them against the risk of erosion from wind or water. Measures include:

- ripping of ground to increase surface roughness and slow wind speed at ground level; and

- establish a cover crop. Improved pasture species are considered the most likely to be suitable as their seed is readily germinated.

Drainage zones will not receive special erosion control treatments. Sediment movement associated with stream flow is a natural phenomenon in the region, however if excessive sediment movement occurs then supplementary earthworks will be undertaken to return the drainage channels to design levels.

5.6 Revegetation

Disturbed areas will be revegetated with improved pasture seed.

Fertiliser may be applied at an appropriate rate with seed-mixes to increase the likelihood of initial revegetation success. The pasture grass species will be chosen to suit the proposed grazing strategy, as well as species that are suitable for fast establishment of an initial cover crop. The timing of the seeding operation will take into account the seasonal growing season for the grass species, but should not be delayed after the soil has been returned to prevent soil erosion.

5.7 Post-closure maintenance

5.7.1 Rehabilitation monitoring

Maintenance will encompass post-rehabilitation monitoring to identify areas requiring maintenance, and identify and address deviations from the expected outcomes. Rehabilitated areas will be assessed against performance indicators (refer Section 6) and regularly (at least on an annual basis) inspected for the following aspects:

- evidence of any erosion or sedimentation;
- success of initial establishment cover;
- natural regeneration of improved pasture;
- weed infestation (primarily noxious weeds, but also where rehabilitation areas are dominated by other weeds);
- integrity of graded banks, diversion drains, waterways and sediment control structures; and
- general stability of the rehabilitation areas.

Where rehabilitation criteria have not been met, maintenance works will be undertaken. This may include the following:

- re-seeding and, where necessary, re-soiling and/or the application of specialised treatments;
- use of materials such as composted mulch to areas with poor vegetation establishment;
- replacement of drainage controls if they are found to be inadequate for their intended purpose, or compromised by vegetation or wildlife; and
- de-silting or repair of sediment control structures.

5.7.2 Weed management

The presence of weed species has the potential to have a major impact on revegetation outcomes. Additionally, any significant weed species within the surrounding land has the potential to impact on the success of the rehabilitated areas. Weed management will be an important component of rehabilitation activities.

The spread of declared noxious weeds (and other invasive weeds that could impact revegetation success and/or plants that are undesirable to grazing stock) will be managed across the project area through a series of control measures, including:

- herbicide spraying or scalping weeds;
- post-mining use of rehabilitated areas as a working farm, with associated management practices; and
- rehabilitation inspections to identify potential weed infestations.

5.7.3 Access

Access tracks may be required to facilitate the revegetation and ongoing maintenance of the project. These tracks will be kept to a practical minimum and will be designated prior to the completion of the project.

5.7.4 Public safety

Controls will be implemented to minimise the potential for impacts on public safety, and may include maintenance of fencing and warning signs around areas that have the potential to cause harm and are that are accessible to the public. Public safety measures will be implemented following consideration of the Work Health and Safety (Mines) Regulation and *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February, 2012*.

5.7.5 Rehabilitation resources

Environmental personnel will implement specific management requirements arising from this strategy.

Earth moving operations will be performed by machinery operators with experience and skill in the operation of the relevant machinery (scrapers, loaders, excavators etc). Project Supervisors will be responsible for compliance with the requirements of this strategy and its future revisions.

The Mine Manager will be responsible for achieving the rehabilitation criteria.

6 Performance indicators and completion/relinquishment criteria

6.1 Secondary domains

Secondary domains (as defined in the MOP Guidelines) (DRE 2013) are defined as land management units characterised by a similar post-mining land use objective (ie following mining). The secondary domains form the basis of performance criteria used for measuring rehabilitation and closure success.

All of the project primary domains have a secondary domain (post-mining land use) of "D – Rehabilitation Area – Pasture." The secondary domain is shown in Figure 4.1.

6.2 Rehabilitation criteria and reporting

Rehabilitation completion criteria will be used as the basis for assessing when rehabilitation of the project is complete. Indicators will be measured against the criteria, and are set for the 6 phases of rehabilitation, as follows:

- Phase 1 – Decommissioning (ie removal of equipment and infrastructure);
- Phase 2 – Landform Establishment (ie earthworks);
- Phase 3 – Growth Medium Development (ie topsoil spreading);
- Phase 4 – Ecosystem and Land Use Establishment (ie vegetation establishment);
- Phase 5 – Ecosystem and Land Use Sustainability (ie established vegetation is able to support post-mining land use); and
- Phase 6 – Land Relinquishment.

Interim rehabilitation criteria for the project have been developed with the current knowledge of rehabilitation practices and success in similar project environments. They have been based largely on experience elsewhere in Australia. They consist of a set of objectives; rehabilitation criteria and evidence that criteria have been met.

Whether rehabilitation criteria have been met depends on the trending of measurements over time compared to pre-mining or reference site conditions. The criteria will be refined and confirmed in the MOP and in the detailed closure plan as the project progresses towards closure.

The rehabilitation criteria need to demonstrate that the rehabilitation objective has been achieved. Consequently, interim rehabilitation criteria are presented in Table 6.1 that address the following outcomes:

- restoration of a safe and stable landform that is non-polluting; and
- reinstate soil profiles and function and create landforms that are compatible with surrounding topography; and reestablishment of landforms that permit grazing and improved pasture.

Reporting on rehabilitation activities, monitoring and progress towards achieving agreed rehabilitation criteria will occur via an annual environmental management report.

Table 6.1 Interim completion criteria at each phase of decommissioning and rehabilitation

Objective	Primary Domain	Completion criteria	Indicator
Phase 1 – Decommissioning (ie removal of equipment and infrastructure)			
All infrastructure that is not to be used as part of the future intended land use will be removed so that the site is safe, free from hazardous materials, and will not pose a threat of environmental harm.	Infrastructure	Removal of all above ground services (power, water, communications) that have been connected on site as part of the project and that will have no future use. Decommissioning and removal of all plant, equipment and associated surface infrastructure. All access roads and tracks not required for the future intended land are removed and rehabilitated.	Certification by a suitably qualified person
	Water management area	Removal of all water management infrastructure (including pumps, pipes and power).	Certification by a suitably qualified person
	Underground management area	All exploration drill holes undertaken on the mining lease have been rehabilitated or converted to water bores.	Certification by a suitably qualified person
There is no residual contamination of soil or water on site that is incompatible with the intended land use or that poses a threat of environmental harm.	Infrastructure	No stockpiled materials of coal product or coal reject to remain on the surface of the project area. Any hazardous material or potential sources of contamination have been isolated, remediated or removed.	Certification by a suitably qualified person
Underground workings are sealed and present no safety risks for humans and animals now and in the long-term.	Underground management area	Sealing and backfilling of drifts and vent shafts in accordance with approved design and relevant guidelines.	Certification by a suitably qualified person
	Infrastructure	Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards.	Certification by a suitably qualified person
Phase 2 – Landform Establishment (ie earthworks)			
The rehabilitated land is suitable for the planned land use and is compatible with surrounding landscape.	Infrastructure, Water management area, Stockpiles	Rehabilitated land is contoured in similar form to the existing and/or surrounding topography.	Rehabilitated land surveyed for extent, height and slope

Table 6.1 Interim completion criteria at each phase of decommissioning and rehabilitation

Objective	Primary Domain	Completion criteria	Indicator
The rehabilitated land is stable and does not present a risk of environmental harm downstream of the site or a safety risk to the public/ stock/ native fauna.	Infrastructure, Water management area, Stockpiles	If engineered structures to control water flow are required (eg contour banks, channel linings, surface armour, engineered drop structures and other required measures), they are installed and functioning.	Certification by a suitably qualified person
		Rehabilitated land does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site (with similar chemical and physical characteristics including slope to the rehabilitated site).	Certification by a suitably qualified person
		Dimensions and frequency of occurrence of erosion of rills and gullies are no greater than that in comparable reference site(s).	Rate of soil loss; certification by a suitably qualified person
Phase 3 – Growth Medium Development (ie topsoil spreading)			
Returned soil on the rehabilitated land is able to support the planned land use.	Infrastructure, Water management area, Stockpiles	Soil thickness is adequate to support growth of pasture species suitable for desired land-use.	Soil depths
		Site soil characteristics (eg pH, salinity, nutrient content , sodium content, rockiness, depth of soil, wetness and plant available water capacity) are able to support growth of pasture species suitable for desired land-use.	Soil testing of relevant soil physical properties
Phase 4 – Ecosystem and Land Use Establishment (ie vegetation establishment)			
Vegetation establishment is adequate and able to support the desired land use.	Infrastructure, Water management area, Stockpiles	Vegetation growth parameters are no less than that exhibited at a comparable reference site.	Biomass, percent cover, height and vigour of plant species
		The abundance of declared plants (weeds) identified in rehabilitated areas in no greater than comparable reference sites.	Percentage weed cover
Phase 5 – Ecosystem and Land Use Sustainability (ie established vegetation is able to support post-mining land use)			
The rehabilitated land is stable and does not present a risk of environmental harm downstream of the site or a safety risk to the public/ stock/ native fauna	Infrastructure, Water management area, Stockpiles	Rehabilitated land does not exhibit signs of continued erosion greater than that exhibited at a comparable reference site (with similar chemical and physical characteristics including slope to the rehabilitated site).	Rate of soil loss; certification by a suitably qualified person
		Dimensions and frequency of occurrence of erosion of rills and gullies are no greater than that in comparable reference site(s).	Certification by a suitably qualified person

Table 6.1 Interim completion criteria at each phase of decommissioning and rehabilitation

Objective	Primary Domain	Completion criteria	Indicator
Phase 6 – Land Relinquishment			
The rehabilitated land is sustainable for the long-term and only requires maintenance that is consistent with the final land use.	Infrastructure, Water management area, stockpiles	The re-established topsoil/subsoil is capable of supporting the targeted pasture regime on a sustained basis.	Physical and chemical soil properties.
		Pasture establishment is consistent with the range of species suitable for the targeted pasture regime.	Pasture species present
		Pasture establishment is in good health and provides adequate cover.	Ground cover, biomass, etc
Runoff water quality is similar to, or better than, the pre-disturbance runoff water quality.	Infrastructure, Water management area, stockpiles	Downstream surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the five years previous to closure are compared to monitoring results for the rehabilitated landform.	Surface water quality
Ground level and surface stability not impacted by the presence of the underground workings.	Underground management area	Mining has been undertaken generally in accordance with designs and tolerances that provide for long-term geotechnical stability. Where land access can reasonably be obtained, no evidence of perceptible surface impacts are evident in the area above underground operations.	Mine survey plans are developed by a registered mine surveyor as mining progresses and provided to DRE annually and following completion of mining.

6.3 Rehabilitation monitoring and research

6.3.1 Sampling intensity

The sampling intensity for rehabilitation monitoring will take into account:

- practical and cost effective monitoring techniques;
- standard rehabilitation monitoring practice; and
- the need for broadscale monitoring, ensuring that overall project rehabilitation performance is obtained.

6.3.2 Frequency of monitoring

Regular monitoring of the rehabilitated areas will be required during the initial vegetation establishment period and beyond to demonstrate whether the objectives of the strategy (as amended for the MOP) are being achieved and whether a sustainable and stable landform has been provided. Monitoring will be conducted periodically by suitably skilled and qualified persons at locations which will be representative of the range of conditions on the rehabilitating areas. Regular reviews of monitoring data will be undertaken to assess trends and monitoring program effectiveness.

6.3.3 Reference/analogue sites

In addition to the rehabilitated areas, reference/analogue sites will be established and monitored to allow a comparison of the development and success of the rehabilitation against a target control site. Reference sites will indicate the condition of surrounding undisturbed areas for land currently utilised for agriculture.

6.3.4 Rehabilitation monitoring

Rehabilitation methods will be improved as additional knowledge develops from monitoring data collected through these programs. The specific monitoring program will be outlined in the detailed closure plan, to be prepared within five years of closure. Monitoring will include:

- surface water and groundwater monitoring;
- erosion monitoring;
- soil profile; and
- vegetation condition.

Key aspects are described further below.

i Soil profile assessment

In the first year of rehabilitation, preliminary soil pits may be excavated to allow early confirmation of the soil profile and identification of any limiting factors such as compaction. Early identification of such factors will allow remedial activities such as ripping to be performed in a timely manner.

The final post-mining assessment of the rehabilitated soil profile will be performed by a suitably experienced soil scientist. This assessment will not be performed until several years after establishment of the improved pasture. This timing is so that plant root distribution through the profile may be assessed.

Assessment of the post-mining soil profile will utilise similar methods to the pre-mining soil survey. Pits or auger holes will be excavated. The soil profile will be recorded, with all soil horizons described and their location within the profile measured. Similar physical and chemical parameters assessed in the pre-mining survey will be reassessed within each soil horizon.

The results of the soils assessment will be presented to the regulatory authorities in a rehabilitation report.

ii Vegetation

Rehabilitated vegetation will be monitored annually in the first three years following rehabilitation, subject to review of observed vegetation growth rates. Subsequent monitoring is likely to be decreased to lower intervals. These intervals will be determined in consultation with rehabilitation specialists.

Control sites will be established to allow comparison of rehabilitation with undisturbed sites under the same seasonal conditions.

The number and location of vegetation monitoring plots for rehabilitated and control sites will be determined in consultation with rehabilitation specialists, as will the most appropriate survey method. As the rehabilitated land will be used as grazing pasture, the vegetation assessment will include pasture quantity and quality.

The following techniques may be used:

- **Quadrats:** The quadrat (eg. 1m x 1m) surveys will be carried out using standard vegetation survey methods. Samples of pasture will be cut from a selected number of quadrats and dried and weighed to estimate kg of pasture dry matter per hectare. Other observations from the quadrats may include the percent cover, species composition including weeds (ie undesirable to grazing stock), proportion of legume, growth phase of the plants, and proportion of leaf to stem (leaf is more edible).

- **Photographic Monitoring Points (Photopoints):** Photograph frames will be aligned at set monitoring points, so that comparisons can be made between sampling intervals.

6.3.5 Research and continual improvement

Knowledge of appropriate rehabilitation practices required to achieve the rehabilitation objectives is continually growing. Hume Coal will consult with various experts during preparing of the detailed closure plan to investigate key aspects of the rehabilitation process, such as benchmarking against industry rehabilitation best practice, and review of mechanical process which are relied upon in the rehabilitation process against new available technologies at the time.

Abbreviations

ANZECC	Australian and New Zealand Environment and Conservation Council
ANZMEC	Australian and New Zealand Minerals and Energy Council
AMD	Acid mine drainage
CEMP	Construction Environmental Management Plan
CPP	Coal processing plant
DoEE	Commonwealth Department of the Environment and Energy
DP&E	NSW Department of Planning and Environment
DPI Water	NSW Office of Water
DRE	NSW Division of Resources and Energy
EC	Electrical conductivity
EIS	Environmental impact statement
EMM	EMM Consulting Pty Limited
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ha	hectares
LGA	Local government area
Local Government Act	*Local Government Act 1993*
LSC	Land and soil capability
m	metres
MCA	Minerals Council Australia
MIA	Mine infrastructure area
MOP	Mining operations plan
Mt	Million tonnes
Mtpa	Million tonnes per annum
NAF	Non-acid forming
NMD	Neutral mine drainage
NSW	New South Wales
PAF	Potentially acid forming
ROM	Run of mine
SEARs	Secretary's environmental assessment requirements
SFMC	*Strategic Framework for Mine Closure*
TLO	Train load Out
TDS	Total dissolved salts
WHS	Workplace health and safety
WLEP	Wingecarribee Local Environmental Plan
WM Act	NSW *Water Management Act 2000*
WSC	Wingecarribee Shire Council

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Appendix A

Closure Risk Assessment

Rehabilitation and Closure Risk Workshop

Date: 30th November 2015

Attendees: Greig Duncan (Project Director); Luke Edminson (Manager – Environmental Planning, Hume Coal Project); Alex Pauza (Manager, Mine Planning - Hume Coal Project); Nicole Armit (Associate Environmental Scientist – EMM Consulting); Kylie Drapala (Senior Soil Scientist – EMM Consulting)

Risk assessment boundaries:

- Hume Coal project area
- Infrastructure areas vs areas above mine layout
- Timeline: Construction to operational to decommissioning and rehab works to monitoring

Key considerations for risk assessment:

- Decommissioning activities and regulatory requirements (eg MDG 6001)
- Coal treatment activities - washing, tailings?
- Rehabilitation criteria for on-going monitoring link to chosen controls
- Transitions from operational controls to rehabilitation controls

Not considered in risk assessment:

- Groundwater impacts – this is assessed in the Water Assessment process

Risk assessment matrix:

- Table A1 shows the matrix used for risk ranking. Risk ranking was assessed as a residual risk, after control measures were put in place.

Table A.1 Risk assessment matrix tool

Potential consequence				Probability				
Score	**People**	**Environment**	**Community**	**A Almost certain to happen**	**B Likely to happen at some point**	**C Moderate: possible, heard of**	**D Unlikely: not likely to happen**	**E Rare: practically impossible**
5 Catastrophic impact	Fatality	Disastrous environmental impact, where there is long term effects, requiring remediation, regulatory intervention or premature closure of the operation	Public international condemnation .Major breakdown of social order in affected communities	**1**	**2**	**4**	**7**	**11**
4 Severe negative impact	Major injuries or health effects to multiple people Permanent total disability	Serious environmental impact, with medium term effect, requiring significant remediation or resulting in prosecution	Loss of community's economic viability. Significant damage to reputation of the operations	**3**	**5**	**8**	**12**	**16**
3 Major negative impact	Minor injury or health effects to multiple people Major injury or health effects (eg LTIs or permanent disabilities)	Moderate reversible environmental impact with short term effect, requiring moderate remediation, such as reportable incident	Significant public criticism eg community complaints. NGO or media "taking up the issue". Major negative impact on economic viability	**6**	**9**	**13**	**17**	**20**
2 Negative impact	Minor injury or short-term health effects requiring restricted work	Minor reversible environmental impact, requiring minor remediation such as non reportable environmental incident	Flare up of issue in affected communities Media criticism	**10**	**14**	**18**	**21**	**23**
1 Minor negative impact	Minor injury or short-term health effect (eg requiring first aid)	Negligible reversible environmental impact, requiring very minor or no remediation	Slight negative impact on individuals in local community	**15**	**19**	**22**	**24**	**25**

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Air quality	Community complaints about dust nuisance during rehabilitation.	Mine will operate a complaints phone number and register for recording and actioning complaints. All complaints will be investigated with appropriate actions being completed as required to mitigate against future risk.	1	C	22
Air quality	Impact of exceeding dust limits in approval - low impact.	Air quality/dust management plan - closure construction phase, ongoing phases, consultation for closure. Management plan to deal with specifics, eg monitoring requirements of approval. Mine closure plan to consider dust impacts and management of rehabilitation timing - (including progressive rehab) Incident reporting procedures will be in place.	1	D	24
Air quality	Community complaints about nuisance dust after rehabilitation is complete ie landform has been created and seed has been spread.	Location of infrastructure is planned to avoid trees/forest and the proposed final land use of cropping and grazing provides control. Monitoring during rehabilitation phase expected to identify dust generation from farming activities not in excess of surrounding land users.	1	D	24
Air quality	Gas emissions from underground workings after closure.	Very low gas content of coal - analysis shows a very low risk of ongoing emissions. Individual panels will be sealed and flooded as mine progresses shafts and drifts will be backfilled and capped as part of rehab works.	2	E	23
Strategic risk	In the future local weather patterns may change (ie rainfall, ambient temperature, bushfire) resulting in weather patterns that are not compatible with a future land use of cropping and light grazing causing completion criteria to not be achieved and relinquishment delayed.	The micro-climate is created by elevated topography and orographic rainfall. Seasonal variability is already a feature of this landscape, and the grazing/cropping cycles are adjusted accordingly. Any significant changes to the climate would affect the entire region, not just the small area of surface disturbance that has been created by the mine. The closure management plan includes landforms and vegetation that is compatible to a future land use of cropping and light grazing and is compatible with current weather patterns and existing seasonal variations; completion criteria will take seasonal variation into consideration.	2	C	18

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Strategic risk	Mine owner cannot deliver closure due to bankruptcy; site left unrehabilitated.	Rehabilitation security deposit calculated as per regulatory requirements on an ongoing basis. Ensure that latest costings and guidelines are referenced as part of rehabilitation costings.	2	E	23
Strategic risk	Failure to identify all stakeholders and all stakeholder concerns. Stakeholder groups perceive insufficient stakeholder engagement and become vocal with opposition.	Undertake a detailed closure planning process as required by ESG3 (DRE 2013) for the Mine Operations Plan - include Stakeholder consultation at the time.CCC - update over time.	1	E	25
Strategic risk	Risk - loss of jobs, impacts to service providers, flow on economic effects on local businesses	Detailed closure plan address socio-economic impacts of closure Mine approved for known period of time, ongoing stakeholder engagement throughout mine life.	3	B	9
Finance	Unable to relinquish the mine because of changed regulator expectations leading to increased post closure costs. Modifications provide opportunity to change approvals.	Mine Closure Plan to be reviewed and updated as required. Completion criteria to be proposed within the Mine Closure Plan and agreed with regulators as soon as practicable; investigate opportunities for progressive certification of rehabilitation. Security deposit updated with annual submission. Current mine design for long term stability (underground).	3	C	13
Finance	Poor staff retention leading to delayed rehabilitation works and loss of historical knowledge. Impacts on costs of rehabilitation planning and works.	Knowledge sharing, documentation and document control; the level of impact is dependent on the level of the person leaving. Undertake a detailed closure planning process as required by ESG3 (DRE 2013) for the Mine Operations Plan at closure.	1	C	22
Water resources	Subsidence creates permanent impact. New drainage points in the landscape and affects natural surface water flow. Subsidence may cause activity areas to become drainage depressions.	Underground pillars designed for long-term geotechnical stability is the main control. Predicted surface settlement will be within the traditionally accepted survey value of “zero” ie <20mm, and immeasurable using traditional surveying techniques as it is less than survey error which is 20mm. Ongoing monitoring to detect subsidence will be carried out.	3	E	20

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Water resources	High rainfall events cause excessive runoff of from rehabilitated landforms, releasing sediment to surface water. Triggers reporting level.	Mine has been designed with a small surface disturbance area Works will be sequenced to ensure minimal disturbance at any one time, areas will be progressively rehabilitated. Erosion and sediment controls will be used and monitored during onsite landforming works. PIRM - pollution incident response management in place.	3	D	17
Water quality	Risk that water quality stored in dams is not compatible with a future land use of light grazing If agreements in place to handover dams.	Rehabilitation schedule will remove operational dams in final landform designs. Remove any sources of contaminants through rehabilitation of infrastructure areas. Water treatment on site to initially treat water to acceptable quality to suit land use. Water quality testing at regular intervals during monitoring phase.	2	D	21
Water quality	Dam decommissioning - quality of water and sediment makes it difficult to dispose (limited options) with significant financial implications for disposal.	Treat water same way as during operations until dams are decommissioned. Options to reinject the water.Water and sediments tested and develop plans to dispose of as appropriate based on resultsDevelop a detailed closure plan prior to closure and rehabilitation to identify suitable disposal options.	2	C	18
Soil/Landform	Non-reportable fuel and machinery spills (eg hydraulic fluids) affects soils during decommissioning and rehabilitation works.	All vehicles scheduled to take part in the field rehab programs will be inspected prior to accessing site and daily pre-starts to ensure no hydrocarbon leaks or other defects. Management of spills to ground - contain and manage any effected volume of soil material. PIRM - pollution incident response. Spill kits provided on site during rehabilitation activities.	1	C	22

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Soil/Landform	Reportable fuel and machinery spills (eg hydraulic fluids) affects soils during decommissioning and rehabilitation works.	Incident management and reporting procedures will be developed and updated over time (PIRM - Pollution incident response). All vehicles scheduled to take part in the field rehab programs will be inspected prior to accessing site and daily pre-starts to check for hydrocarbon leaks or other defects. Spill management to contain and manage any effected volume of soil material. Spill kits provided on site during rehabilitation activities.	3	C	13
Soil/Landform	Closure contamination assessment identifies hydrocarbon contamination of soils/materials in storage areas or along buried pipe lines.	Design controls to minimise potential for hydrocarbon spills Bunded storage areas, use of suitable piping materials. Minimise pipe length through infrastructure design. Consideration for not burying diesel pipes.	2	B	14
Soil/Landform	Perceived quantities of soil inaccurate and not enough subsoil and topsoil available to stabilise and rehabilitate disturbed areas.	Identify appropriate stripping depths for top and subsoil based on mapped soil types in proposed infrastructure areas. Stockpile topsoil and subsoil separately and stabilise to prevent erosion and dust generation. Investigate alternative storage or treatment options for long term storage of topsoil (eg storing subsoil stockpiles as bunds).	2	D	21
Soil/Landform	Rates of soil amendments (eg fertiliser and seed) required is cost prohibitive.	Identify appropriate stripping depths for top and subsoil based on mapped soil types in proposed infrastructure areas. Stockpile topsoil and subsoil separately and stabilise to prevent erosion and dust generation.At rehabilitation identify appropriate ameliorants based on soil typesFactor in costs for rehabilitation associated with machinery to amend and ameliorate should more material be required.	2	D	21
Soil/Landform	Amendment of soil (topsoil and subsoil) is ineffective resulting in poor vegetation cover and increased erosion rates or potential.	Rehabilitation monitoring program to determine success of selected option. Planning and management for topsoil. Potential land management plan - for future land use - link to land use policy.	2	D	21

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Soil/Landform	Subsidence - risk of potholing or sinkholes in final landform.	Mine design control - designed everything to be >80m or deeper to avoid sink hole effects.	3	E	20
Waste	Volume of waste generated is greater than budgeted for (HDPE liners (if used), other decommissioned infrastructure) and transport of waste off site is cost prohibitive.	Develop a waste disposal management plan specific to the project methodology and infrastructure requirements to capture what will be re-used and what is required for removal from site and ensure cost implications are understood. Identify all hazardous waste, demolition waste and municipal waste streams. Ongoing MOP amendment and rehabilitation security deposit calculations (incorporate waste management realistically).	2	C	18
Waste	Temporary accommodation village - potential contaminated soils from sewerage disposal site.	Design of amenities in accordance with AS/NZS 3500.2:2003 - Plumbing and drainage - Sanitary plumbing and drainage, location of amenities away from sensitive receivers where practical, appropriate containment structures ie bunding, good onsite drainage design, appropriate maintenance of amenities, safe work methods, use of licensed contractors (Australian Standards and NSW legislation), emergency management and response plans/training/equipment, environmental management plan, operator training. Undertake a contaminated land assessment of any irrigation disposal areas prior to rehabilitation.	2	C	18
Noise	Noise perceived by local land holders and complaints received.	Maintain a complaints register and response system during the rehabilitation and monitoring phase. Stakeholder engagement program. Closure and rehabilitation plan to cover noise management (monitoring as per existing etc).	2	B	14
Noise	Exceedance of noise limits during decommissioning (construction noise goals) - reportable	Closure and rehabilitation plan to cover noise management (monitoring as per existing etc). Incident management and reporting procedures implemented.	3	D	17

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			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Fire	Non-Hume caused fire (eg bushfire) - effect rehabilitation, increase cost.	Fire fighting facilities provided on site – eg water cart or extinguishers; Install a fire break around specified landforming work areas and rehabilitation areas Land use of farmland suitable to area (cropping and pasture).	2	D	21
Fire	Risk of bushfire effects on biodiversity offset area.	Implement a bushfire management plan and monitoring program where required to allow measurement of rehabilitation resilience from pressures such as fire.	3	D	17
Fire	Fire risk to from spontaneous combustion.	Fire fighting system, sufficient buffer between vegetated areas/flammable materials storages and coal stockpiles, coal relatively non-combustible in a non-pulverised form. Studies show targeted coal seams are low risk for spontaneous combustion - and seam has had no combustion events.	2	E	21
Fire	Fire risk from hotwork or other rehab activities.	Hot works permit system used during rehabilitation works Daily Pre-Start Meetings to consider weather and fire conditions to inform activities or work plans. Contractor SME fire fighting facilities systems.	2	D	21
HSE	Increased potential for mine based environmental personnel to be injured completing a task that is a non standard (monitoring phase only).	Activity in accordance with WHS legislation and Hume requirements (Safety management plans etc). Use of suitably trained and/or qualified employees/contractors.	2	D	21
HSE, Impact on reputation	Death or injury to people and cattle during rehabilitation of shafts.	Clear marking of site boundaries and delineation of entry point. Controlled entry point. Site access is managed and a comprehensive risk assessment is completed regarding site security. Comprehensive risk assessment and system of work developed to rehabilitate shafts. Decommissioning of shafts will be in accordance with regulatory requirements (eg MDG6001 or equivalent). Communication procedure for persons with right of entry, traffic controls and barricades, warning signs.	5	D	7

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			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Flora and fauna	Vegetation cover on the rehabilitated landform is dominated by weeds; and is not compatible with a future land use of light grazing because it is not palatable and/or nutritious for cattle.	Develop a pest and weed management plan and a rehabilitation monitoring program identifies weeds that require attention. Monitoring and completion criteria; demonstration cattle grazing trials; and weed control as required. Source local seed to ensure site suitability and higher germination rates for native and improved pasture species and native vegetation rehab areas.	1	D	24
Fauna and Flora	Rehabilitation of offset area fails resulting in being unable to relinquish lease.	Implement monitoring program for biodiversity offset areas to flag development problems during the rehabilitation and monitoring phase.	3	D	17
Fauna and Flora	Threatened native fauna injured during rehabilitation works.	Regular fence inspections by environmental team, gate etiquette included in employee inductions. Inspections prior to landforming works and stockpile deconstruction.	1	C	22
Aboriginal Heritage	Reputation Impact to Hume if aboriginal heritage sites are impacted by future land owner.	Heritage sites will be listed on register for potential land owners to search during conveyance. High significance sites will be clearly marked and delineated.	2	D	21

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