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Narrabri Mine
Mining Operations Plan (MOP)

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Narrabri Coal Operations Pty Ltd
Locked Bag 1002
NARRABRI NSW 2390

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Narrabri Mine

Mining Operations Plan (MOP)

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road
New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305 Australia)
+61 2 4037 3200 +61 2 4037 3201
newcastleau@slrconsulting.com www.slrconsulting.com

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Narrabri Mine Mining Operations Plan	
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MOP Completion Date	31 December 2020
Mining Authorisations	ML 1609
Name of Authorisation/Authorisation holder(s)	Narrabri Coal Pty Ltd
Name of Mine Operator	Whitehaven Coal Limited
Name and Contact details of Mine Manager	Steve Bow General Manager – Narrabri Mine Ph: 02 6794 4755
Name and Contact Details of Environmental Representative	Steve Farrar Environmental Superintendent 02 6794 4755
Name of Representative (s) of the Authorisation Holders	Steven Bow
Title of Representative (s) of the Authorisation Holders	General Manager – Narrabri Mine
Signature of Representative (s) of the Authorisation Holders	
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1 INTRODUCTION

This Mining Operations Plan (MOP) has been prepared by SLR Consulting Australia Pty Ltd (SLR) in conjunction with Narrabri Coal Operations Pty Ltd (NCOPL) for the Narrabri Mine in the Gunnedah Basin of north-west New South Wales (NSW). The Narrabri Mine is located within the Narrabri Local Government Area (LGA), approximately 30 km south-east of Narrabri, and 10 km north-west of Baan Baa. Narrabri Mine is operated by NCOPL, and is a joint venture between Narrabri Coal Pty Ltd (NCPL), (70%), Upper Horn Investments (Australia) Pty Ltd (7.5%), J-Power Australia Pty Limited (7.5%), EDF Trading Australia Pty Limited (7.5%) and Daewoo International Narrabri Investment Pty Limited & Kores Narrabri Pty Limited (7.5%). NCPL is a 100% owned subsidiary company of Whitehaven Coal Mining Limited (WCL), a publicly listed Company (ASX:WHC) with several mining interests in the Gunnedah-Narrabri region of NSW.

This MOP has been prepared in accordance with *ESG3: Mining Operations Plan (MOP) Guidelines* (Department of Planning and Environment– Division of Resources and Geosciences, 2013), to satisfy Condition 3 of Mining Lease (ML) 1609. It has been developed in accordance with the relevant provisions of Project Approval (PA) 08_0144 (PA 08_0144) Modification 6 (MOD 5) issued by the Department of Planning and Environment (DPE) on 13 January 2017 under Section 75W of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1 History of Operations

The Narrabri Mine was developed after exploration investigations identified an in-situ coal resource of approximately 229 million tonnes. Stage 1 of the Narrabri Mine was approved under Part 3A of the EP&A Act in 2007 (PA 05_0102) and involved initial site establishment activities and continuous miner mining operations producing up to 2.5 million tonnes per annum (Mtpa). This approval was modified in March 2010 and involved changing the sequence of underground panel roadway development and construction and operation of additional mine infrastructure.

PA 08_0144 for Stage 2 of the Narrabri Mine was issued under Part 3A of the EP&A Act in July 2010 and allowed the mine to convert to a longwall mining operation. The Stage 1 approval was subsequently surrendered on 2 August 2011. PA 08_0144 has been modified on five occasions since it was issued, as shown in **Table 2**.

PA 08_0144 (as modified) allows for the production and processing of up to 11 Mtpa of ROM coal for a period of 21 years. ROM coal is processed at the Narrabri Mine to produce thermal and Pulverised Coal Injection (PCI) product coal. Product coal is transported from the Narrabri Mine by rail to Newcastle.

Operations at Narrabri Mine have been undertaken in accordance with the MOPs listed in **Table 1**.

Table 1 MOP History

Name	Version	Date of Approval	Expiry Date
Mining Operations Plan for the Stage 2 Longwall Project of the Narrabri Mine	Amendment B	30 September 2015	31 December 2017
	Amendment A	27 November 2012	31 December 2017
	Original MOP	8 August 2011	31 December 2017
Mining Operations Plan for the Stage 1 Continuous Miner Operation	Amendment 2	30 March 2010	31 December 2011
	Amendment 1	6 July 2008	31 December 2011
	Original MOP	8 February 2008	31 December 2011

1.2 Current Consents, Authorisations and Licences

Table 2 lists the approvals, leases and licences held for the Narrabri Mine at the time of MOP preparation.

Table 2 Approvals, Leases and Licences

Issuing/ Responsible Authority	Type of Approval	Date of Issue	Expiry	Comments
Division of Resources and Geoscience (DRG)	Exploration Licence EL6243	21 May 2004	20 May 2019	Approval for exploration (not applicable to this MOP).
	Mining Lease 1609	18 January 2008	18 January 2029	Approval for mining.
Minister for Planning	Project Approval PA 05_0102	13 November 2007	18 January 2029	Project Approval for Stage 1. Surrendered 2 August 2011.
	Project Approval PA 05_0102 MOD 1	26 March 2010	18 January 2029	Changed sequence of underground development, and additional mine infrastructure. Surrendered 2 August 2011.
	Project Approval PA 08_0144	26 July 2010	26 July 2031	Project Approval for Stage 2.
	Project Approval PA 08_0144 MOD 1	30 March 2011	26 July 2031	Updates to subsidence management conditions.
	Project Approval PA 08_0144 MOD 2	21 December 2011	26 July 2031	One off road transport of coal to Tarrawonga.
	Project Approval PA 08_0144 MOD 3	N/A	N/A	Emergency road transport of coal. Application withdrawn.
	Project Approval PA 08_0144 MOD 4	22 September 2015	26 July 2031	Extension of ROM and product stockpiles.
	Project Approval PA 08_0144 MOD 5	9 December 2015	26 July 2031	Increase ROM production to 11 Mtpa and mine layout.
	Project Approval PA 08_0144 MOD 6	13 January 2017	26 July 2031	Change Annual Review reporting to calendar year basis.
Environment Protection Authority (EPA)	Environment Protection Licence 12789	20 February 2008	Nil – Anniversary date: 20 February	For mining operation >5,000,000 T (handled and produced)
Narrabri Shire Council	Construction Certificate DP 816020	17 October 2008	N/A	Stage 1 Mine Surface Facilities
	Inspection Report/Permit to Occupy No 2413	6 August 2009		
	Construction Certificate DP 816020	23 September 2010	N/A	Stage 2 Mine Surface Facilities
Department of Primary	90CA811347 / WAL15922	Various	Various	GAB – Water supply (248ML)

Issuing/ Responsible Authority	Type of Approval	Date of Issue	Expiry	Comments	
Industries – Water (DPI Water)	90WA812891 / WAL20131 90WA812891 / WAL12833			GW – Water supply (150ML) GW – Water supply (67ML)	
	90CA802130 / WAL6762 90CA802130 / WAL2671 90CA802130 / WAL2728 90CA802130 / WAL2952			River – High Security (20ML) River (48ML) River (10ML) River (600ML)	
	90BL254679			Aquifer Interference (818ML)	
	90BL254481 - 90BL254487 90BL254660 - 90BL254663 90BL254658 90BL254659 90BL254701 90BL254958 - 90BL254967 90BL255167 - 90BL255173 90BL255216 - 90BL255218 90BL255769 – 90BL255772			Groundwater Monitoring Purposes	
	Department of Environment (DoE)	EPBC Approval 2009/5003	29 October 2014	31 December 2040	Federal approval to impact threatened species and communities listed under the EPBC Act.
	WorkCover NSW	Notification for explosives use and storage	5 August 2010	20 July 2020	Licence to store – 07- 100215-001 Licence to handle – various

This MOP submission is the first following the modification of PA 08_0144 (MOD 6). A copy of the PA is available on the Whitehaven Coal website. Narrabri Mine is classified as State Significant Development under the EP&A Act, therefore it is considered a Level 1 mine in accordance with ESG3.

1.3 Land Ownership and Land Use

1.3.1 Land Ownership

ML 1609 covers an area of approximately 5,298 hectares (ha) within the Parishes of Milner, Turrawan, and Gorman, in the County of White and the Narrabri LGA (see **Plan 1C**). Narrabri Mine comprises a number of land parcels, including freehold land owned by NCOPL, privately owned freehold land, land owned by the NSW government (managed by the Forestry Corporation of NSW) and Crown Land (road reserves). Land ownership within and surrounding Narrabri Mine is shown on **Plan 1C**.

A schedule of lands is provided in **Appendix A**.

1.3.2 Land Use

Land use within the ML1609 boundary includes agriculture, forestry, and mining activities. Prior to commencement of mining operations, the historic land use within ML1609 was predominantly agriculture and forestry.

Narrabri Mine is located in an area that is removed from any urban areas and has a relatively low density of surrounding residences. Surrounding land uses include mining (Maules Creek Coal Mine, Boggabri Coal Mine and Tarrawonga Coal Mine), commercial forestry (Pilliga East, Leard, and Jacks Creek State Forests), biodiversity conservation (Leard State Conservation Area and Mount Kaputar National Park), and traditional agriculture (cropping and grazing) on privately held freehold land. The existing land use within and surrounding Narrabri Mine is shown on **Plan 1B**.

1.4 Stakeholder Consultation

1.4.1 Consultation during Preparation of MOD 5 EA

NCOPL has developed a number of mechanisms to facilitate on-going consultation with local, State and Commonwealth government agencies, surrounding residents, the wider community and other relevant stakeholders. These mechanisms were the foundation of the consultation process undertaken throughout all stages of the PA08_0144 MOD 5 assessment and approval process¹. The Environmental Assessment (EA) (Resource Strategies, 2015) prepared for the Project addressed the mine plan on which this MOP is based, along with the proposed mining and rehabilitation activities, and proposed environmental management.

Stakeholders engaged in this consultative process include:

- NSW Department of Planning and Environment (DP&E)
- NSW Office of Environment and Heritage (OEH);
- DPI Water;
- NSW Division of Resources and Geoscience (DRG) – formerly Division of Resources and Energy (DRE);
- NSW Roads and Maritime Service (RMS);
- Environment Protection Authority (EPA);
- North-West Local Land Service (LLS);
- Forestry Corporation of NSW;
- Narrabri Shire Council;
- Gunnedah Shire Council;
- Rail and Port Operators;
- Registered Aboriginal Parties; and
- CCC members and affected landowners.

All issues raised in the consultation process for the Project EA were comprehensively addressed in the approval process and are reflected in the commitments in the Project EA Statement of Commitments and PA 08_0144 MOD 5 conditions.

1.4.2 MOP Consultation

Prior to submitting this MOP, consultation was undertaken with DRG regarding the requirements for MOP development. It was confirmed that following approval of MOD 5 a new MOP would be required that aligned with the requirements of ESG3.

¹ Note: MOD 6 only required an administrative modification application, in letter form, and did not require an EA.

A meeting was held at the DRG offices in Maitland on 28 January 2016 between Whitehaven, DRG, and SLR personnel. Aspects discussed at the meeting included:

- Infrastructure remaining in the final landform (however for the purposes of this MOP it has been assumed all infrastructure will be removed);
- Tree deaths and ponding;
- The use of analogue sites in rehabilitation monitoring;
- Capping and monitoring of the REA;
- Consultation; and
- Exploration.

These aspects have been addressed in the relevant sections of this MOP. Additionally, a meeting was held at the DRG offices in Maitland on 15 August 2016 with Whitehaven, DRG and ATC Williams personnel to discuss the reject emplacement area capping requirements. Whitehaven also met DRG at DRG's offices on 23 August 2017 to discuss the capping of the REA.

In response to feedback received from the DRG regarding capping of the REA, Whitehaven engaged ATC Williams (2016a and 2016b) to undertake additional capping studies. The outcomes of these studies have been incorporated into this MOP (refer **Section 2.3.4**).

Additionally, in March 2017, O'Kane Consultants were engaged to assess the proposed REA rehabilitation design methodology, and recommend any further studies if required. A summary of this assessment has been included in **Section 2.3.4** and the recommendations made have been included in **Appendix B**.

1.4.3 Stakeholder Expectations and Agreements

As noted in the PA 08_0144 EA, the approved post mining land use involves the establishment of a 1,590 ha on-site Biodiversity Offset Area (BOA), and a 1,243 ha off-site BOA, resulting in total offsets of 2,833 ha. A legally binding conservation covenant will be placed on the title of the BOA's. The post mining land use is discussed in further detail in **Section 4.2**.

2 PROPOSED MINING ACTIVITIES

2.1 Project Description

Operations at Narrabri Mine during the MOP term will involve the following activities/operations:

- Underground mining of the Hoskissons Seam within ML 1609 using the longwall retreat method, with an annual production rate of up to 11 Mtpa ROM coal;
- Construction and use of mine ventilation and gas drainage infrastructure, and associated access tracks and power lines;
- Exploration activities within ML1609;
- Mine dewatering and water treatment;
- Processing coal through the Coal Handling and Preparation Plant (CHPP);
- Emplacement of processing reject and storage of saline water;
- Use of a water pipeline from the Namoi River;
- Transportation of the coal from the mine site to Port Newcastle via train;
- Subsidence management and remediation;
- Ongoing rehabilitation of areas no longer required for operations; and
- All ancillary and related activities.

Based on the currently approved average production rate of a maximum of 11 Mtpa via longwall mining operations, the expected mine life is approximately 21 years, ceasing in 2031. The proposed sequence and staging of mining over the life of the project is presented in **Table 3**.

Table 3 Proposed Mining Sequence

Project Year	Calendar Year	Longwall	ROM Coal Production
7	2017	LW 106-107	9.6
8	2018	LW 107-108	10.0
9	2019	LW 108-109	10.5
10	2020	LW 109-110	9.5
11	2021	LW 110-111	10.4
12	2022	LW 111-112	10.1
13	2023	LW 112-113	10.2
14	2024	LW 113-114	10.2
15	2025	LW 114-115	10.1
16	2026	LW 115-116	10.1
17	2027	LW 116-117	10.2
18	2028	LW 117-118	9.8
19	2029	LW 118-119	10.0
20	2030	LW 119-120	10.0
21	2031	LW 120	10.0

2.2 Asset Register

The asset register (**Table 4**) provides a summary of the key features of each primary domain (see Section 5), and principal activities required for decommissioning and rehabilitation. The areas for each domain represent the footprint at the start of the MOP term, as depicted on **Plan 2**.

Table 4 Asset Register

Domain	Area (Ha)	Major Assets
Domain 1 – Infrastructure Area	212.1	Site access road and internal access tracks, office and administration buildings, light vehicle carpark, workshop and stores buildings, electrical sub-station and associated electricity infrastructure, equipment laydown areas, rail loop and train loadout bin and train loader, sewage treatment plant, box cut and mine portals, drift and skyline conveyors, coal crushing station, CHPP, ROM and product coal pad hardstand areas, explosives magazine, ventilation fans and shafts, gas drainage infrastructure, and water pipelines.
Domain 3 – Water Management Area	52.2	Incorporates the network of dams, lined evaporation ponds, brine storage ponds, water diversion bunds and associated water management infrastructure.
Domain 4 – Reject Emplacement Area	10.9	Coarse rejects from the CHPP.
Domain 5 – Stockpiled Material	34.5	Includes stockpiled topsoil, as well as the material stockpiled in the visual amenity bund and box-cut stockpile.
Domain 7 - Rehabilitation	9.4	Includes all rehabilitation undertaken to date at the site.
Domain 8 – Underground Mining Area	3,247.9	Area of land subject to subsidence from underground mining activities. No significant assets.

This asset register is intended to provide a suitable level of context for the Rehabilitation Cost Estimate (RCE). The RCE provides for third party rates to undertake the following:

- Decommissioning and demolition of all surface infrastructure;
- Rehabilitation of all areas disturbed by mining as depicted in **Plan 2**, with the exception of some dams that will be retained for post mining use; and
- Mobilisation costs, project management and contingencies.

A copy of the RCE has been submitted to DRG with the submission of this MOP.

2.3 Activities over the MOP Term

The activities planned at Narrabri Mine throughout the MOP term are detailed in the following sections, and are presented in **Plan 3A to 3D**.

2.3.1 Exploration

During the MOP term, exploration activities will be undertaken at 46 sites within ML 1609 for coal quality, geotechnical and/or hydrogeological evaluation purposes. It should be noted that five of these exploration sites located in the south-west of the site also fall within EL6243. Although exploration activities within exploration leases fall under a separate approval pathway, they have been included in this MOP as they also fall within the ML. As far as practicable, access to exploration sites will utilise existing tracks to minimise disturbance. All exploration will be undertaken in accordance with the relevant conditions of ML 1609. A summary of proposed exploration is provided in **Table 5**.

Table 5 Summary of Proposed Exploration

Title Number	ML1609
Titleholder	Narrabri Coal Pty Ltd, Upper Horn Investments (Australia) Pty Ltd, J-Power Australia Pty Limited, EDF Trading Australia Pty Limited and Daewoo International Narrabri Investment Pty Limited & Kores Narrabri Pty Limited.
Operator	Narrabri Coal Pty Ltd
Activity Type	Category 2 (g) access tracks, drill pads or line clearing
Activity Scope	46 exploration sites are planned to be drilled for coal resource definition. Eight access tracks are planned to be cleared for exploration drilling access.
Activity Location	Within ML1609

Exploration activities will be undertaken until the end of the MOP period to identify geological structures, coal quality changes and coal seam gas contents within ML1609. The activities are expected to be conducted in front of longwall panel development and will comprise HQTM core and 100mm open hole drilling. Two and three dimensional seismic surveys may be necessary to further define geological structures.

A description of the proposed exploration activities during the MOP term is provided below:

- **Clearing:** Vegetation clearing will be undertaken in order to prepare the Exploration Program area for drilling activities and access track construction. Clearing of vegetation will be undertaken using an excavator, dozer and/or a tractor with a slashing implement;
- **Access Tracks:** The areas will be accessed through the mine or through the state forest using existing tracks where possible. Access tracks will be constructed to facilitate the movement of vehicles and equipment to a number of the Exploration Program drilling sites. These access tracks will be constructed to a nominal width of 5m for exploration activities however these areas have been chosen based on future mine disturbance requirements and as such will be increased to approximately 10m in width when required for the operation. Where access tracks are located in areas that have been previously cleared for agricultural activities, these areas will be slashed;
- **Exploration Drilling:** Exploration drilling will be generally undertaken during the hours of 7am to 6pm, seven days per week. Approximately 46 exploration boreholes will be drilled at a 100 mm hole diameter. Boreholes will generally be drilled to a depth of between 236 - 373 metres. 19 of the boreholes will be constructed on 30m x 30m drill pads, and 27 will be constructed on 5m x 5m drill pads. Above ground sumps will be used and any drilling wastes transported back to the Narrabri Mine Reject Emplacement Area for disposal. Borehole rehabilitation will be completed in accordance with Condition 17 of ML1609, *Exploration Code of Practice: Rehabilitation* (DP&E, 2015), and the *Guideline for Mineral Exploration Drilling; Drilling and Integrity of Petroleum Exploration and Production Wells* (DRE, 2016). Drilling equipment used on-site may include a truck mounted multi-purpose drill rig, above ground sumps, support truck (water, rods and fuel), and light vehicles (4WD).

A summary of environmental management commitments for exploration sites has been provided in **Table 6**.

Table 6 Exploration Environmental Management

Item	Commitment
Activity Location	Within ML1609
Activity Scope	The overall drilling program to be undertaken includes: <ul style="list-style-type: none"> • Approximately 19 drill pads, typically 30 m x 30 m in area; • Approximately 27 drill pads, typically 5 m x 5 m in area; and • Various minor access tracks.
Hours of Operation	Exploration drilling will be generally undertaken between 7am and 6pm, seven days per week. Vegetation clearing activities will be conducted in daylight hours, during the hours of 6.00 am and 6.00 pm, seven (7) days per week.
Activity Duration	Drilling will occur over a two year period to coincide with other exploration activities.
Rehabilitation Commitments and timeframes	All access tracks constructed for drill site access will be rehabilitated once no longer required.
Erosion & Sediment Controls	Sediment fencing will be erected where required as per the Blue Book. It will remain in place until the risk of erosion occurring is negligible post-rehabilitation. Drill sites and access tracks will be slashed where possible.
Chemical Use	Hazardous substances will be stored in accordance with the relevant Australian Standard (AS1940:2000). Contaminated soil will be rehabilitated in accordance with NCOPL procedures. Spill kits will be available onsite.
Waste	Hazardous wastes will be disposed of in accordance with the MSDS relevant to each substance. General waste will be disposed of in a licenced landfill with all other wastes managed as per the NCOPL Waste Management Plan.
Air Quality	Existing access tracks will be used where possible to reduce the requirement to construct new tracks. Dust generating activities will be confined to the access tracks. All equipment is to be maintained and switched off when not in use.
Noise	Sensitive receivers are located a substantial distance from the drilling locations (2.2 km – mine owned). Only drilling between the hours of 7am to 6pm, seven days per week. All equipment is to be maintained and switched off when not in use when practical.
Aboriginal Heritage	Mitigation measures to reduce the risk of impact include: Pre-disturbance inspections and disturbance monitoring in accordance with the site's Aboriginal Cultural Heritage Management Plan (ACHMP) with representatives of the Registered Aboriginal Parties (RAPs).
Other Heritage	Should previously unidentified heritage items be identified, work is to cease and the NCOPL Environmental Personnel and OEH contacted. Should human remains be identified, work is to cease and the NCOPL Environmental Personnel and NSW Police notified.
Ecology	Slashing will be used wherever possible to reduce the impact upon vegetation communities. Areas to be disturbed accounted for in the approval for the mine with offset commitments in place. Avoid disturbing any native vegetation adjacent to the proposed impact area. Operate only within the approved clearing limits. If the removal of any habitat tree is unavoidable the tree should only be felled in the presence of a qualified ecologist. If clearing is required beyond the pre-determined extent, a site inspection must be undertaken by a qualified ecologist to determine if any threatened flora or threatened fauna habitat may potentially impacted and amendments be incorporated into this impact assessment.

Item	Commitment
Surface Water	<p>Drainage line crossings will use appropriate sediment and erosion controls if necessary and will not impede the flow of water.</p> <p>No water will be extracted from water bodies.</p> <p>Any wastewater generated will be contained and disposed of in the NCOPL water management system.</p>
Groundwater	<p>Qualified drillers are to be used to conduct drilling activities.</p> <p>Small amounts of groundwater will be extracted during the drilling process.</p>
Bushfire	<p>All drilling and ancillary equipment should be well-maintained.</p> <p>Drill rigs are fitted with fire-fighting equipment as per Australian Standards.</p> <p>Flammable substances are stored correctly and removed from site once drilling activities are completed. Only minimal amounts of these substances are to be present onsite.</p> <p>The fire danger will be reviewed daily, and drilling activities modified dependent upon the fire rating.</p>

Details on exploration completed and proposed over the preceding and following 12 month periods will be recorded in each Annual Review for the mine. NCOPL will also provide six monthly and annual exploration reports to DRG for exploration and expenditure within the EL area.

2.3.2 Construction

Access Roads and Service Corridors

During the MOP term access roads and service corridors will be constructed along the tailgate of each panel to the west of each retained chain pillar, in order to access the pre-drainage and goaf gas drainage sites. The alignment of each access track and services corridor will be defined based on the preferred surface location but with consideration for environmental value(s) of the preferred location.

Reject Emplacement Area

The coal preparation process is expected to remove up to 2% of the total ROM feed as reject, which will be predominantly rock from the floor of the mine workings, and stockpiled within a reject pile. Currently coarse rejects are transferred from the reject pile to the Reject Emplacement Area (REA) located on the north-facing side of a low ridge immediately to the west of the box cut. Fine rejects are mechanically dewatered and loaded onto the thermal product stockpile.

Based on the recoverable coal resource, up to 8.2 million tonnes of coarse reject will be disposed of in the REA over the Life of Mine. The REA will be constructed progressively in a westerly direction. The emplacement will be constructed against the slope of the ridge, rising to a maximum of approximately 15m above the natural surface level (Plan 5).

Ventilation Shafts

One ventilation shaft of approximately 6m in diameter will be constructed during the MOP term in the West Mains (Plan 3A). The preferred method for construction has not yet been decided but will be either "blind bore", "raise bore", conventional or a combination of these. It may be necessary to initiate small blasts within the shaft, particularly when the harder volcanic units are encountered. Such blasts are routine for shaft construction and cause few effects because of their size and depth below the surface. In any event, all blasts will satisfy OEH blasting criteria.

The construction area for the ventilation shaft will be approximately 5 ha and incorporate the following components:

- Drill rig foundation and shaft drilling zone;
- General equipment laydown area;
- Casing laydown area;
- Stores and container area;
- Construction offices and amenities;
- Parking area;
- Generators, compressors, lighting and fuel storage area;
- Spoils handling area;
- Water and drill spoil settlement pond(s); and
- Sediment dam.

Permanent installations at the shaft site may include:

- Service bore(s);
- Personal Emergency Device (PED) Cable;
- Sediment basin;
- Air compressors;
- Gas drainage plant;
- Nitrogen plant; and
- Emulsion plant.

Surface to In-Seam Pre-Drainage Drilling Sites

Surface to In-Seam (SIS) pre-drainage requires a number of small diameter SIS boreholes to be drilled into and then along the length of the coal seam. Once drilled into the Hoskissons Coal Seam, the SIS boreholes are split into two or more smaller diameter lines (branches) to increase the capacity for gas desorption into the boreholes and therefore drainage from the seam. The effective length of these boreholes may extend to over 2km.

An area of approximately 80m x 80m will be required for each SIS borehole drill site (0.64 ha), however, as with other surface drilling sites mature trees and other vegetation will be retained where practicable within each site. Each drill site will be designed and constructed such that any overflow from sediment basins or sumps will be retained on the drill pad itself (i.e. no run-off will be discharged to local drainage or impact on undisturbed vegetation). Any run-off from stockpiled material will be directed to the drill site sediment basins or sumps, with overflow from these prevented from discharging.

At the lowest seam RL of each set of SIS boreholes, a vertical production well (VPW) is constructed to intersect each SIS borehole. A pump at the top of each VPW is used to extract the gas and water accumulating in the SIS boreholes. The current pre-drainage arrangements provide for up to two VPW's per SIS branch at each gas production site, requiring an area of approximately 2.9 ha. In addition to the VPW's, Ranging Well's (RW) and Control Pressure Well's (CPW) are also required to be drilled along the SIS branch to assist with guiding the SIS drilling and gas/water production. It is anticipated that the majority of the longwall panel gate roads will require two sets of SIS production wells in the northern section of the longwall panels.

Goaf Gas Drainage Drilling Sites

Gas concentrating in the goaf (an area of the mine which has been previously mined and the ground has subsequently collapsed) of the underground workings is removed via a vacuum pump attached to the top of a borehole, located towards the edge of the completed longwall panel at varying intervals. The boreholes are drilled from surface and therefore require the creation of a drill pad of approximately 30m x 30m. Within the drill pad, provision is made for the drill site itself as well as sump(s) and storage of vehicles and drilling materials. Access tracks are also cleared and maintained for as long as the goaf gas drainage vacuum pump is required to operate.

Two small sumps (approximately 6m x 6m) or one sump (approximately 12m x 6m) are constructed for recycling and storage of water and drilling waste. Drill spoil collected and consolidated within the sump(s) is removed as necessary and ultimately used, in conjunction with stockpiled subsoil, to backfill the sump(s) of the drill site or transported to the REA where a greater volume of drill spoil is present. Each drill site is designed and constructed such that any overflow from sump(s) will be retained on the drill pad itself (i.e. no runoff will be discharged to local drainage or impact on undisturbed vegetation). Any runoff from stockpiled material will be directed to the drill site sump(s), with overflow from these prevented from discharging.

As the longwall mining operation progresses to the west, and the slope of the surface increases, some of the drill sites are likely to be located adjacent to ephemeral drainage lines. To prevent runoff from significant rainfall events flowing through the disturbed areas of each drill site, upslope catch banks will be constructed parallel to the contour at each of these sites. These catch banks will divert overland flows away from the drill sites and discharge the water down-slope of the sites.

Brine Storage Ponds

During Year 4 of the MOP term, as shown by MOP Plan 3D, construction of the first cell of the brine storage ponds, i.e. BR1, will commence. The area of BR1 will total 8.6 ha. The footprint for the entire Brine Storage Area identified on Plan 4 covers an area of approximately 160 ha, which with an average storage depth of 5m will provide storage capacity of approximately 8,000 ML, which is sufficient for the predicted brine generated over the life of the project. This area accounts for the proposed construction of the Brine Storage Area as a series of progressively constructed cells (which will reduce the total storage capacity due to the volume of earth required to construct each cell wall).

Acknowledging the uncertainty associated with mine in-flow predictions, NCOPL will progressively construct brine storage ponds within the nominated area (generally 6-12 months prior to the cell being needed). Each cell will provide sufficient capacity for several years predicted brine generation and will provide NCOPL with flexibility to modify the brine management to reflect observed mine in-flows and brine generation.

In the event that mine in-flows are significantly less than predicted, or that a beneficial use for either the raw groundwater or brine is identified (reducing the reliance on either brine generation or storage), the total footprint area will be reduced. In the event that mine in-flows are greater than predicted, the depth of each brine storage pond will be increased to ensure that the total footprint area will not be increased.

Each brine storage pond will be constructed with a storage depth of approximately 5m and 0.5m freeboard. The cell walls will be constructed with a slope of no greater than 3:1 (H:V). A sequential process of topsoil removal will be adopted, with subsoil recovered from the floor of each cell used to construct the perimeter walls. The topsoil will be used to stabilise the outer slopes of the cell walls (which form the perimeter of the Brine Storage Area). Surplus topsoil will be stored in dedicated stockpiles around the perimeter of the Brine Storage Area.

As the water to be held within the brine ponds will be saline in nature, the ponds will be constructed to be effectively impermeable, i.e. HDPE lined to achieve a permeability of 1×10^{-14} m/s.

Additional Hardstand Area

The Additional Hardstand Area, approximately 1.0 ha, will comprise a flat area constructed by cut and fill methods within the Pit Top Area. The hardstand area will be constructed during Year 1 and will be located adjacent to the existing staff carpark as shown in **Figure 1**. The site had been cleared for agricultural purposes prior to the commencement of mining activities. Topsoil and subsoil will be initially stripped and stockpiled for use in other rehabilitation activities onsite. The excavated 'cut' material will be preferentially used to build up the 'fill' section of the area, however, this may be supplemented by imported material if required. The hardstand area will be used as a car parking area.



Figure 1 Additional Hardstand Area

Water Infrastructure

Based on the predicted dewatering requirements identified in the Groundwater Assessment undertaken by HydroSimulations (2015) for the MOD 5 EA, the volume of raffinate will exceed the storage capacity of Dams B1 and D after approximately 3 to 4 years. NCOPL is currently considering possible beneficial uses of this good quality water (e.g. irrigation water), however, the mine is currently approved to discharge this water to the Namoi River via the pipeline already installed.

During the MOP term evaporator spray stems may be installed on water storage dams A1, A2, A3, B2, and/or C to increase evaporation of mine water and brine to minimise reverse osmosis treatment requirements. Should the evaporators be required they would be operated during the daytime only.

Subsidence Monitoring Line Access Tracks

For longwall panels (LW) 101 to LW107, NCOPL has installed subsidence monitoring survey pegs between 10m and 15m apart, with either longitudinal lines extending in-by and/or out-by from each longwall panel starting and finishing point, or a transverse subsidence line across the centre of the panels. The mine is proposing to install a monitoring line in the northern and southern sections of LW108 and extend the centre line into LW110. Monitoring lines are also installed along Pine Creek and its tributaries. The mine utilises Aerial Laser Scanning (ALS) surveys to supplement the monitoring data and intends to phase out the longitudinal surveys should this technique prove effective. Future Extraction Plans will outline subsidence monitoring requirements at the mine, which have to be developed in consultation with DRG. To establish each subsidence monitoring line, an access track the width of a light vehicle will be required (approximately 6m). The mine will utilise pre-existing tracks for access where possible.

2.3.3 Mining Operations

Mining Design and Mining Method

Mining activities during the MOP term will involve the sequential development of gate road headings orientated north-south from the West Mains to define the longwall panels. The longwall panels at Narrabri Mine have been numbered LW101 to LW120 to illustrate the sequence of development (i.e. LW101 was developed and mined initially, followed by LW102, then LW103 etc.). During the MOP term LW107 to LW109 will be mined with development also occurring in LW119 and LW120.

The mining sequence involves a continuous miner unit being driven off the headings within the West Mains towards the west. At the same time, additional continuous miners are deployed to develop the three-heading gate roads and two rows of chain pillars from the West Mains to a point set back from the lease boundary or where the Hoskissons Coal Seam is at least 4m thick. In LW119 and LW120 cut and flit development operations will be undertaken during the MOP term. Once the three gate road headings are established on both sides of each longwall panel and connected up, the longwall equipment will be installed within an installation road driven between the main and tailgate roads and the coal recovered as the longwall unit retreats back towards the West Mains. All coal is conveyed back to the Pit Bottom Area for transfer to the surface via the conveyor drift.

The mine design includes the following design parameters:

- The longwall panels mined during the MOP term (LW107-109) will range in length from approximately 2.95 km to 4.03 km. Longwalls 107 to 109 will be 400 m wide, with a total void width of approximately 408.9 m;
- The longwall panels are located at depths increasing from approximately 230m below the surface at LW106 to 325 m below surface at LW109 as the Hoskissons Coal Seam dips to the west;
- The longwall panels will have an average face extraction height of 4.3m taken from the floor of the seam (which is between 5m to 9.8m thick). The face height will be graded back to the gate roads at a height of 3.7m at the maingate and tailgate ends.
- The chain pillars formed between each longwall panel will be 3.7m high, with the pillar widths increasing as depth of cover increase, from 30m at LW107, to 34 m at LW109;
- The longwall panel width to cover depth (W/H) ratio for LW107 to LW109 will range from 1.2 to 1.7. The chain pillar W/H ratio will increase from 8.0 at LW107 to 9.7 at LW109; and
- The chain pillars formed for the cut and flit panels will be 3.7m high, with the pillar widths increasing as depth of cover increase, from 24m at LW120, to 25m at LW119.

Equipment

The longwall design will be based on proven technology with an emphasis on reliability of equipment. The principal components of the system will include:

- Double-ended ranging drum shearer rated at 4,500tph with full horizon control;
- An armoured face conveyor rated at 4,500tph with provision for single tailgate drive and dual maingate drives;
- Beam Stage Loader rated at 5,000tph; and
- High capacity two leg and four leg chocks shields with shearer initiation, base lift and high set functions.

Additional underground mining equipment to be used in association with the longwall mining unit is listed in **Table 7**. With respect to underground equipment, there will be regular movements of the personnel transport vehicles between the surface and underground, while the Load/Haul/Dump (LHD) vehicles will be on the surface at various times intermittently during operations for loading and unloading. The remaining equipment listed in **Table 7** will remain underground at all times unless major maintenance is required.

Table 7 Indicative Underground Operational Equipment

Equipment	Number	Use
Longwall Unit	1	Underground mining
Continuous miner	5	Underground primary and secondary mining
Shuttle cars	8	Transfer of coal from continuous miner to feeder breaker
Feeder Breaker	4	Breaking of coal
LHD vehicle	10	Material transport
Personnel transport vehicle	10	Personnel transport
Panel conveyor belt	3	Transfer of coal from feeder breaker to transport drift conveyor

The continuous miner units are designed to extract a 3.7m x 5.4m roadway profile. Each unit is fitted with six bolting rigs (4 roof and 2 rib-bolting rigs).

Mining Rate

The headings of the West Mains will be developed by the continuous miners at a rate of approximately 120m per week, with the gate road headings developed at a rate of approximately 240-280m per week and the cut and flit panels developed at a rate of approximately 350m per week. On completion of the gate road headings, it will take approximately 6 weeks to install the longwall or move the longwall unit from one panel to the next. With a nameplate capacity of 5000tph, the longwall mining rate is forecast to be approximately 230,000 tonnes per week. The maximum annual rate will not exceed 11 Mt.

Mine Ventilation and Gas Drainage

Tests conducted by Geogas Pty Ltd established that while gas compositions within the Hoskissons Seam vary considerably, the predominant gas is CO₂ (~90%) with concentrations of CH₄ and N₂ also present in varying proportions. The results of gas desorption tests established the total desorbable gas content within the mine varies from 4m³/t to 13m³/t on a 9% ash basis. Considering these parameters, and based on the extraction of 4.3m of coal from the seam of 9m average thickness, NCOPL expects that gas emissions during development could reach 1,200L/s CO₂ in deeper horizons if high permeability persists at depth.

In order to minimise the potential for outburst, which for CO₂ rich environment requires the gas content to be less than 8.0m³/t, and to ensure safe working conditions underground, the gas content from the exposed coal is drained, ventilation has been established and goaf gas is drained from the extracted section of each longwall panel.

Pre-drainage is undertaken using surface to in-seam (SIS) and underground to in-seam (UIS) techniques. As the West Mains, gate road headings and longwall panels are developed, the mine ventilation system will be progressively upgraded to adequately ventilated the underground workings.

As the longwall unit retreats, and the remaining section of the seam collapses, the gas accumulating in the goaf is also drained. Goaf gas drainage is completed by the development of boreholes from the surface into the collapsed panel, with the gas drawn out the goaf by the installation and operation of a vacuum plant connected to the top of each borehole.

Proposed ventilation and gas drainage strategies are described below.

Mine Ventilation

The ventilation of the mine is progressively established to maintain the general body CO₂ concentrations below the time weighted average (TWA) statutory requirement of 1.25%. This involves the progressive establishment of ventilation shafts in the West Mains.

Sources of CO₂ reporting to the tailgate ventilation include cut coal at the longwall face, from remnant coal in the active goaf and also the adjacent goaf if there is leakage through the chain pillar seals.

The mine ventilation network utilises a longwall face ventilation quantity of 130m³/s, all of which will report to the tailgate. Pre-gas drainage and goaf gas drainage techniques are used to assist in maintaining average tailgate CO₂ concentrations below the statutory limits.

Surface to In-Seam Pre-drainage

SIS pre-drainage using medium radius drilling involves drilling from surface into and along the coal seam. After removal of seam water, the gas is then drawn from the seam with the assistance of a vacuum pump. Due to the very low methane concentration within the gas, power generation or flaring of the gas is not feasible and so the predominantly CO₂ gas is dispersed.

The water pumped to the surface is piped to the Pit Top Area for storage in the water storages/evaporation ponds. SIS pre-drainage provides a significant advantage over conventional in-seam pre-drainage in low desorption underground environments as the coal can be drained well in advance of mining. For gas reservoirs, such as that of the Hoskissons Seam which are CO₂ rich, undersaturated with significant fluid pressure reduction required for effective pre-drainage, SIS pre-drainage allows commencement of pre-drainage well in advance of underground in-seam-drainage requirements.

Conventional Underground In-Seam Pre-Drainage

The conventional Underground In-Seam (UIS) pre-drainage method of gas extraction is undertaken by drilling from the developed gate road heading into the adjacent longwall panel and subsequent gateroads. The gas is collected and then pumped to the surface through an exhaust pipe range for dispersion. Narrabri Mine utilises the conventional UIS pre-drainage method with three underground drill rigs operating at the mine.

Goaf Gas Drainage

As each longwall panel is completed, the remaining coal above the section mined will continue to desorb gas. In order to maintain all ventilation roadways within the statutory compliance limit, post drainage of the caved (goaf) area is undertaken to evacuate the CO₂ desorbed from the remaining caved roof. This can only be achieved post mining by goaf drainage holes drilled from the surface.

NCOPL's goaf drainage design provides for cased boreholes located about 35m off the tailgate corner of the active goaf at varying intervals. The boreholes will be drilled to the top of the Hoskissons Seam and connected to the surface goaf drainage vacuum plant.

With respect to spontaneous combustion, coal of propensity displayed by the Hoskissons Coal Seam probably has a worst case incubation period of 1 to 2 months. Spontaneous combustion is managed effectively through a combination of physical properties of the coal seam, surrounding strata and the operating practices employed at the mine. These include:

- Seam gas composition of 90% CO₂ creates an extinctive atmosphere in the goaf reducing the oxidation process;
- Coal strength and minimal cleats/joints creates stable conditions reducing air ingress into the goaf;
- High retreat rates from the longwall reduces exposure of coal in the goaf to air from the ventilation circuit;
- Use of high quality seals to stop air ingress into the goaf; and
- A monitoring regime that provides early detection of possible increased oxidation.

Subsidence Impacts

A subsidence assessment was undertaken by Ditton Geotechnical Services Pty Ltd (DgS) in 2017 for the LW107 to LW110 Extraction Plan (Whitehaven 2017), as required by PA 08_0144 (Schedule 3, Condition 4). The subsidence assessment predicted a first maximum panel subsidence of between 2.53 m and 2.71 m for LW107 to LW110. The ground surface will tend to subside more towards the centre of the panel (i.e. away from the chain pillars between the longwall panels). As a consequence of this differential subsidence, DgS (2017) has predicted the following possible impacts:

- Final maximum panel subsidence is anticipated to be between 2.58 m to 2.75m (55% to 64% of the 4.3 m mining height);
- Final maximum chain pillar subsidence for LW107-1010 is estimated to range between 0.28 m and 0.69 m above twin chain pillar widths ranging from 30 m to 34 m;
- Maximum surface cracking within tensile strain zones above all longwalls was predicted to range in width from 360 mm to 260 mm;
- Surface shearing and uplift within compressive strain zones above all longwalls was predicted to range in width from 30 mm to 260 mm;
- Surface gradients are likely to increase or decrease by up to 3% (+/- 1.5°) along creeks, with occasional increases of up to approximately 4%;
- Potential ponding depths of 0.1 to 2.6 m may develop above several of the longwalls along creeks in the flatter areas of the mine, based on post-mining contour predictions;
- Possible impacts on subsurface aquifers within 174 m to 282 m above the panels as a result of direct hydraulic connections to the workings; and
- Possible interaction between discontinuous sub-surface fracturing and surface cracks (where cover depths are <355 m) leading to possible flow rerouting.

2.3.4 Reject Emplacement

The coal preparation process currently removes approximately 2% of the total ROM feed as reject, which is predominantly rock from the floor of the mine workings. Currently coarse rejects are unloaded onto a reject stockpile before being transferred via truck to the REA on the north-facing side of a low ridge immediately to the west of the box cut. Fine rejects are mechanically dewatered and loaded onto the thermal product stockpile.

Based on a recoverable coal resource of approximately 170 million tonnes and a 21 year mine life, the total reject to be accommodated in the REA will approximate 8.2 million tonnes. Assuming a conservative dry density of 1.5t/m^3 , the total volume of the reject to be managed within the REA throughout the life of the mine will approximate 5.7 million m^3 .

The proposed maximum footprint of the REA is approximately 25 ha, however, it will be constructed progressively in a westerly direction. The emplacement will be constructed against the slope of the ridge, rising to a maximum of 15m above the natural surface level. Prior to placing waste, the emplacement footprint will be progressively stripped of topsoil and subsoil to a depth of about 400mm, with the stripped material being either stockpiled for later use in the rehabilitation of the emplacement, or placed directly on completed sections of the emplacement or at other locations on the mine site where rehabilitation may be required. Testing of the reject has been undertaken with the results indicating that the reject material is non-acid forming and non-saline generating. Testing will be undertaken every 5 years throughout the mine life (or if conditions change) to determine the propensity of the material for spontaneous combustion and to generate saline, or otherwise contaminated leachate. The base of the REA has been designed to achieve a permeability of $<1 \times 10^{-9}\text{ m/s}$ utilising a compacted clay layer. Quality assurance testing, which comprises insitu density tests and laboratory permeabilities, is typically undertaken to confirm the quality of base preparation work. Testing undertaken for the current REA footprint area confirms the quality of these base preparation works (ATC Williams, 2016b).

Shallow piezometers have been installed down-slope of the REA to monitor salinity levels and confirm no leaching of saline material. A comprehensive drainage system has been constructed. The surface water system includes:

- Diversion drains around the REA to prevent clean runoff from entering the disturbed area;
- Catchment drains within the active areas of the REA; and
- Sediment basin (SB3) at the northern end of the REA to collect runoff water, which is pumped back to the main mine water management ponds for re-use and/or treatment as appropriate.

Reject will be paddock dumped within the active area and then spread by dozer. Each area will be compacted by a combination of track rolling by the dozer and trafficking by the reject delivery haul trucks. The initial eastern batter of the REA will be created with a slope of up to 14° (4H:1V) and the progressive development of the northern and southern batters will be created with a slope of up to 10° (5H:1V) as this will form the final face of the landform once the REA is completed.

2016 Engineering Assessment

In April 2016 an engineering assessment of the REA was undertaken (ATC Williams, 2016a) to determine if the proposed capping approach would achieve acceptable environmental outcomes for the final landform. The assessment found that:

- Whilst under extreme conditions, release of acid or saline leachate from the REA may occur, the likely impact of the discharge would not be severe. As such, leachate generation was not considered to present a risk;
- The potential for contact between surface water runoff and reject material within the REA, under rainfall conditions, was considered to be low, with low potential for impact on receiving water environments;
- A review of geotechnical stability indicated that a very low risk of global batter failure or displacement exists. As such, this exposure pathway was considered to be of low risk;
- While natural soils taken from the site as part of REA development, being potentially dispersive or sodic soils, were potentially erodible, it was found that the below management approach to this aspect would achieve a low impact risk; and
- As the coarse reject comprises predominantly broken rock (sandstone/ siltstone material) which is not carbonaceous, the propensity of the reject for spontaneous combustion, or to sustain any fires, was considered very low.

Consequently, the only potential risk identified during the assessment was the integrity of the capping layer subject to direct rainfall, with the potential for erosion to occur (ATC Williams, 2016a). This aspect has been considered by NCOPL, with careful design and management of the capping system being applied, with emphasis on the following management measures:

- Treatment/conditioning of capping soils to improve stability of the capping layer against erosion during placement/prior to vegetation establishment;
- Application of erosion control techniques, with such techniques including but not limited to contour banks (to reduce slope length) and surface roughening. On completion of each cell the top surface will be profiled prior to seeding, and additional contours will be incorporated within the design to limit surface water flows; and
- Further treatment/conditioning of soils insitu (such as treating with gypsum, hydro-mulching, and watering) to enhance rapid establishment of a sustainable vegetation growth.

Under these conditions, it was considered that the proposed capping approach for the REA would achieve acceptable environmental outcomes, being adequate to minimise or eliminate the risk of any long term issues related to landform integrity (ATC Williams, 2016a). To address the potential concern with erosion of the completed capping profile, NCOPL updated the risk assessment previously prepared for the REA development and completion, with a view to capturing the outcomes of the ATC Williams study, as well as the points of clarification provided by DRG during consultation. Based on these actions, a supplementary assessment in relation to the REA was undertaken by ATC Williams (2016b), the outcomes of which are summarised below:

- A review of the conditions of the REA previously assessed, together with the NCOPL risk assessment confirmed that the key issue in relation to capping of the REA was maintaining integrity of the capping profile, subject to stormwater drainage conditions and influenced by post-development conditions;
- The assessment highlighted the sensitivity of factors such as capping thickness and material quality to long term erosion of the capping profile, with the key risks associated with exposure of coarse reject material leading to the difficulties in maintaining the vegetated cover and land use capability; and
- It was assessed that amelioration/modification of the material used to form the 400mm thick capping profile would be necessary to maintain long term performance expectations.

To reduce the erosion risk, the proposed management approach is to create a robust capping material that is erosion resistant on the batters of up to 4(H) to 1(V) (ATC Williams, 2016b). The proposed capping material will comprise a rocky soil (or rock mulch), utilising the available topsoil/subsoil reserves on-site, but with a mix of between 10 and 20% (nominal) of competent rock fragments, typically 50 to 150mm size. This rocky soil is likely to be more resistive to cattle or other livestock walking on the REA final landform batters and plateau. The rocky soil would also provide a more stable surface for a tractor fitted with a slasher or trimmer. Furthermore, these soils containing a higher degree of rock are also expected to reduce the development of trees and shrubs, and the risk of trees falling over exposing rejects material.

In addition, conditioning of the soil component using lime or gypsum (or suitable alternative) will be undertaken as necessary, as a means of reducing sodicity. A native grass seed mixture will be propagated on the placed ameliorated soils and irrigated (if rainfall is inadequate) until vegetative stage is completed. Access to the rehabilitated area will be prohibited within the first reproductive cycle of the grass or until access can be safely provided for cattle and humans.

The potential erosion risk will also be further reduced with contour drains (refer **Figure 2**), which will be lined with coarse rock at the base to create a more erosion resistant surface. Drains will be formed on the batters at a maximum grade of 5% and with a maximum length of 80 metres. Some contour drains will be intended for batter runoff and will be shallower and narrower than contour drains receiving REA surface water discharge. Coarse rock sizing will be adjusted for the anticipated design event velocities, and in some areas placed onto a geotextile providing a barrier for the soils below. The top surface will be shaped and compacted to create a suitable surface for the cover layers and drainage.

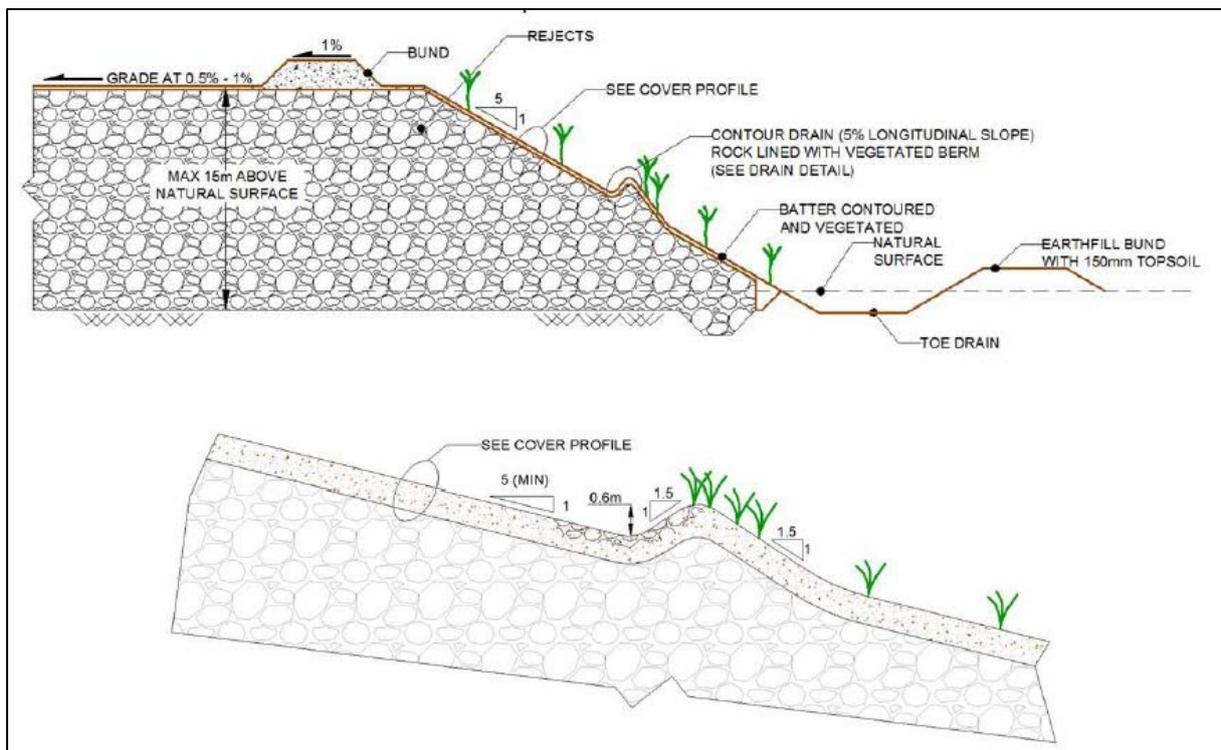


Figure 2 Proposed REA Contour Drains (ATC Williams, 2016)

Additionally, NCOPL will undertake additional sampling from the coarse rejects stockpile if the coal bearing geology changes significantly. NCOPL currently mines the 2-ply part of the seam. Some mudstone makes its way into the coal seam from roof falls on the longwall. If tuff bands became common within the mining horizon this would trigger testing. A representative sample will be taken and tested for spontaneous combustion potential, as well as the following parameters which would identify any changes in elements that could increase salinity, acid forming potential or metal enrichment as well as the solubility of the materials:

- pH and electrical conductivity (EC) determination;
- total sulfur (S) and sulfide S assay;
- acid neutralising capacity (ANC) determination;
- net acid producing potential (NAPP) calculation;
- single addition net acid generation (NAG) testing;
- multi-element scans on solids and water extracts;
- proximate analysis (moisture, ash, volatile matter and fixed carbon content); and
- toxicity characteristic leaching procedure (TCLP) test.

The results of any testing will be reported in the Annual Review. Following any testing NCOPL will undertake a review of the rejects emplacement management and rehabilitation strategy assessing if this strategy is adequate based on the results.

2017 Rehabilitation Methodology Assessment

In March 2017, O'Kane Consultants, in collaboration with DRG, assessed the proposed REA rehabilitation design methodology to determine whether the approved final land use can be sustained by the closure design as presented and if the landform at closure would present 'minimal' risk to its surrounds with respect to environmental pollution and potential spontaneous combustion. Based on O'Kane's assessment a number of recommendations were made:

- That further sampling be conducted of the reject material currently in place, and of future rejects material, to ensure that the proposed design and any modelling assumptions are consistent with the operations. This testing should cover geotechnical and geochemical aspects of the rejects material, as well as the risk for spontaneous combustion;
- A comprehensive Water Quality Monitoring Programme specific to the REA should be developed;
- Guidelines are developed for the construction of the proposed basal liner with respect to the material to be utilised, its placement methods, and QA/QC procedures to ensure it meets design objectives; and
- Further comprehensive closure cover system and landform design specific to the REA may be required in order to ensure the long-term stability of the REA, in addition to meeting the required final land use for the facility.

NCOPL will undertake the above recommendations. A table summarising the recommendations of the O'Kane report and the proposed actions and timeframes for implementing each have been included as **Appendix B**. A comprehensive water quality monitoring Programme specific to the REA is already in place, with 3 piezometers installed around the REA. Notwithstanding, the additional recommendations made in the O'Kane report will be implemented during the MOP term. Water levels and field parameters are collected from the piezometers on a monthly basis and full chemical analysis is completed annually. The results of this testing will be reported in the Annual Review.

2.3.5 Coal Processing and Transport

Transportation of the mined coal to the ROM coal stockpile occurs via the conveyor drift from the Pit Bottom Area to the Pit Top Area. The ROM coal is then drawn from the ROM coal stockpiles via one of two reclaim valves and tunnels from where it is fed to a rotary breaker for size reduction and waste/stone removal. The broken coal is then transferred to a dry screen with the <20mm coal fraction transferred directly to the thermal product coal stockpile area and the remainder transferred to the CHPP where the coal is washed. The fine and ultra-fine coal is mechanically dewatered via a belt press and added to the thermal product stockpile. The washed coal is transferred to the product coal stockpile area as either a thermal coal or Pulverised Coal Injection (PCI) grade product.

The bypass crusher is fed by dozer from the ROM stockpile. The coal is then conveyed over a screen to remove waste material. The coal is then crushed to ≤ 50 mm and fed by conveyor on the product stockpile as a thermal coal product.

The product coal is then drawn from the product stockpile via three reclaim valves and tunnels and conveyed to the train load-out bin. The loading of product coal via the drawdown valves and train load-out bin is fully automated with batches drawn from the stockpiles and loaded into train wagons on the Narrabri Mine Rail Siding.

Product coal is loaded onto trains 24 hours per day, seven days per week. An average of four trains are loaded each day and a maximum of eight trains per day are loaded during peak coal transport periods. The trains are generally 82 wagons with a capacity of approximately 8,000 tonnes. Product coal from the mine is transported via the Werris Creek Mungindi Railway to the Port of Newcastle for export.

2.3.6 Waste Management

The principal wastes that will be generated throughout the life of the mine are described in the sections below.

Production Waste

Excess material and drill cuttings generated from construction of ventilation shafts, exploration, gas drainage and service borehole drilling activities is disposed of in the REA or consolidated with excavated soil to backfill the sump (where minor amounts of cuttings are present). An area at the REA has been established to allow excess water from the drill cuttings to decant off and then the cuttings are added to the REA to help consolidate material when emplacing reject from the CHPP. Production waste will be placed at least 2m from a landform edge, and drill cuttings (as mostly rock) will be placed at least 1m from a landform edge so that material with potentially higher propensities is not near the surface of the REA.

Domestic-type Wastes and Routine Maintenance Consumables

All general wastes originating from the surface facilities area together with routine maintenance consumables from the daily servicing of equipment, such as empty grease cartridges and air filters, are disposed of in mobile garbage bins located adjacent to the various buildings. These bins are collected and disposed of offsite by a licenced waste contractor on a regular basis.

Separate collection systems are utilised onsite for recyclables, such as paper and cardboard, and ferrous and non-ferrous metals, each of which are collected and removed from site on a regular basis.

Oils and Grease

The bunded permanent waste oil storage area adjacent to the washbay has three bunded 1,000L Intermediate Bulk Containers (IBC). The waste oil area also includes bunded containers for waste oil drum storage. A drum crusher is also used onsite. A self bunded 4,000L waste oil tank is also located at the workshop. An oil-water separator is located at the washbay and another oil-water separator is located at the workshop.

Routine maintenance of the more mobile mining and earthmoving equipment is generally undertaken in the maintenance workshop within the Pit Top Area, while underground equipment and surface civil equipment will be subject to minor maintenance in-situ and brought to the workshop or taken offsite for more substantial maintenance.

Within the maintenance workshop, waste oils and greases are collected and placed in a self-bunded 4,000L waste oil tank or Intermediate Bulk Containers (IBC's). All parts and packaging are collected and transferred to the maintenance workshop and stores facility for disposal or recycling. Waste oils and grease are stored within a bunded waste oil storage area adjacent to the washbay. A drum crusher is also used onsite. An oil-water separator is located at the washbay and another oil-water separator is located at the workshop.

Sewage

Effluent from the sewage and ablutions facilities at the mine is managed through a Sewage Treatment Plant (STP) with a Continuous Extended Aeration Process. The plant is made up of a series of industrial plastic tanks. Each tank provides a separate function in order to treat the sewage for the required quality and quantity. The treated septic system water is used to irrigate an area adjacent to the system. The existing facilities are considered adequate for the MOP term.

2.3.7 Decommissioning and Demolition Activities

During the MOP term the 'Barton Hedge' property will be vacated prior to undermining and decommissioned.

Other infrastructure that will be decommissioned during the MOP term will be gas drainage infrastructure, including SIS boreholes and goaf drainage boreholes, as the mine progresses. Gas drainage infrastructure is generally removed 12 months after the area has been mined.

2.3.8 Temporary Stabilisation

Temporary stabilisation, involving seeding of a cover crop, will be undertaken at various locations around the pit-top as required during the MOP term. Visual inspections of the area treated will be undertaken to determine whether any follow up work is required to achieve stability.

2.3.9 Progressive Rehabilitation and Completion

Progressive rehabilitation of subsidence areas and gas drainage infrastructure sites will continue during the MOP period, as shown on **Plans 3A to 3D**. Rehabilitation activities will be undertaken as required over the underground mining area during this MOP period.

Further details of rehabilitation procedures to be undertaken are included in **Section 7**.

2.3.10 Material Production Schedule

The material production schedule for the duration of the MOP period is listed in **Table 8**.

Table 8 Material Production Schedule during the MOP Term

Material	Unit	Year 1 2017	Year 2 2018	Year 3 2019	Year 4 2020
Stripped Topsoil	m ³	3,816	3,445	2,815	15,099
Rock/Overburden	m ³	0	0	0	0
ROM Coal	Mt	8.8	10.0	10.5	10.0
Reject Material	Mt	0.17	0.5	0.5	0.5
Product Coal	Mt	7.8	9.5	10.0	10.0

3 ENVIRONMENTAL ISSUES MANAGEMENT

3.1 Environmental Risk Assessment

A risk assessment was undertaken for this MOP on 10 August 2015 which addressed all risks to rehabilitation at Narrabri Mine. This risk assessment was undertaken in accordance with *AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines*, along with the Whitehaven risk assessment process. The completed risk assessment is provided in **Appendix C** while **Section 3.2** provides proposed risk management measures for the site.

The workshop assessed 33 key rehabilitation risks, all of which were identified as low or moderate risk, given the existing controls in place. It should be noted that none of the elements were categorised as being a high or critical risk.

Further, in accordance with the current MOP Guidelines, mine closure and rehabilitation based issues were addressed in the risk assessment.

3.2 Environmental Risk Management

NCOPL has implemented an Environmental Management System (EMS) that details the roles and responsibilities of site personnel and environmental incident response and reporting procedures.

The EMS is supported by a comprehensive set of environmental management plans (EMPs). These plans have been developed and implemented by NCOPL in accordance with PA08_0144 (as modified) and other regulatory requirements, including EPL 12798. The EMPs describe environmental monitoring that includes meteorological, air quality, noise, subsidence, surface water and groundwater monitoring. NCOPL will continue to implement the existing strategies, plans and programs at Narrabri Mine, and where necessary, undertake their review and/or revision.

The EMPs currently in place at Narrabri mine are outlined below, and can be found on the Whitehaven Coal website (www.whitehavencoal.com.au).

- Environmental Management Strategy;
- Extraction Plan LW 101 – LW 106 (includes Coal Resource Recovery Plan, Subsidence Predictions, Subsidence Monitoring Program, Built Features Management Plan, Land Management Plan, Biodiversity Management Plan, Heritage Management Plan, Water Management Plan, Landscape Management Plan, Rehabilitation Management Plan, Mine Closure Plan and Public Safety Management Plan);
- Extraction Plan LW 107 – LW 110 (includes Coal Resource Recovery Plan, Subsidence Predictions, Subsidence Risk Assessment, Subsidence Monitoring Program, Built Features Management Plan, Land Management Plan, Biodiversity Management Plan, Heritage Management Plan, Water Management Plan, Landscape Management Plan, Rehabilitation Management Plan, Mine Closure Plan and Public Safety Management Plan);
- Water Management Plan (includes Site Water Balance, Erosion and Sediment Control Plan, Groundwater and Surface Water Monitoring Programs, Raffinate Discharge and Transfer Control and Monitoring Plan, and Groundwater and Surface Water Response Plans);
- Noise Management Plan;
- Air Quality Monitoring Program;
- Landscape Management Plan (includes Rehabilitation Management Plan and Mine Closure Plan);
- Aboriginal Cultural Heritage Management Plan (ACHMP);
- Energy Savings Action Plan;
- Greenhouse Gas Minimisation Plan;

- Waste Management Plan; and
- Biodiversity Offset Strategy (includes On-Site Biodiversity Offset Management Plan, and Offsite “Kenna” Biodiversity Offset Management Plan).

The following sections address some of the key environmental risks identified for Narrabri Mine.

3.2.1 Erosion and Sedimentation Control

Erosion and sediment control (ESC) at Narrabri Mine is managed in accordance with the Water Management Plan (including an Erosion and Sediment Control Plan), relevant regulatory requirements, and the guideline documents *Managing Urban Stormwater Volume 1: Soils and Construction* (Landcom 2004) and *Managing Urban Stormwater Volume 2E: Mines and Quarries* (DECC 2008).

Key sources of erosion and sedimentation include:

- Surface runoff and/or erosion from limited vegetation clearing, topsoil stripping and stockpiles;
- Surface runoff from unsealed roads and newly constructed embankments and drains;
- Erosion of stormwater drainage channels; and
- Operation of the REA.

Elevated winds may also result in erosion of finer material during clearing and soil stripping activities, and from exposed surfaces and stockpiles. Key potential erosion and sediment risks are managed by:

- Installing erosion and sediment controls prior to disturbance of any land;
- Limiting the extent of the disturbance to the practical minimum;
- Reducing the flow rate of water across the ground particularly on exposed surfaces and in areas where water concentrates;
- Establishment of non-persistent cover crops on exposed surfaces not required for operational purposes or stockpiles retained for periods greater than 3 months;
- Revegetation of embankments and bunds;
- Rehabilitating disturbed land and constructing drainage controls following the mining of the adjacent longwall panel (typically 12-15 months after mining) to improve stability of rehabilitated land;
- Ripping of rehabilitation areas to promote infiltration;
- Protecting natural drainage lines and watercourses by the construction of erosion control devices such as diversion banks, channels and sediment basins;
- Restricting access to rehabilitated areas; and
- Installing sediment basins to settle out sediment prior to off-site release.

A series of dirty water diversion drains have also been constructed to divert runoff from the Pit Top Area to the sediment basins and storage dams.

As stated in **Section 2.3.4**, an engineering assessment of the REA undertaken in 2016 found that the natural soils taken from the site as part of REA development, being potentially dispersive or sodic soils, were potentially erodible (ATC Williams, 2016a). The assessment found that under worst case conditions, the loss of soil cover from the REA could cause exposure of the rejects and increased potential for release of leachate or contact surface water runoff to the receiving environment.

To reduce the erosion risk, the proposed management approach is to create a robust capping material that is erosion resistant on slopes of up to 4(H) to 1(V) (ATC Williams, 2016b). The capping material will comprise a rocky soil (or rock mulch), utilising the available topsoil/subsoil reserves on-site, but with a mix of between 10 and 20% (nominal) of competent rock fragments also available onsite, typically 50 to 150mm size. In addition, conditioning of the soil component using lime or gypsum (or suitable alternative) would likely be necessary, as a means of reducing sodicity, to provide further robustness to the capping layer surface particularly during the revegetation phase. For further detail refer **Section 2.3.4**.

Erosion and sedimentation is monitored and reported in the Annual Review.

3.2.2 Surface Water and Groundwater

Surface and groundwater at Narrabri Mine is managed in accordance with the Narrabri Mine Water Management Plan. PA 08_0144 and EPL 12789 impose requirements for managing surface and groundwater quality and quantity, monitoring requirements and water quality discharge criteria. EPL 12365 includes four licenced discharge points (LDPs) from SD2, SD4, SD5, and SD7 (when constructed), together with upstream and downstream monitoring locations within the adjacent creek systems.

Water is required on the mine site primarily for dust suppression purposes, operational requirements (e.g. CHPP and longwall) and potable and toilet ablutions purposes. Where practicable, water collected onsite is retained or reused, with water for dust suppression sourced from a combination of onsite water harvesting and mine dewatering.

Surface water and groundwater quality monitoring, water discharges, and level records are reported in the Annual Review and/or the EPL Annual Return.

3.2.3 Biodiversity

Impacts to native flora and fauna within the mine boundary are managed in accordance with the Narrabri Mine Landscape Management Plan.

Flora

During specialist studies undertaken by Ecotone Ecological Consultants Pty Ltd in 2009 as part of the Stage 2 EA, a total of seven vegetation communities were identified within the mine site and along the route of the water pipeline to the Namoi River, six of which are native vegetation communities.

No threatened or rare flora species were detected within the mine site. However, one species, *Bertya opposens*, was assessed as having a high likelihood of occurring. Its occurrence on site and adjacent to site was confirmed during additional flora survey work conducted to develop an appropriate biodiversity offset strategy. A second species, *Cadellia pentastylis*, was assessed as having a moderate likelihood of occurring and a third species, *Lepidium aschersonii*, a low to moderate likelihood of occurring.

All activities onsite are undertaken to minimise the impact on flora species. This is achieved by limiting areas of surface disturbance to those areas specifically required, as approved through the Narrabri Mine 'Permit to Disturb' process. Any large trees, particularly hollow bearing trees, are avoided where possible. If avoidance is not possible, the trees are inspected for habitation by fauna, felled as instructed by an ecologist and inspected for fauna following felling.

In addition to pre-clearance surveys undertaken by suitably qualified ecologists, spring flora surveys are undertaken as required by the Extraction Plan. The spring survey is used to determine the effectiveness of management measures when compared to the results of the baseline surveys and future annual spring surveys.

Fauna

During specialist studies undertaken by Ecotone Ecological Consultants Pty Ltd in 2009 as part of the Stage 2 EA, sixteen threatened fauna species were recorded with potentially suitable habitat present for a further 20 threatened or migratory species that were not identified during field surveys.

Based on the proposed mine design, it is estimated that up to approximately 210 ha of native woodland vegetation could be disturbed. This will be offset by an identified Biodiversity Offset Area (BOA), with management measures specified in the approved Biodiversity Offset Management Plans as part of the over-arching offset strategy.

Other operational safeguards to minimise impacts to fauna include undertaking pre-clearing surveys, relocating felled hollow bearing trees and control of feral animals. In addition to pre-clearance surveys undertaken by suitably qualified ecologists, spring fauna surveys are undertaken as required by the Extraction Plan. The spring surveys are used to determine the effectiveness of management measures when compared to the results of the baseline survey and future annual spring surveys.

Flora and fauna will be monitored in accordance with PA 08_0144 and the approved Landscape Management Plan. Monitoring results and any control activities will be reported in the Annual Review.

3.2.4 Weeds and Pests

Weeds and pests are currently managed in accordance with the Narrabri Mine Landscape Management Plan.

Weeds

The ecological assessment undertaken by Ecotone Ecological Consultants (2007) for Stage 1 and Ecotone Ecological Consultants (2009) for Stage 2 and site visits for the development of the RMP for Stage 1 and Stage 2 has identified 93 species of introduced flora on the mine site. Of these weeds, nine species are declared noxious weeds under the NSW *Noxious Weeds Act 1993* in the Narrabri LGA, of which the majority are Category 4 noxious weeds, with one Category 5 noxious weed.

The growth and spread of all noxious weeds across the Pit Top Area and Longwall Area is controlled in accordance with the *Noxious Weeds Act 1993*. Coolatai Grass is controlled by the techniques described by the former I&I NSW. Other agricultural and environmental weeds are controlled by techniques described in the local management plan published by the local control authority (NSC).

Noxious weed management within the ML has been ongoing to date, and various methods for controlling Prickly Pear and Mother-of-Millions have been successful. These methods include: Prickly Pear - being managed using cochineal insects. This method will continue, targeting new stands when identified by transferring the insects from existing stands; and Mother-of-Millions - spraying Mother-of-Millions as soon as they are identified has proven the best control method and this method should continue as new stands are identified.

Vertebrate Pests

The aim of feral animal control is to minimise the effect that introduced vertebrate pests may have on grazing production, wildlife populations and soil stability. Fauna surveys during the environmental assessments for the project recorded eight introduced species of fauna across the mine. Three species, the Wild Dog (*Canis familiaris*), Rabbit (*Oryctolagus cuniculus*) and Pig (*Sus scrofa*), are declared pests under the NSW *Rural Lands Protection Act 1998* (RLP Act). One species, the Red Fox (*Vulpes vulpes*) is considered a nuisance species in NSW under the RLP Act and three other significant pest species, the Feral Cat (*Felis catus*), Brown Hare (*Lepus capensis*) and Starling (*Sturnus vulgaris*) were also recorded. The remaining introduced animals, Cattle (*Bos taurus*) and Sheep (*Ovis aries*), are domestic stock and these animals will be prevented from grazing in the Pit Top Area but may graze within the Longwall Areas that have been designated as agricultural grazing land.

All feral animals declared as pests under the RLP Act, found on the Pit Top Area and Longwall Area are controlled using techniques recommended by the local LHPA. Nuisance species will be controlled if they are affecting the management of the Pit Top Area and Longwall Area using techniques recommended by the local Livestock Health and Pest Authority (LHPA).

Weeds and vertebrate pests will be monitored in accordance with the approved Landscape Management Plan. Monitoring results and any control activities will be reported in the Annual Review.

3.2.5 Spontaneous Combustion

The Hoskissons Coal Seam has been identified as having a high intrinsic spontaneous combustion propensity. As a consequence, a Spontaneous Combustion Major Hazard Management Plan (SCMHMP) and a Stockpile Management Plan have been developed for the site as part of the Narrabri Mine Health and Safety Management System. The SCMHMP and Stockpile Management Plan were developed to give Narrabri Mine a structured system of work to allow the mine to manage and control spontaneous combustion. The plans define how to establish and maintain a safe working environment for mine personnel and the mine itself.

To reduce the potential for spontaneous combustion of coal stockpiles:

- Coal will be routinely turned over in the ROM and product coal stock pile areas to minimise stockpile storage time;
- Longer term stockpiles will be shaped with a battered face created in the direction of the prevailing winds;
- The stockpile area will be compacted by the use of mobile equipment; and
- Regular visual inspections for evidence of combustion (visual and smell) will be undertaken.

To reduce the potential for spontaneous combustion of the underground longwall panels and associated gas drainage systems, spontaneous combustion will be managed as outlined in the Environmental Assessment (R.W. Corkery & Co. 2009). In summary, these will include:

- The mine design which employs a low resistance ventilation system;
- Small diameter ventilation shafts will be considered at the rear of every third gate road panel in the southern longwall panels for ventilation of the gate road inbye of the active longwall face. This system will support the discontinuation of a perimeter roadway that otherwise results in a pressure differential across goaves and therefore reduce potential for spontaneous combustion;
- Pre- and post- (goaf) gas drainage systems are to be implemented for gas management purposes thereby minimising ventilation pressures that would result if the ventilation system only were used to maintain gas concentration to acceptable levels;
- Installation of high standard ventilation control devices such as stopping, regulators and overcasts;
- Installation, operation and maintenance of a dual ventilation monitoring system (telemetric and tube bundle);
- On-site gas chromatograph;
- On-site inertisation capability:
 - Pipework and valves fitted to all goaf seals to allow the injection of inert gas.
 - Potential utilisation of in-seam drainage ranges.
 - A nitrogen generating plant is located onsite and reticulated underground via a dedicated pipeline.
- Implementation of Ventilation and Monitoring Arrangements and the related spontaneous combustion procedures and action response plans; and

- Implementation of a Gas Drainage and Outburst Management Plan.

Spontaneous combustion events (if any) will be reported in the Annual Review.

3.2.6 Contaminated Land

No contaminated or polluted land has been identified at Narrabri Mine and as such no specific management controls or monitoring procedures are required. The greatest risk for the contamination or pollution of land as a result of the mine is associated with the potential for fuel or oil spills/leaks. The following hydrocarbon management controls are implemented by NCOPL:

- All water from wash-down areas and workshops is directed to oil separators and containment systems;
- All storage tanks are either self-bunded or partitioned with an impermeable bund with a capacity to contain a minimum 110% of the largest storage tank capacity;
- All hydrocarbon products are securely stored; and
- Most equipment is refuelled at the bunded fuel farm in the Pit Top Area and refuelling in the field is undertaken by a trained and competent person with a fully operational service truck.

In the event of a hydrocarbon spill, the Pollution Incident Response Management Plan (PIRMP) would be triggered and an Incident Report Form will be completed and the affected area will be regularly inspected after rectification to ensure there is no ongoing effect on the land that will prevent it from being successfully rehabilitated.

All contamination monitoring activities and mitigation measures will be reported in the Annual Review.

3.2.7 Bushfire

Bushfire management is outlined in the Narrabri Mine Rehabilitation Management Plan, the Bushfire Prevention Standard and the Bushfire Emergency Response Procedure. The bushfire management strategy for Narrabri Mine is to identify all hazards and risks associated with bushfires for all properties owned by NCOPL. The following are recognised as potential causes of bushfire across the mine:

- Fires on plant and equipment and/or occurring as a consequence of maintenance activities of plant or equipment;
- Spontaneous combustion from stockpiled coal;
- Inappropriate staff behaviour i.e. smoking on-site (which is in breach of site rules) and/or undertaking activities without adequate controls;
- Unrelated mining incidents e.g. lightning strike and ember attack; and
- Fire from adjacent land holdings.

Narrabri Mine is equipped to attend to emergency fire situations with appropriate machinery and personnel. Any involvement in such situations would be at the discretion of the local Rural Fire Service (Baan Baa or Turrawan). A fire break has been installed around the northern section of longwall panels. This fire break will assist emergency vehicles requiring access to the western portion of the mining lease. Narrabri Mine has also met with the NSW Rural Fire Service (RFS), Namoi/Gwydir team, along with other industry representatives during the reporting period. Information on equipment available onsite, locations of watering points/access tracks/infrastructure areas and Geographic Information System (GIS) mapping information have been provided to the RFS for the Narrabri Mine.

Bushfire events and mitigation measures will be reported in the Annual Review.

3.2.8 Acid Mine Drainage

Assessments undertaken for the Stage 2 Project EA (Aquaterra, 2009) identified that the low relative sulfate concentrations in groundwater suggest that there is little concern for acid producing potential from groundwater inflows. Testing of the reject has been undertaken with the results indicating that the reject material is non-acid forming. Testing will be undertaken every five years throughout the mine life (or if conditions change) to determine the propensity of the material to generate contaminated leachate, with the results reported in the Annual Review.

Monthly surface and groundwater pH testing is also undertaken to determine if any acid is generated from reject. All monitoring activities and the management of any potential acid forming materials will be reported in the Annual Review.

3.2.9 Air Quality

Air quality at Narrabri Mine is monitored through the Air Quality Monitoring Program. In order to satisfy the criteria in PA08_0144, Narrabri Mine employs a range of air quality control measures including:

- No burning of materials on-site. Any vegetation removal for surface infrastructure works is retained for subsequent replacement on the rehabilitated landscape;
- Limiting groundcover removal to areas required for immediate operational requirements;
- Groundcover removal as part of the topsoil removal activities;
- Where practicable, limiting soil stripping activities to periods when there is sufficient soil moisture to prevent significant dust lift-off and avoiding periods of high winds;
- Application of water to exposed surfaces, with emphasis on those areas subject to frequent vehicle / equipment movements which may cause dust generation and dispersal;
- Use of water injection on drill rigs;
- Progressive shaping and rehabilitation;
- Speed limit restrictions on all vehicles and equipment on the mine site; and
- Trigger Action Response Plans (TARPs) for the major dust generating activities onsite which currently includes: the coal processing area; surface drilling activities; and surface civil works.

Narrabri Mine has eight depositional dust monitoring gauges (ND1-ND8), which are monitored monthly. The site also has two High Volume Air Samplers (HVAS) (PM₁₀) located on the project-related properties "Claremont" (ND9) and "Turrabaa" (ND10) located to the south-east and south-west of the Pit Top Area. The samplers run for 24 hours every 6 days.

3.2.10 Blasting

During construction of ventilation shaft bores it may be necessary to initiate small blasts within the shaft, particularly when the harder volcanic units are encountered. Such blasts are routine for shaft construction and cause few effects because of their size and depth below the surface. Given the very minor nature of the blasts that will occur on an infrequent basis and the depth at which they will occur, no specific management measures are proposed.

3.2.11 Noise

Noise is managed in accordance with the Narrabri Mine Noise Management Plan. PA 08_0144 and EPL 12789 prescribe operational noise limits and management requirements. The following noise management controls are adopted at the mine:

- Prior to being brought onto site, or upon commissioning, all additional plant and equipment is required to exhibit sound power levels consistent with those levels specified in the Noise Management Plan (NMP);
- High frequency reversing alarms are not permitted on any equipment brought onto site. Rather, all reversing alarms should be of the broadband frequency type;
- The approved hours of operation are adhered to;
- Site personnel are required to pay due attention to site weather conditions and modify or stand down from operational activities if directed by mine management; and
- Monitoring of emitted noise levels is undertaken during mining operations to verify compliance with noise criteria and to assess the need, if any, for additional noise attenuation measures.

Transport and other noise controls, as specified in the NMP, comprise:

- Regular maintenance of the sealed site access road;
- Strict adherence to the approved hours of operation for transport activities will be enforced by mine management;
- All project employees and contractors will be instructed to enter and exit the mine site in a courteous manner and without undue traffic noise;
- All access roads are signposted and speed limited to minimise transport noise;
- Equipment with lower sound power levels is used in preference to more noisy equipment;
- All equipment used on-site will be regularly serviced to ensure the sound power levels remain at or below the levels used in the modelling to assess generated noise levels and compliance with the criteria; and
- The onsite road network will be well maintained to limit body noise from empty trucks travelling on internal roads.

Narrabri Mine also regularly liaises with the majority of surrounding neighbours to seek feedback on the mining activities.

Noise will be monitored in accordance with PA 08_0144 and the approved Noise Management Plan, and results will be reported in the Annual Review.

3.2.12 Visual and Lighting

The Narrabri Mine is positioned to the west of, and upslope of, the Kamilaroi Highway, and is thereby visible to passing motorists and to adjacent property holders to the east. The constructed amenity bund on the southern and western boundary of the site obscures views of the site from the south and west, whilst vegetation associated with Kurrajong Creek obscures views to the site from the north. Narrabri Mine has undertaken strategic tree planting across the site to further enhance visual screening from adjacent areas.

Lights from the mine site are visible during the night, however, it is not considered a significant detrimental impact given the distance from adjacent non-project related residences and the presence of the amenity bund. All lighting is designed to comply with *Australian Standard 4282 – 1997: Control of the Obtrusive Effects of Outdoor Lighting*.

The initial ventilation shaft and associated fans have been constructed in an area already shielded from residences to the south and southeast by topography and existing vegetation. Narrabri Mine has also purchased all of the land in the southern portion of the mining lease except for one property in the south-west. Each additional ventilation shaft will be surrounded by substantial vegetation, which will reduce visual contrast.

Gas drainage drilling activities are temporary in nature, and similar visually to the exploration drilling activities which have been ongoing over the mine site for a number of years. Beyond a distance of a few hundred metres, the activities will be virtually imperceptible with dust suppression activities undertaken to reduce dust generation, likely to be the most noticeable aspect of these operations. Once completed, the gas drainage and drilling sites will be rehabilitated to establish the pre-existing vegetation.

The site is maintained in a clean and tidy condition at all times, with areas of disturbance reshaped and rehabilitated as soon as practicable.

Visual and lighting impacts will be monitored and results will be reported in the Annual Review.

3.2.13 Aboriginal Heritage

Aboriginal heritage is currently managed in accordance with the ACHMP which was developed in consultation with Registered Aboriginal Parties (RAPs) and OEH.

Two assessments of Aboriginal cultural heritage at the mine site have been undertaken. The first assessment (Archaeological Surveys & Reports Pty Ltd, 2007) was undertaken for the Stage 1 project and encompassed the Pit Top Area of the mine site. The second assessment (Archaeological Surveys & Reports Pty Ltd, 2009) was undertaken for the Stage 2 project and consisted of a detailed survey of the surface area associated with Longwall Panels 1 to 7, the Brine Storage Pond Area and the Namoi River Water Pipeline. All assessments and surveys were undertaken in consultation with representatives of the local Aboriginal community.

To ensure compliance with the requirements of the NPW Act, EP&A Act and the conditions of PA 08_0144, the following measures will be implemented:

- Include information relating to Aboriginal cultural heritage in inductions for all site personnel;
- Identification of sites on plans kept in the Administration building for ease of access;
- Implement the 'Permit to Disturb' procedure, which includes cross referencing proposed disturbance areas and recorded Aboriginal sites;
- Sites determined to be of high significance as agreed between Narrabri Mine, the registered Aboriginal stakeholders and an archaeologist will be pegged, fenced and identified as an 'Environmental Protection Zone';
- Undertake all salvage works, which requires the approval of the Secretary, in accordance with requirements of PA 08_0144;
- Undertake regular consultation with stakeholders; and
- Undertake regular reviews of the ACHMP.

In the event of inadvertent damage to any Aboriginal site or place, the activities causing the damage would cease immediately and procedures identified in the ACHMP followed. Subject to the nature of the damage, appropriate professional advice in addition to that provided a consultant archaeologist may be sought.

Aboriginal cultural heritage will be monitored in accordance with the ACHMP and the results summarised in the Annual Review.

3.2.14 European Heritage

No listed heritage sites were identified during a desktop survey of the mine site area. One structure of interest, an abandoned sawmill, was identified during field surveys undertaken by Archaeological Surveys and Reports Pty Ltd (AS&R). AS&R concluded, however, that the sawmill is of no local historical interest, and of only low educational value, insufficient to warrant its classification as a structure of Heritage Significance.

On this basis, no management or monitoring of natural heritage is proposed.

3.2.15 Impacts on Agricultural Resources

The 1:100,000 scale Land Capability map of the Baan Baa map sheet area prepared by the former Soil Conservation Service of NSW indicates that land within the mine site is mapped mainly as Class III land with a small area of Class IV and the remaining areas as Class VI and Class VIII near Jacks Creek State Forest.

Field investigations undertaken for the Stage 2 EA indicated that much of the area that has been cleared and farmed in the past is Class III land, land along the major drainage lines is Class IV and the remaining land of rocky ridges and sandy soils is Class VII. Potential impacts of the mine on soils would relate primarily to:

- Disturbance of in-situ soil resources within disturbance areas and as a result of subsidence;
- Alteration of soil structure beneath infrastructure items, hardstand areas and roads;
- Possible soil contamination resulting from spillage of fuels, lubricants and other chemicals;
- Increased erosion and sediment movement due to exposure of soils; and
- Alteration of physical and chemical soil properties (e.g. structure, fertility, permeability and microbial activity) due to soil stripping and stockpiling operations.

The proposed rehabilitation of Class III agricultural suitability lands will result in no long-term change in the area of Class III agricultural suitability lands on the site. Agricultural land resource management at Narrabri Mine will include the following key components:

- Minimisation of disturbance to agricultural lands, where practicable;
- Continued use of adjoining Whitehaven-owned land for agricultural uses;
- Management of soil resources at the site so that they can be used for rehabilitation; and
- Inclusion of agricultural lands in the mine rehabilitation strategy (i.e. reestablishment of Class III land).

Rehabilitation is a key focus of this MOP and the outcomes will be included in the Annual Review.

3.3 Operational Issues which affect Rehabilitation

This section describes aspects of the operation that have the potential to significantly impact the quality and/or timing of rehabilitation.

3.3.1 Geology and Geochemistry

The mine is located within the Permo-Triassic Gunnedah Basin, which forms the central part of the north-south elongate Sydney-Gunnedah-Bowen Basin system. The mine site is located within the Mullaley sub-basin which contains Permian and Triassic sedimentary and volcanic rocks.

The strata throughout ML 1609 strikes north-south and dip gently to the west. The coal resource is located within the Gunnedah Basin Sequence (Permian to Triassic). The Hoskissons Coal Seam and the Melville Coal Seam are present within ML 1609. Thickness and quality characteristics are such that only the Hoskissons Coal Seam is currently considered to contain coal resources with mining potential. The Hoskissons Coal Seam comprises dull lustrous coal, which consists of a low ash working section (basal 4.2m) and a high ash coal with claystone bands (upper 5.2m).

As stated in **Section 2.3.4**, an assessment of the REA rehabilitation methodology and final landform design was undertaken by O'Kane (2017). The assessment recommended that further sampling be conducted of the material currently in place in the REA, and of future rejects material to ensure that the design and modelling assumptions are consistent with the operations. During the MOP term these recommendations will be implemented and the results reported in the Annual Reviews.

3.3.2 Material Prone to Spontaneous Combustion

A spontaneous combustion assessment completed for the Hoskissons Coal Seam (Beamish, 2006) indicated that it has a high propensity to spontaneously combust. As a consequence, a Spontaneous Combustion Major Hazard Management Plan (SCMHMP) and a Stockpile Management Plan have been developed for the site as part of the Narrabri Mine Health and Safety Management System. The Stockpile Management Plan also includes a Stockpile Heating and Spontaneous Combustion TARP.

With the implementation of these management plans, spontaneous combustion is not considered a risk to rehabilitation at Narrabri Mine.

Additionally, as noted in **Section 2.3.4**, a 2016 engineering assessment of the REA found that as the coarse reject comprises predominantly broken rock (sandstone/ siltstone material) which is not carbonaceous, the propensity of the reject for spontaneous combustion, or to sustain any fires, was considered very low (ATC Williams, 2016a). Additionally, the REA will be capped, which will further reduce the spontaneous combustion risk.

All other carbonaceous material will be removed from the surface of the site or buried. Subsidence areas will be remediated, and the depth to the coal seam makes spontaneous combustion in the rehabilitated subsided landform extremely unlikely.

3.3.3 Material prone to generating Acid Mine Drainage

As noted in **Section 3.2.8**, assessments undertaken for the Stage 2 Project EA (Aquaterra, 2009) identified that the low relative sulfate concentrations in groundwater suggest that there is little concern for acid producing potential from groundwater inflows. Testing of the reject has been undertaken with the results indicating that the reject material is non-acid forming. Furthermore, a 2016 engineering assessment of the REA found that whilst under extreme conditions, release of acid or saline leachate from the REA may occur, the likely impact of the discharge would be minimal, and as such, leachate generation was not considered to present a risk to rehabilitation (ATC Williams, 2016a).

Notwithstanding, testing will be undertaken every five years throughout the mine life (or if conditions change) to determine the propensity of the material to generate contaminated leachate. The results will be reported in the Annual Reviews.

3.3.4 Mine Subsidence

Mining activities at Narrabri Mine are currently undertaken using the longwall retreat method of mining. Due to the underground nature of mining operations, the proposed mining method is not considered a significant risk to rehabilitation during the MOP term. Potential subsidence related impacts include surface cracks, shearing and ponding (DgS, 2017). As detailed further in **Section 2.3.3**, subsidence related impacts are not predicted to be a significant constraint to rehabilitation. Surface cracking as a result of mine subsidence has previously resulted in root shear and tree death above LW101 and LW102 where the depth of cover was less than 170m. As there is no further mining planned for areas with a depth of cover of less than 170m, this is not anticipated to pose a risk to future rehabilitation at Narrabri Mine. Notwithstanding, a trigger for tree death in subsidence areas had been included in the TARP (refer **Section 9.2**).

Ongoing monitoring and remediation of subsidence impacts will be undertaken following mining. Management of these issues within LW101 to LW110 are outlined in the current approved Extraction Plans. The LW101 to LW110 Land Management Plans outline the monitoring and management measures that will be implemented to manage potential impacts from the extraction of LW101 to LW110.

3.3.5 Erosion and Sediment Control

Given the mine is underground; there are relatively few areas of exposed ground with potential for erosion and sedimentation at Narrabri Mine. Consequently, there will be minimal areas requiring ongoing or temporary rehabilitation during the MOP term. Following disturbance, rehabilitation sites will utilise recognised structures such as sediment ponds and sediment fences as appropriate ways to manage runoff water and manage erosion and sedimentation. Inspections will be carried out to ensure that the effectiveness of erosion and sediment control structures are maintained. Erosion and sediment control will be undertaken in accordance with the approved Site Water Management Plan.

However, as stated in **Section 2.3.4**, an engineering assessment of the REA undertaken in 2016 found that the natural soils taken from the site as part of REA development, being potentially dispersive or sodic soils, were potentially erodible (ATC Williams, 2016a). The assessment found that under worst case conditions, the loss of soil cover from the REA could cause exposure of the rejects and increased potential for release of leachate or contact surface water runoff to the receiving environment.

To reduce the erosion risk, the proposed management approach is to create a robust capping material that is erosion resistant on slopes of up to 4(H) to 1(V) (ATC Williams, 2016b). The capping material will comprise a rocky soil (or rock mulch), utilising the available topsoil/subsoil reserves on-site, but with a mix of between 10 and 20% (nominal) of competent rock fragments also available onsite, typically 50 to 150mm size. In addition, conditioning of the soil component using lime or gypsum (or suitable alternative) would likely be necessary, as a means of reducing sodicity, to provide further robustness to the capping layer surface particularly during the revegetation phase. For further detail refer **Section 2.3.4**.

With the implementation of the proposed management plans and procedures, erosion and sedimentation are not anticipated to pose a significant risk to rehabilitation at the site.

3.3.6 Soil Type(s) and Suitability

The EA (R.W. Corkery & Co, 2009) identified a variety of soil types across the mine site. Some of the soil types, particularly those derived from the Purlawaugh Formation, were identified as being moderately to highly dispersive, erodible and saline, and management of these soils is required where subsidence results in cracking, slope increases or occurs within drainage lines.

Furthermore, as stated in **Section 3.3.5**, an engineering assessment of the REA undertaken in 2016 found that the natural soils taken from the site as part of REA development, being potentially dispersive or sodic soils, were potentially erodible (ATC Williams, 2016a).

During topsoil stripping, all soils are handled as little as possible by ensuring the area to be stripped and the area of stockpiling are clearly identified. All topsoil is stripped and re-used in site rehabilitation, with the stripping and use of subsoil in rehabilitation or other works restricted to those soils identified as amenable for this purpose. Topsoil stockpiles do not exceed 2m in height, while the subsoil stockpiles do not exceed 3m in height.

The MOP risk assessment (**Appendix C**) identified poor topsoil quality (due to stockpile times, weeds, site conditions and management) as a potential risk to reaching closure and relinquishing the lease. Inadequate volumes of topsoil were also identified as a potential risk to rehabilitation, due to limited stripping opportunities and/or poor recovery of topsoil from the visual bund. Should topsoil quality/quantity be inadequate for rehabilitation, NCOPL will source suitable ameliorants and topsoil alternates. Topsoil quality will be managed in accordance with the Rehabilitation Management Plan and weed management activities undertaken on-site (refer **Section 3.2.4**). Managing topsoil quantities will be undertaken through maintaining a topsoil balance, and surveying topsoil stockpiles on a plan.

With the implementation of the proposed management plans and procedures, soil types and suitability are not anticipated to pose a significant risk to rehabilitation at the site.

3.3.7 Flora and Fauna

Flora and fauna are not expected to pose a risk to the success of the rehabilitation at Narrabri Mine. Due to the underground mining methods, only small areas of vegetation are required to be cleared for mining activities, and these will be rehabilitated to the pre-mining land use following immediately mining.

During clearing activities for drilling and gas drainage sites in forested areas, trees upon felling are positioned adjacent to the disturbed areas for future use in the rehabilitation of the disturbed areas for fauna habitat. Clearing activities across the remainder of the ML incorporate the dispersal and spread of cleared native vegetation around the disturbed areas to provide fauna habitat, increase seed bank and to provide a mulch material for nutrient cycling and water retention.

Hollow-bearing trees removed during authorized clearing works will be relocated into appropriate areas (i.e. rehabilitation areas or areas outside the current operations) where practicable for potential fauna habitat. Any clearing of native vegetation requires approval from the Environmental Personnel under the pre-clearance permit arrangements. The protection of habitat by these means will minimise the impacts on fauna and ensure the protection of habitat for threatened species that have been recorded in the area.

Management of weeds and pest species are outlined in **Section 3.2.4**. Weeds and pests at Narrabri Mine are not a significant risk to rehabilitation.

3.3.8 Other Risks

No other factors have been identified as significant risks to rehabilitation at Narrabri Mine.

4 POST MINING LANDUSE

4.1 Regulatory Requirements

The approvals, licences and leases held for Narrabri Mine at the time of MOP preparation are listed in **Table 1**. Regulatory requirements for post mining land use and rehabilitation are listed in **Table 9**.

This MOP has been developed to meet the requirements of PA 08_0144, ML1609, and EPBC Approval 2009/5003.

Table 9 Regulatory Requirements

Source	Requirement	Domain	Where addressed in the MOP										
PA 08_0144 MOD 5 Schedule 2, Condition 1	The Proponent shall implement all practicable measures to prevent and/or minimise any harm to the environment that may result from the construction, operation, or rehabilitation of the project.	All domains	Section 3										
PA 08_0144 MOD 5 Schedule 2, Condition 5	The Proponent may undertake mining operations on the site for 21 years from the date of this approval. Note: Under this Approval, the Proponent is required to rehabilitate the site and to perform additional undertakings to the satisfaction of the Secretary. Consequently, this approval will continue to apply in all other respects other than the right to conduct mining operations until the site has been rehabilitated to a satisfactory standard.	All domains	Section 7										
PA 08_0144 MOD 5 Schedule 5, Condition 1	The Proponent shall rehabilitate the site to the satisfaction of the Secretary and DRE in accordance with the rehabilitation objectives in Table 1. Table 1: Rehabilitation Objectives	All domains	Section 7										
<table border="1"> <thead> <tr> <th>Domain</th> <th>Rehabilitation objective</th> </tr> </thead> <tbody> <tr> <td>Surface Facilities Area</td> <td>Set through condition 4 below</td> </tr> <tr> <td>Other land affected by the project</td> <td>Restore ecosystem function, including maintaining or establishing self-sustaining native ecosystems: · comprised of local native plant species; with · a landform consistent with the surrounding environment.</td> </tr> <tr> <td>Built features</td> <td>Repair/restore to pre-mining condition or equivalent.</td> </tr> <tr> <td>Community</td> <td>Minimise the adverse socio-economic effects associated with mine closure including the reduction in local and regional employment. Ensure public safety.</td> </tr> </tbody> </table>		Domain	Rehabilitation objective	Surface Facilities Area	Set through condition 4 below	Other land affected by the project	Restore ecosystem function, including maintaining or establishing self-sustaining native ecosystems: · comprised of local native plant species; with · a landform consistent with the surrounding environment.	Built features	Repair/restore to pre-mining condition or equivalent.	Community	Minimise the adverse socio-economic effects associated with mine closure including the reduction in local and regional employment. Ensure public safety.		
Domain	Rehabilitation objective												
Surface Facilities Area	Set through condition 4 below												
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Built features	Repair/restore to pre-mining condition or equivalent.												
Community	Minimise the adverse socio-economic effects associated with mine closure including the reduction in local and regional employment. Ensure public safety.												

Note: The Proponent may be required to define other rehabilitation objectives in management plans or strategy required under this schedule.

Source	Requirement	Domain	Where addressed in the MOP
PA 08_0144 MOD 5 Schedule 5, Condition 2	To the extent that mining operations permit, the Proponent shall carry out rehabilitation progressively, that is, as soon as reasonably practicable following the disturbance.	All domains	Section 7
PA 08_0144 MOD 5 Schedule 5, Condition 3	The Proponent shall revise the Landscape Management Plan for the Stage 1 project to encompass all proposed mine activities and potential impacts associated with landscape management for the site (Stages 1 and 2) and subsequently implement this revised version of the Landscape Management Plan to the satisfaction of the Secretary and DRE. This plan must: (d) include a: <ul style="list-style-type: none"> · Rehabilitation Management Plan; and · Mine Closure Plan. 	All domains	Mine Closure Plan Section 5 Rehabilitation Management Plan Section 6
PA 08_0144 MOD 5 Schedule 5, Condition 4	The Rehabilitation Management Plan must include: (a) the rehabilitation objectives for the site; (b) a strategic description of how the rehabilitation of the site would be integrated with surrounding land use; (c) a general description of the short and long term measures that would be implemented to rehabilitate the site; (d) a detailed description of the measures that would be implemented to remediate predicted subsidence impacts under individual Extraction Plans; (e) a detailed description of the measures that would be implemented to minimise environmental impacts of mining operations and to rehabilitate the site, including measures to be implemented for: <ul style="list-style-type: none"> · managing remnant vegetation and habitat on site; · minimising impacts on fauna; · minimising visual impacts; · conserving and reusing topsoil; · controlling weeds, feral pests, and access; · managing bushfires; and · managing any potential conflicts between rehabilitation works and Aboriginal cultural heritage. (f) detailed performance and completion criteria for the rehabilitation of the site; (g) a detailed description of how the performance of the rehabilitation works would be monitored over time to achieve the stated objectives and against the relevant performance and completion criteria; and (h) details of who is responsible for monitoring, reviewing and implementing the plan. <i>Note: In accordance with condition 11 of schedule 2, the preparation and implementation of Rehabilitation Management Plans is likely to be staged, with each plan covering a defined area (or domain) for rehabilitation. In addition, while mining operations are being carried out, some of the proposed remediation or rehabilitation measures may be included in the detailed management plans that form part of the Extraction Plan. If this is the case, however, then the Proponent will be required to ensure that there is good cross-referencing between the various management plans.</i>	All domains	Rehabilitation Management Plan Sections: (a) Section 3 (b) Section 4 (c) Section 3 (d) Section 5 (e) Section 6 (f) Section 7 (g) Section 8 (h) Section 9

Source	Requirement	Domain	Where addressed in the MOP
PA 08_0144 MOD 5 Schedule 5, Condition 5	The Mine Closure Plan must: (a) define the objectives and criteria for mine closure; (b) investigate options for the future use of the site; (c) provide a detailed methodology for decommissioning the site's evaporation/storage ponds and the treatment of any accumulated salt within or around those ponds; (d) investigate ways to minimise the adverse socio-economic effects associated with mine closure, including reduction in local and regional employment levels; (e) describe the measures that would be implemented to minimise or manage the on-going environmental effects of the project; and (f) describe how the performance of these measures would be monitored over time.	All domains	Mine Closure Plan Sections: (a) Section 2 (b) Section 1.4 (c) Section 5.1 (d) Section 4.4 (e) Section 7 (f) Section 7.3
PA 08_0144 MOD 5 Schedule 5, Condition 6	The Proponent shall provide a suitable biodiversity offset strategy to compensate for the impacts of Stages 1 and 2 of the project. This offset strategy must: (a) be prepared in consultation with OEH; (b) be submitted to the Secretary for approval by 31 December 2010, or as otherwise agreed by the Secretary; (c) provide a detailed assessment of offset proposal/s involving the property/ies (agreed to by OEH) adjoining Mt Kaputar National Park to confirm the ability of either of these property/ies to meet "like for like or better" and "maintain or improve" conservation outcomes; (d) include and assess proposals to offset impacts to the Inland Grey Box EEC, <i>Bertya opposens</i> , and foraging habitat for the Superb Parrot; (e) include proposals on offsetting both direct and indirect impacts (i.e. edge effects) of the project; and (f) determine the best overall combination of lands to provide a suitable offset.	Domain F – Biodiversity Offset Area	Section 5.1
PA 08_0144 MOD 5 Schedule 5, Condition 7	The Proponent shall make suitable arrangements to provide appropriate long-term security for the offset areas by 31 December 2011, or other date agreed by the Secretary, to the satisfaction of the Secretary.	Domain F – Biodiversity Offset Area	Section 5.1
ML1609 Condition 2	The proponent shall implement all practicable measures to prevent and/or minimise any harm to the environment that may result from the construction, operation or rehabilitation of the development.	All domains	Section 3
ML1609 Condition 3 (b)	(b) The MOP must • Identify how the mine will be managed to allow mine closure.	All domains	Section 3
ML1609 Condition 7	Disturbed land must be rehabilitated to a sustainable/agreed end land use to the satisfaction of the Secretary	All domains	Section 7
ML1609 Condition 16	Abandoned shafts and excavations opened up or used by the lease holder must be filled in or otherwise rendered safe to a standard acceptable to the Secretary.	Domain 1 – Infrastructure	Section 7.3.1

Source	Requirement	Domain	Where addressed in the MOP
ML1609 Condition 17 (2)	If the lease holder drills exploratory drill holes he must satisfy the Director General that: (f) once any drill hole ceases to be used the hole must be sealed in accordance with Departmental guidelines. Alternatively, the hole must be sealed as instructed by the Secretary (g) once any drill hole ceases to be used the land and its immediate vicinity is left in a clean, tidy and stable condition.	Domain 1 – Infrastructure	Section 7.3.1
ML1609 Condition 22	Temporary access tracks must be ripped, topsoiled and revegetated as soon as possible after they are no longer required for mining operations.	Domain 1 – Infrastructure	Section 7.3.1
EPBC 2009/5003 Condition 2	In order to mitigate impacts on EPBC Act listed threatened species and communities, by 30 June 2017, or another date agreed in writing by the Minister, the person taking the action must: a) Secure the 933 hectare property known as "Kenna" as outlined in Annexure 2 under a legal conservation mechanism that has been agreed to in writing by the Department. b) Secure the 422 hectare property as outlined in Annexure 3 under a legal conservation mechanism that has been agreed to in writing by the Department. Evidence of compliance with this condition must be provided to the Department within 30 days of finalising the legal conservation mechanism.	Domain F – Biodiversity Offset Area	Section 3.2.3
EPBC 2009/5003 Condition 5	In order to minimise potential impacts on EPBC Act listed threatened species and communities within the mine site, the person undertaking the action must actively manage progressive disturbance of the mine site in accordance with a <i>Rehabilitation Management Plan</i> for the life of the mine. The <i>Rehabilitation Management Plan</i> must be developed and implemented prior to any Works commencing and in accordance with the NSW Director General's Assessment Report and approval conditions (26 July 2010). The final version of this plan must be submitted to the Department.	All domains	Rehabilitation Management Plan Section 6
EPBC 2009/5003 Condition 6	Within 12 months prior to the Cessation of Operation of the Action and in accordance with the NSW Director General's Assessment Report and approval conditions dated 26 July 2010 (including subsequent revisions), the person undertaking the action must submit and implement a <i>Mine Closure Plan</i> . The person taking the action must have consideration of matters protected under the EPBC Act at this time and ensure that these matters will not be significantly impacted by the mine closure. The final version of this plan must be submitted to the Department.	All domains	Not triggered during this MOP term

Source	Requirement	Domain	Where addressed in the MOP
EPBC 2009/5003 Condition 8	<p>Within three months of every 12 month anniversary of the Commencement of the Action, the person undertaking the action must provide a report to the Department demonstrating compliance with the conditions of this approval over the previous 12 months. This report must include details of how the plans required by the conditions of this approval have been implemented.</p> <p>Annual reports must be provided until the Minister is satisfied that the person undertaking the action has complied with all conditions of the approval.</p>	All domains	Section 10
EPBC 2009/5003 Condition 14	<p>In order to mitigate impacts on EPBC Act listed threatened species and communities, the person taking the action must:</p> <p>a) Develop and implement an active monitoring and management plan for the property mentioned in 2(a) for a period of 20 years to enhance White Box Grassy Woodland on the site as it provides habitat for the EPBC listed Superb parrot. The active management plan must include:</p> <p>i. Management actions, including but not limited to, rehabilitation and restoration measures, pest management, fencing, weed control, fire management, sediment and erosion control, exclusion of livestock and restrictions of access.</p> <p>ii. Details of who is responsible for monitoring, reviewing and implementing the plan.</p> <p>b) Develop and implement an active monitoring and management plan for the site mentioned in (2b) for a period of 20 years to enhance Red Ironbark-Brown Bloodwood Shrubby Woodland which provides habitat for EPBC listed <i>Bertya opponens</i> and for the White Box Grassy Woodland which provides habitat for the EPBC listed Superb Parrot. The active management plan must include:</p> <p>i. Management actions, including but not limited to, land rehabilitation and restoration measures, pest management, fencing, weed control, fire management, sediment and erosion control, exclusion of livestock and restrictions of access.</p> <p>ii. Details of who is responsible for monitoring, reviewing and implementing the plan.</p>	Domain F – Biodiversity Offset Area	Section 3.2.3
EA (2009) S.O.C 4.1	<p>Confirm the proposed final land use of the Mine Site lands and identify the infrastructure and services to be retained to support this land use.</p>	All domains	Section 4
EA (2009) S.O.C 4.2	<p>Demolish or deconstruct and remove infrastructure and services not required by the confirmed future land use.</p>	Domain 1 – Infrastructure	Section 7.3.1

Source	Requirement	Domain	Where addressed in the MOP
EA (2009) S.O.C 4.3	Stabilise all earthworks, drainage lines and disturbed areas no longer required for mine-related activities in order to minimise erosion and sedimentation, and to reduce the visibility of the activities from adjacent properties and the local road network.	All domains	Section 7.3.2
EA (2009) S.O.C 4.4	Provide a low maintenance, stable and safe landform that blends with the surrounding topography and which is commensurate with re-established agricultural land uses.	All domains	Section 4.3
EA (2009) S.O.C 4.5	Ensure any areas of disturbance that require profiling meet the requirements of the final landform.	All domains	Section 7.3.2
EA (2009) S.O.C 4.6	Replace subsoil and topsoil over areas of disturbance in the same order and approximately same depths as it was removed.	All domains	Section 7.3.2
EA (2009) S.O.C 4.7	Ensure the most appropriate crop / pasture species are planted in areas returned for agricultural use.	Domain D – Rehabilitation Area – Pasture	Section 7.3.4
EA (2009) S.O.C 4.8	Conduct ongoing rehabilitation monitoring and maintenance throughout and beyond the operation.	All domains	Section 8
EA (2009) S.O.C 4.9	Restrict areas of disturbance to the areas identified and marked in accordance with Commitments 1.1 to 1.5.	All domains	Section 2.3
EA (2009) S.O.C 4.10	Remove gas drainage equipment and backfill and cap each remaining bore hole in accordance with Condition 17 of ML1609, <i>Exploration Code of Practice: Rehabilitation</i> (DP&E, 2015), and the <i>Guideline for Mineral Exploration Drilling; Drilling and Integrity of Petroleum Exploration and Production Wells</i> (DRE, 2016).	Domain 1 – Infrastructure	Section 7.3.1
EA (2009) S.O.C 4.11	Allow water retained within the sump(s) to evaporate, excavate any consolidated drill cuttings and fines, remove the plastic liner and backfill each sump.	Domain 1 – Infrastructure	Section 7.3.1
EA (2009) S.O.C 4.12	Respread previously stripped and stockpiled topsoil and vegetation over the backfilled sumps and other cleared areas.	All domains	Section 7.3.2
EA (2009) S.O.C 4.13	Complete periodic inspections of the rehabilitated sites to confirm a return to the vegetation of the surrounding landform.	All domains	Section 8
EA (2009) S.O.C 4.14	(Unless required for future access to monitor or manage subsidence related impacts), close, cross-rip and respread previously cleared vegetation over access tracks.	Domain 1 – Infrastructure	Section 7.3.1
EA (2009) S.O.C 4.15	Obtain certification from plant supplier / contractor that equipment imported to the Mine Site has been cleaned and is free of soil and vegetation.	All domains	Section 8.1.3
EA (2009) S.O.C 4.16	Undertake campaign weed spraying over the Pit Top Area and areas of surface disturbance of the Mining Area in consultation with DII-Agriculture and/or the local Noxious Weeds Inspector.	All domains	Section 8.1.3

4.2 Post Mining Land Use Goal

The final land use goal at Narrabri Mine is to create a physically and chemically stable mine landform that is adequately drained and integrates with the surrounding landform and to ensure all mine induced subsidence is remediated and rehabilitated. The rehabilitation of mining disturbed areas into the surrounding landscape will be planned to deliver final land uses that achieve biodiversity and agricultural outcomes. Rehabilitated landforms will also integrate with the adjoining State Forests to enhance regional biodiversity and conservation outcomes.

As stated in the Narrabri Mine Modification 5 EA (Resource Strategies, 2015), some infrastructure (e.g. rail loop, site access roads, water storages) may be retained for alternate post-mining uses (where agreed in consultation with the relevant landholders). However as an agreement with a future landholder has yet to be developed, for the purposes of this MOP, a grazing final land use has been assumed.

Approximately 1,630 ha of agricultural land will be re-established to a comparable land capability to that of the pre-disturbance environment (i.e. Class III) at mine closure.

The western extent of the mining lease will become part of the onsite Biodiversity Offset Area (BOA). 422 ha of on-site offsets will be established, which contains woodland vegetation and threatened fauna habitat which will not be directly or indirectly affected by the project. A further 1,168 ha of woodland vegetation that will be subject to subsidence impacts will be allocated at the end of the mine life. In addition, an offsite BOA (the "Kenna" property) has been established which covers an area of 1,243 hectares (ha), resulting in a total offset area of 2,833 ha. Both the offsite and onsite BOAs consists of five vegetation types that meet the 'like for like' offset requirements consistent with PA08_0144 as documented in the approved Biodiversity Offset Strategy (EcoLogical, 2014). In accordance with the EPBC approval, a legally binding conservation covenant will be placed on the title of the BOA's.

4.3 Rehabilitation Objectives

In order to achieve the rehabilitation goal outlined in **Section 4.2**, Narrabri Mine has developed a number of rehabilitation objectives. These objectives are:

- Rehabilitation will be consistent with the Environmental Assessments which formed the basis for any approvals;
- Rehabilitation will be based on mine closure criteria and outcomes developed through stakeholder consultation;
- Compliance with the relevant regulatory requirements and that regulatory consensus is attained on the successful closure and rehabilitation of the site;
- 2,833 ha of BOA are established at the end of mine life (1,590 on-site and 1,243 off-site);
- The rehabilitated site will be a low maintenance, geotechnically stable, safe and vegetated landform which blends with the surrounding natural landscape;
- Agricultural land will be re-established to a comparable land capability to that of the pre-disturbance environment (i.e. Class III);
- The rehabilitated site will not present a hazard to persons, stock or native fauna;
- The site will be clean and tidy and any remaining structures will be left in a condition that provides for the safety of the public; and
- Mine closure works are to be completed as quickly and cost effectively as possible whilst providing that the above objectives are achieved.

5 REHABILITATION PLANNING AND MANAGEMENT

5.1 Domain Selection

Primary and secondary domains have been defined in accordance with the methodology prescribed in ESG3 (DTIRIS 2013). As such the following applies:

- Primary Domains are defined as the set of discrete areas that have a particular operational or functional purpose. Land management units with similar operational function are likely to have similar geophysical features and constraints /opportunities for rehabilitation.
- Secondary Domains are land management units with similar post mining land use objectives, such as woodland communities and pasture.

Accordingly, domains have been defined considering the operational function and specific final land use objectives. Domains at the commencement of the MOP period are shown in **Plan 2**, and listed in **Table 10** and **Table 11**.

Table 10 Primary Domains

Domain	Code	Description
Infrastructure Area	1	This domain incorporates all surface infrastructure, including the site access road and internal access tracks, office and administration buildings, light vehicle carpark, workshop and stores buildings, electrical sub-station and associated electricity infrastructure, equipment laydown areas, rail loop and train loadout bin and train loader, sewage treatment plant, box cut and mine portals, drift and skyline conveyors, coal crushing station, CHPP, ROM and product coal pad hardstand areas, explosives magazine, ventilation fans and shafts, gas drainage infrastructure, and water pipelines.
Tailings Storage Facility	2	Not applicable to this MOP.
Water Management Area	3	Incorporates the network of dams, lined evaporation ponds, brine storage ponds, water diversion bunds and associated water management infrastructure.
Reject Emplacement Area	4	This domain relates to the REA.
Stockpiled Material	5	This domain includes stockpiled topsoil, as well as the material stockpiled in the visual amenity bund.
Void (Open Cut Void)	6	Not applicable to this MOP.
Rehabilitation Area	7	Incorporates all rehabilitation undertaken at the site prior to MOP commencement.
Underground Mining Area	8	Area of land subject to subsidence from underground mining activities.
Conservation and Biodiversity Offset Area	9	Not applicable to this MOP

Table 11 Secondary Domains

Domain	Code	Description
Infrastructure	A	Not applicable to this MOP.
Water Management Area	B	Footprint of water management structures and dams retained in the final landform. All retained dams (for agricultural use) will meet water harvesting requirements and/or, if in a 'turkey's nest' setting, be supported by a pumping arrangement that is licensed (if necessary). NCOPL plans to decommission mining related dams, and the subsidence ponds are predicted to self-correct or be corrected to flow so won't require rights for these ponds in the future. This domain will cover approximately 21 ha.
Rehabilitation Area - Grassland	C	Not applicable to this MOP.
Rehabilitation Area – Pasture	D	Landholdings that were previously used for agriculture and have been impacted by mining, such as subsidence areas and some infrastructure areas. This Domain will be rehabilitated to Class III agricultural suitability land, capable of pasture production and occasional cropping.
Rehabilitation Area – Woodland (Existing)	E	Woodland areas that have been impacted by mining, such as subsidence areas and some infrastructure areas will be rehabilitated to woodland, however will not form part of the State Forest or Offset area. This domain will cover approximately 443 ha.
Rehabilitation Area - State Forest - Existing	F	The current parts of Jacks Creek and Pilliga East State Forests that are within the ML will continue to be used for forestry post-mining. This domain will cover approximately 367 ha.
Rehabilitation Area – Rural Land	G	Not applicable to this MOP.
Relinquished Lands	H	Not applicable to this MOP.
Final Void	I	Not applicable to this MOP.
Conservation and Biodiversity Offset Area	J	Area that will be conserved for biodiversity offset following the cessation of mining (approximately 1,590 ha). In accordance with the EPBC approval, a legally binding conservation covenant will be placed on the title of this domain following the cessation of mining.

In the event that the rail loop is not retained, the rail embankment will be reshaped and the cutting will be backfilled with material excavated from within the site. The disturbance footprint will be re-profiled to recreate a similar topography to pre-mining. The entire area would then to be deep-ripped and spread with topsoil, before being lightly cultivated and seeded.

It is expected that each domain will require particular rehabilitation objectives and methodologies to achieve the desired final land use outcomes. Domain objectives and rehabilitation methods are discussed in the following sections.

5.2 Domain Rehabilitation Objectives

The key rehabilitation objectives for the Domains identified in **Section 5.1** are defined in **Table 12**.

Table 12 Domain Rehabilitation Objectives

Domain	Rehabilitation Objectives
Primary Domains	
Infrastructure Area	<ul style="list-style-type: none"> All mining infrastructure will be removed progressively, and the area rehabilitated, when no longer required. All land contamination will be identified and appropriately remediated.
Water Management Area	<ul style="list-style-type: none"> Water management structures in the final landform will be designed and constructed prior to disturbance, in accordance with Best Practice and “the Blue Book”. Sediment dams and associated water management structures will remain in place until the catchment is rehabilitated and discharge water quality is similar to comparable undisturbed landforms.
Reject Emplacement Area	<ul style="list-style-type: none"> The REA will be rehabilitated progressively. The majority of the outside batters of the REA will be formed generally to a grade of 11 degrees (5:1) with a maximum grade of 14 degrees (4:1) in the current NE batter. The advancing (internal) dump face exists at angle of repose (in the order of 30 degrees). The REA will be progressively capped with approximately 400mm of subsoil/topsoil initially stripped from the emplacement area. Erosion control structures will be installed in accordance with the ATC Williams design specifications (refer Section 2.3.4). Contour banks and diversion drains will be used to direct water into stable areas or sediment control basins.
Stockpiled Material	<ul style="list-style-type: none"> Topsoil stockpiles will be stabilised with sterile cover pasture crops to minimise weed infestation and retain soil biological health. Topsoil stockpiles will be constructed and managed to optimise physical, chemical and biological characteristics. Stockpile areas will be rehabilitated progressively when material is required for use on-site.
Rehabilitation Area	<ul style="list-style-type: none"> Rehabilitated areas will be maintained so that they are geotechnically stable and compatible with the surrounding landscape. Rehabilitated areas will be maintained so that they are adequately drained and incorporate drainage structures designed and constructed in accordance with “the Blue Book”.
Underground Mining Area	<ul style="list-style-type: none"> Areas affected by mine induced subsidence will generally have gradients that are consistent with the pre-mining and/or the surrounding topography and which are geotechnically stable (i.e. no increased risk of landslip or mass slope failure). Contour banks and diversion drains will be used where required to prevent erosion of slopes and direct water into stable areas or storage dams. Areas of surface ponding will be either remediated to enable drainage to occur (where there is a salinity risk) or retained in accordance with the requirements of the Land Management Plan. To maintain the pre-mining land capability of the site.

Domain	Rehabilitation Objectives
Secondary Domains	
Water Management Area	<ul style="list-style-type: none"> • The final landform drainage will integrate with the surrounding catchments and will achieve long term geomorphic stability and minimise erosion. • Sediment dams identified for retention in the final landform will be decontaminated and preserved as clean water farm dams or water sources for native fauna. • All retained dams (for agricultural use) will meet water harvesting requirements and/or, if in a 'turkey's nest' setting, be supported by a pumping arrangement that is licensed (if necessary).
Rehabilitation Area – Pasture	<ul style="list-style-type: none"> • At least 1,630 ha of Class III agricultural land will be reinstated on areas disturbed by mining. • Dimensions and frequency of occurrence of erosion rills and gullies will be generally <200 mm and no greater than that in reference sites that exhibit similar landform characteristics. • Final landform of the REA will be safe, stable and adequately drained. • The former REA will have slopes up to 14°. • The REA will be capped with approximately 400mm of subsoil/topsoil initially stripped from the emplacement area. • Erosion control structures will be installed in accordance with the ATC Williams design specifications (refer Section 2.3.4). • All landforms will be free draining except where specific structures (i.e. dams) have been constructed for the storage of water as required for sediment and erosion control or some post mining landuse. • Buildings, water storage, roads (except those used by the public) and other infrastructure have been removed.
Rehabilitation Area – Woodland (Existing)	<ul style="list-style-type: none"> • Areas affected by mine induced subsidence will have gradients that are consistent with the pre-mining and/or the surrounding topography and which are geotechnically stable (i.e. no increased risk of landslip or mass slope failure). • Subsidence cracking will have naturally closed/filled or been actively remediated and revegetated. • Erosion mitigation measures will be applied. • Drainage lines are vegetated and/or stable (non-eroding)
Rehabilitation Area - State Forest	<ul style="list-style-type: none"> • Areas affected by mine induced subsidence will have gradients that are consistent with the pre-mining and/or the surrounding topography and which are geotechnically stable (i.e. no increased risk of landslip or mass slope failure). • Subsidence cracking will have naturally closed/filled or been actively remediated and revegetated. • Erosion mitigation measures will be applied. • Drainage lines are vegetated and/or stable (non-eroding)
Conservation and Biodiversity Offset Area	<ul style="list-style-type: none"> • Approximately 1,168 ha of woodland BOA will be established on areas disturbed by mining. • Approximately 422 ha of woodland BOA will be established on areas not disturbed by mining. • Woodland Rehabilitation Areas will be comparable with adjacent undisturbed remnant native vegetation including areas. • A legally binding conservation covenant will be placed on the title of the BOA following the cessation of mining.

5.3 Rehabilitation Phases

The rehabilitation process can be described as a sequence of conceptual rehabilitation phases to achieve a final land use that is self-sustaining. These phases of rehabilitation are described in **Table 13**.

Table 13 Rehabilitation Phases

Phase	Description
Decommissioning	The process of removing plant and equipment from active services and rendering the area safe.
Landform Establishment	The process of shaping material into a desired land surface profile. This includes earthworks activities such as cut and fill, rock raking, water storage and drainage construction.
Growth Medium Development	The process of establishing and enhancing the physical structure, chemical properties and biological properties of a soil stratum suitable for plant growth. This includes placing and spreading soil and applying ameliorants.
Ecosystem and Landuse Establishment	The process of seeding, planting and transplanting plant species. Incorporates management actions such as weed and feral pest control to achieve species establishment and growth to juvenile communities, and habitat augmentation.
Ecosystem and Landuse Sustainability	The process of applying management techniques to encourage an ecosystem to grow and develop towards a desired and sustainable post mining land use outcome. Incorporates features including species reproduction, nutrient recycling and community structure.
Land Relinquishment	The completion criteria for rehabilitation are met and the land is determined to be suitable to be relinquished from the mining tenement.

Section 7.3 provides a general overview of the rehabilitation methodology for each rehabilitation phase and **Table 14** provides a summary of the phases expected to be completed for each domain at the end of the MOP period.

Table 14 Summary of Rehabilitation Phases Proposed for Completion at end of the MOP Term

Domain \ Rehabilitation Phase	Infrastructure - Pasture (1D)	Infrastructure - Woodland (1E)	Infrastructure - State Forest (1F)	Infrastructure - Offset Area (1J)	Water Management Area - Water Management Area (3B)	Water Management Area - Pasture (3D)	Reject Emplacement Area - Pasture(4D)	Stockpiled Material – Pasture (5D)	Underground Mining Area - Pasture (8D)	Underground Mining Area - Woodland (8E)	Underground Mining Area - State Forest (8F)	Underground Mining Area - Offset Area (8J)
Active	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Phase 1 – Decommissioning	✓	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗
Phase 2 – Landform Establishment	✓	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗
Phase 3 – Growth Medium Development	✓	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗
Phase 4 – Ecosystem and Land Use Establishment	✓	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗
Phase 5 – Ecosystem and Land Use Sustainability	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Phase 6 – Land Relinquishment	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗

✓ = Areas of this domain are subject to this rehabilitation phase during MOP term.

✗ = Domain not expected to enter this rehabilitation phase during the MOP term.

6 PERFORMANCE INDICATORS AND COMPLETION/RELINQUISHMENT CRITERIA

The completion criteria are objective target levels or values assigned to a variety of indicators (e.g. slope, species diversity, percent groundcover), which can be measured to demonstrate progress and ultimate success of rehabilitation. As such, they provide a defined end point, at which point in time rehabilitation can be deemed successful and the lease relinquishment process can proceed. The rehabilitation completion criteria for Narrabri Mine are listed in **Table 15** to **Table 20**.

These completion criteria, which may be subject to refinement as the operation progresses, including through consultation with the relevant stakeholders, will be utilised to demonstrate achievement of rehabilitation objectives. The achievement (or otherwise) of the completion criteria will be monitored and reported within the annual reports to be submitted to relevant government agencies.

Table 15 Decommissioning Phase

Domain Objective	Performance Indicator	Completion Criteria	Justification/ Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
All Domains						
Public safety	Site Security	Appropriate security measures (e.g. adequate fencing) has been implemented (where required) prior to commencing decommissioning and demolition works. A full post-mining site security Risk Assessment has been undertaken and all controls identified to mitigate any risk have been fully implemented.	Mine Closure Plan (2016)	No	No	Not commenced
Domain 1 - Infrastructure Areas						
Infrastructure (other than that remaining in the final landform) will be decommissioned progressively as plant, equipment and infrastructure becomes obsolete.	Demolition of infrastructure	All demolition work has been carried out in accordance with AS2601-2001: <i>The Demolition of Structures</i> or its latest version.	AS2604-2001	No	No	Not commenced
		All surface infrastructure has been demolished and removed from the site	2009 EA, S.O.C 4.2 Mine Closure Plan (2016)	No	No	Commenced (ongoing)
	Access tracks	Temporary access tracks have been ripped, topsoiled and revegetated as soon as possible after they are no longer required for mining operations.	ML1609 Cond. 22 EA (2009) S.O.C 4.14	No	No	Commenced (ongoing)
	Namoi Water Pipeline	The 300mm diameter pipeline between the mine site and the Namoi River has been removed from the underground trenches and recycled. The disturbance areas are rehabilitated.	Mine Closure Plan (2016)	No	No	Not commenced
	Boreholes and Drill sites	All boreholes have been backfilled and capped in accordance with Condition 17 of ML1609, <i>Exploration Code of Practice: Rehabilitation</i> (DP&E, 2015), and the <i>Guideline for Mineral Exploration Drilling; Drilling and Integrity of Petroleum Exploration and Production Wells</i> (DRE, 2016).	2009 EA S.O.C 4.10 ML1609 Cond. 17(2)	No	No	Commenced (ongoing)

Domain Objective	Performance Indicator	Completion Criteria	Justification/ Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
	Vent Shafts and mine entries	Shafts and mine entries to be filled and capped in accordance with DRG <i>Guidelines for the Permanent Filling and Capping of Entries to coal seams</i> (MDG 6001)	Mine Closure Plan (2016) ML1609 Cond. 16	No	No	Not Commenced
	Site Services	All site electricity and telecommunication services not required for the post mining land use have been isolated, disconnected and terminated to make safe. Inspection pits and junction boxes for underground services have been sealed. Underground services have been made safe and left buried in the ground. Overhead power lines have been removed.	Mine Closure Plan (2016)	No	No	Not Commenced
	Subsidence Pegs	All subsidence pegs removed in consultation with DRG.	MOP Section 7.3.1	No	No	Not Commenced
	Foundations and pavements	All concrete footings, foundation pads and pavements have been dug up, crushed to make an aggregate and utilised across the site or sold for some other beneficial reuse.	Mine Closure Plan (2016)	No	No	Not Commenced
	Waste	All remaining inert, unrecyclable wastes have been either taken to a licensed landfill or buried in the backfill of the box-cut in accordance with DRG/OEH requirements.	Mine Closure Plan (2016)	No	No	Not Commenced
Ensure the site is safe and free of hazardous materials	Carbonaceous material	All carbonaceous material has been removed from the surface of the site and disposed of in the box cut with at least 5m of inert cover.	DECC 2008 ANZECC 1992 EPA 1998	No	No	Not commenced
	Hazardous materials	All hazardous materials (e.g. petroleum, chemicals and explosive products) that are no longer required have been removed from site, verified by Certificates of disposal.		No	No	Not Commenced
	Contamination	A Phase 2 contamination assessment has been undertaken and any contaminated areas have been remediated to an appropriate standard commensurate with the post mining land use.		No	No	Not commenced

Domain Objective	Performance Indicator	Completion Criteria	Justification/ Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
Domain 3 - Water Management Areas						
Mine water dams and sediment dams are decontaminated prior to removal or re-use as retained clean water dams in the final landform.	Brine Storage Dams	Brine storage dams have been de-watered and the stored brine pumped back into the goaf areas and remaining gate roads of the completed longwall panels. The high density polyethylene (HDPE) plastic liner of each dam has been removed and transported to a waste disposal facility, supported by records.	Mine Closure Plan (2016)	No	No	Not commenced
	Removal of water management structures not required in final landform	All water management structures that are not required as part of the post-closure land use have been removed.	MOP Section 4			
	Box Cut Water Management System	The internal water management system in the box-cut has been de-watered and any contaminated water has been appropriately treated or taken from site for treatment, supported by records.	Mine Closure Plan (2016)	No	No	Not commenced
	Hazardous materials	Accumulated salt in the evaporation/storage ponds has been excavated and either placed within the drifts of box-cut prior to backfilling or reinjected back into the goaf, supported by records.	Mine Closure Plan (2016) p.22	No	No	Not commenced
	Pumping Infrastructure	All ancillary equipment including pumps and pipelines have been removed and services terminated.	Mine Closure Plan (2016) p.22	No	No	Not commenced

Table 16 Landform Establishment Phase

Domain Objective	Performance Indicator	Completion Criteria	Justification /Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
All Domains						
Final landform will be suitable for the intended final land use, and blend into the surrounding landforms as far as practicable.	Safety	A risk assessment has been undertaken in accordance with relevant guidelines and Australian Standards and risks reduced to levels agreed with the stakeholders.	Mine Closure Plan (2016)	No	No	Not Commenced
	Landform	The rehabilitated landform is free draining, low maintenance, stable and safe, and blends with the surrounding topography (as determined by specialist engineering and visual amenity assessments)	PA 08_0144 S5, Cond. 1 EA (2009) S.O.C 4.4 and 4.5	No	Yes	Not Commenced
	Stability	All earthworks, drainage lines and disturbed areas no longer required for mine-related activities have been stabilised in order to minimise erosion and sedimentation, and to reduce the visibility of the activities from adjacent properties and the local road network.	EA (2009) S.O.C 4.3	No	No	Not Commenced
	Soil moisture and nutrient distribution (electromagnetic mapping)	Identified areas of electromagnetic mapping change (greater than 1 standard deviation from the mean change) investigated in the field to determine the source of the change. Site specific management report prepared and recommendations implemented where necessary.	EcoLogical (2016)	No	No	Ongoing
	Erosion	Visual inspection confirms no active sheet or gully erosion, or rill erosion >200mm deep as determined by specialist assessment.	DECC 2008	No	Yes	Not Commenced
	Domain 1 – Infrastructure Area					
Final landform will be suitable for the intended final land use, and blend into the surrounding landforms as far as practicable.	Box Cut	The box-cut has been backfilled using material recovered from the perimeter amenity bund and other inert material removed during demolition. The surface has been shaped to restore continuity with the surrounding landscape.	Mine Closure Plan (2016)	No	No	Not Commenced

Domain Objective	Performance Indicator	Completion Criteria	Justification /Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
	Pit Top	The post mining landform has been shaped to create a stable surface with slopes at a maximum of 4 degrees.	Mine Closure Plan (2016)	No	No	Ongoing
	Drainage	Contour banks and diversion drains have been installed to direct water into stable areas or sediment control basins.	Mine Closure Plan (2016)	No	Yes	Not Commenced
Domain 3 - Water Management Areas						
Safe, stable, adequately drained post mining landforms consistent with the surrounding landscape.	Final landform drainage design	Surface water management structures such as contour banks, diversion drains and settlement ponds required to provide permanent, long-term stable water flow and storage have been constructed.	Mine Closure Plan (2016) DECC 2008	No	Yes	Not Commenced
		Final landform drainage structures including drains, banks, drop structures and dams have been designed and constructed in accordance with Blue Book requirements.	DECC 2008 ACARP C13048	No	Yes	Not Commenced
	Geomorphic stability	Geotechnical report completed by qualified person shows that the post-mining landform is stable and slopes are stable for agreed post mining landuse.	Mine Closure Plan (2016)	No	No	Not Commenced
Water quality is appropriate for final land use	EPL discharge criteria	Surface water is non-polluting All discharge water quality criteria (pH, TSS, EC, oil/grease) complies with EPL 12789	EPL 12789 ANZECC 2000	No	No	Not Commenced
	Leachate	No water is observed leaching from dams that will remain in the final landform.	Mine Closure Plan (2016)	No	No	Not Commenced
Domain 4 - Reject Emplacement Area						
Final landforms are shaped appropriately for final land use	Maximum slope and height	The REA has been capped with the previously stripped subsoil and topsoil with slopes up to 14° and maximum 15m height.	Mine Closure Plan (2016)	No	Yes	Not Commenced
	Final landform shaped and rehabilitated	Geotechnical report completed by qualified person at shows that the post-mining landform is stable and slopes are stable for agreed post mining landuse.	Mine Closure Plan (2016)	No	No	Not commenced
Final landforms including slopes and drainage will be	Slumping or uncontrolled erosion	There is an absence of slumping or uncontrolled erosion with rills < 200 mm deep	DECC 2008	No	Yes	Not Commenced

Domain Objective	Performance Indicator	Completion Criteria	Justification /Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
designed to be safe, stable and non-polluting.	Capping depth	Landform is capped with approximately 400mm of capping material comprising a rocky soil (or rock mulch), utilising the available topsoil/subsoil reserves on-site, but with a mix of between 10 and 20% (nominal) of competent rock fragments, typically 50 to 150mm size.	Mine Closure Plan (2016) p.29, ATC Williams (2016b)	No	No	Not commenced
	Visual Amenity	The REA blends in with the surrounding environment (as determined by specialist visual amenity assessment).	Rehabilitation Management Plan p.32	No	No	Not commenced
Domain 5 – Stockpiled Material						
Safe, stable, adequately drained post mining landforms consistent with the surrounding landscape.	Box Cut Filling	Material from visual bund (except the southern section) has been moved into the box cut to make a landform that is commensurate with the surrounding landform as determined by specialist visual amenity assessment.	Mine Closure Plan (2016)	No	No	Not commenced
	Slumping or uncontrolled erosion	There is an absence of slumping or uncontrolled erosion with rills < 200 mm deep	DECC 2008	No	Yes	Not commenced
Domain 8 – Underground Mining Area						
Safe, stable, adequately drained post mining landforms consistent with the surrounding landscape.	Subsidence	Subsidence cracking has naturally closed/filled or been actively remediated in accordance with the requirements of the approved Extraction Plan.	Mine Closure Plan (2016)	No	No	Ongoing
		Subsidence across landscape does not exceed subsidence predictions	EcoLogical (2016)	No	No	Ongoing
	Slope	Areas affected by mine induced subsidence have gradients that are consistent with the pre-mining and/or the surrounding topography and which are geotechnically stable (i.e. no increased risk of landslip or mass slope failure.)	Mine Closure Plan (2016)	No	No	Ongoing
	Erosion	Erosion mitigation measures have been applied. There is an absence of slumping or uncontrolled erosion with rills <200 mm deep.	DECC 2008	No	Yes	Ongoing

Domain Objective	Performance Indicator	Completion Criteria	Justification /Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
	Drainage	Natural drainage lines are stable (non-eroding) and where contour banks and diversion drains have been installed they are assessed as being long-term stable.	Mine Closure Plan (2016)	No	Yes	Ongoing
	Ponding	Areas of surface ponding are assessed and remediated to enable natural drainage to occur (where there is a salinity risk).	Mine Closure Plan (2016)	No	Yes	Ongoing

Table 17 Growth Medium Development Phase

Domain Objective	Performance Indicator	Completion Criteria	Justification/ Source	Complete (Yes/No)	Link to TARP	Progress at MOP start
All Rehabilitation Areas						
Growth media resources are retained and managed to retain structure, chemical and biological properties.	Topsoil stripping depth	Maps show the location and volumes of Topsoils that are stockpiled for later re-use in accordance with management plans and procedures.	Mine Closure Plan (2016)	No	Yes	Ongoing
Topsoil will be replaced in disturbed areas to allow for rehabilitation	Topsoil Spreading	Subsoil and topsoil have been replaced over areas of disturbance in the same order and approximately same depths as it was removed (at least 150mm topsoil), and it has been ripped.	EA (2009) S.O.C 4.6	No	Yes	Ongoing
	Topsoil Quality	Testing verifies that there is a less than 20% increase in EC in comparison to baseline values. Testing verifies that pH is within +/-0.5 of a pH unit of analogue sites at Year 5. If soil amelioration is undertaken, pH of pasture sites is to remain within recommended range of 5.2-8.0 pH units. Testing verifies that there is less than a 20% reduction in organic matter in comparison to baseline values for Nitrogen, Phosphorus, and organic matter.	EcoLogical (2016)	No	Yes	Ongoing
		Spread topsoils are tested and the soil Exchange Sodium Percentage (ESP) is <15%.	Mine Closure Plan (2016)	No	Yes	Ongoing
Topsoils are characterised and ameliorated for use in final land uses.	Amelioration	Where through testing it has been determined to be necessary, appropriate soil ameliorants (e.g. gypsum, fertilisers, mulch) have been applied in accordance with recommendations from specialist assessment, with records kept	MOP Section 7.3.3	No	Yes	Ongoing
Erosion is minimised	Erosion	ESCs are installed prior to topsoil re-spreading.	MOP Section 7.3.2	No	Yes	Ongoing
		Topsoiled rehabilitation areas are sown with a non-persistent cover crop at the sowing rate / ha specified in Table 24 .	DECC 2008	No	Yes	Ongoing

Domain Objective	Performance Indicator	Completion Criteria	Justification/ Source	Complete (Yes/No)	Link to TARP	Progress at MOP start
Domain D - Pasture						
Surface rock density appropriate for agricultural land use	Surface rock density	Surface soils are rock raked to remove rocks and produce a friable surface.	MOP Section 7.3.2	No	No	Ongoing
Domain E - Woodland; and Domain F - State Forest						
Habitat features are salvaged and re-used in native vegetation rehabilitation to provide fauna habitat resources	Habitat features	Habitat features are salvaged during clearing and where assessed as being of use, incorporated into forested rehabilitation areas.	MOP Section 7.3.3	No	No	Ongoing
Domain J – Biodiversity Offset Area						
Habitat features are salvaged and re-used in woodland rehabilitation to provide fauna habitat resources	Habitat features	Habitat features (hollow bearing logs, felled timber not mulched and large rocks) are salvaged during pre-stripping operations for re-use where practicable.	Mine Closure Plan (2016)	No	No	Ongoing
	Log, hollows and nest box density	Habitat features are incorporated into woodland rehabilitation areas (including within watercourses and retained dams) where appropriate.	Mine Closure Plan (2016)	No	No	Ongoing

Table 18 Ecosystem and Land Use Establishment Phase

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
All Domains						
Monitoring demonstrates soil profile development in rehabilitated areas (e.g. development of organic layer, litter layer)	pH	Testing verifies that pH is within +/-0.5 of a pH unit of analogue sites at Year 5. If soil amelioration is undertaken, pH of pasture sites is to remain within recommended range of 5.2-8.0 pH units.	Mine Closure Plan (2016), EcoLogical (2016)	No	Yes	Ongoing.
	EC	Testing verifies that there is a less than 20% increase in soil EC in comparison to baseline values at Year 5 following establishment.	EcoLogical (2016)	No	Yes	Ongoing.
	Nutrients	Testing verifies that there is less than a 20% reduction in Nitrogen, phosphorus, and organic matter in comparison to baseline values at Year 5 following establishment.	EcoLogical (2016)	No	Yes	Ongoing.
Vegetation establishment	Ground Cover	Percentage ground cover within 20% of analogue sites/baseline monitoring within five years of establishment.	EcoLogical (2016)	No	No	Ongoing.
		Identified areas of NDVI change (greater than 1 standard deviation from the mean change) investigated in the field to determine the source of the change. Site specific management report prepared and recommendations implemented where necessary.	EcoLogical (2016)	No	No	Ongoing
Weeds are controlled on NCOPL lands	Weed presence	Annual specialist biodiversity monitoring verifies there are no significant weed infestations and weeds do not comprise a significant proportion of the species in any stratum (less than 10% increase in exotic species number and cover)	Ecological (2016)	No	Yes	Ongoing
		Records indicate that noxious weeds are controlled in accordance with legislation, the Rehabilitation Management Plan, and the MOP.	Ecological, 2016	No	Yes	Not Commenced

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
Feral animal pests are controlled on NCOPL lands	Feral animal density	No increase in feral animal population and monitoring indicates the absence or decline in feral animal species numbers.	MOP Section 8.1.4	No	Yes	Ongoing.
		Vertebrate pest species presence and densities are monitored, and control programs implemented in accordance with the Landscape Management Plan	TSC Act 1995 Rural Lands Protection Act 1998	No	Yes	Ongoing.
	Fence / tree guard installation	Faunal exclusion fencing and/or tree guards are installed (where required) to exclude vertebrate pest species from rehabilitation areas / juvenile vegetation.	TSC Act 1995	No	No	Ongoing.
The area does not present an extreme bushfire hazard to surrounding areas	Fire Management	Bushfire mitigation actions, including managing fuel loads, maintaining fire-breaks and fire-fighting access, are implemented in accordance with the Bushfire Management Plan.	Bushfire Management Plan	No	No	Ongoing.
Water quality from rehabilitation area meets relevant water quality standards	Runoff water quality from rehabilitation areas	Water quality monitoring data provides evidence that runoff water quality from rehabilitation areas is within the range of baseline surface water from nearby creeks.	MOP Section 3.3.5	No	Yes	Ongoing.
Riparian vegetation composition and health	Creek line erosion	Less than 20% increase in length of eroding creek line (bank and bed) when compared to control sites as determined by annual biodiversity assessment undertaken by specialist	EcoLogical (2016)	No	No	Ongoing
	Creek stability	Less than 20% increase in cross-sectional area in comparison to control cross-sectional area (unless stabilisation works have been undertaken) as determined by annual biodiversity assessment undertaken by specialist	EcoLogical (2016)	No	No	Ongoing
Domain D - Rehabilitation Area - Pasture						
Final landform will be capable of being used for agricultural	Pasture species sowing rate.	Approved pasture species mix (refer Table 24) is sown at the specified sowing rate per hectare.	MOP Section 7.3.4	No	No	Ongoing.

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
purposes	Land capability	1,630 ha of Class III agricultural land is established on areas disturbed by mining.	MOP Section 4.3	No	No	Ongoing.
	Pasture Biomass	Less than 20% reduction in pasture biomass in impact zones in comparison to control zones.	Ecological (2016)	No	No	Ongoing
	Aquatic macroinvertebrate and macrophyte assemblages in farm dams	No decline in aquatic habitat quality relative to natural variation in control areas	Ecological (2016)	No	No	Ongoing
Domain E - Rehabilitation Area – Woodland; and Domain F – Rehabilitation Area – State Forest.						
Native vegetation rehabilitation areas species diversity is comparable to analogue native vegetation community	Habitat	No adverse impacts to habitat of threatened species, such as a reduction in habitat area, hollow-bearing trees and woody debris as determined by annual biodiversity monitoring by specialists	EcoLogical (2016)	No	No	Ongoing.
	Vegetation health	More than 75% of trees are healthy and growing as indicated by long term monitoring.	Mine Closure Plan (2016)	No	Yes	Ongoing.
	Species composition	Less than 10% change in floristic composition (relative to natural variation found in control areas) as determined by specialist annual biodiversity monitoring	EcoLogical, 2016)	No	Yes	Ongoing.
Stock have been excluded from rehabilitation areas	Stock exclusion	Stock have been excluded from these domains.	MOP Section 4.3	No	No	Ongoing.
Domain J –Biodiversity Offset Area						
Native vegetation rehabilitation areas species diversity is comparable to analogue native	Offsets	Approximately 1,168 ha of areas disturbed by mining, and 422 ha of land not disturbed by mining, will be rehabilitated with native vegetation communities.	On-Site BOMP p.1	No	No	Ongoing.

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	Link to TARP	Progress at start of MOP
vegetation community	Habitat	No adverse impacts to habitat of threatened species, such as a reduction in habitat area, hollow-bearing trees and woody debris as determined by annual biodiversity monitoring by specialists	EcoLogical (2016)	No	Yes	Ongoing.
	Vegetation Cover	Within 3 years, 25% of seedlings (direct seeding) and 75% of direct landscape plantings have survived.	On-Site BOMP p.24	No	Yes	Ongoing.
	Vegetation health	More than 75% of trees are healthy and growing as indicated by long term monitoring.	Mine Closure Plan (2016)	No	Yes	Ongoing.
	Species composition	Less than 10% change in floristic composition (relative to natural variation found in control areas) as determined by specialist annual biodiversity monitoring	EcoLogical, 2016)	No	Yes	Ongoing.
Fauna diversity is progressing towards the ecosystems planned in the final land use	Stock exclusion	Stock have been excluded from the BOA.	On-Site BOMP p.25	No	No	Ongoing.

Table 19 Ecosystem and Land Use Sustainability Phase

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	Link to TARP	Progress at MOP start
All Domains						
Soil stability and profile development is self-sustaining	Percent nitrogen, potassium and phosphorous.	Soil nitrogen, potassium and phosphorus levels are within two standard deviations of the mean value at analogue sites by Years 1, 5 and Year 15, respectively.	CSIRO 2008. Ecosystem Function Analysis (EFA) Annual Monitoring Reports	No	Yes	Ongoing
	Weed management	Annual specialist biodiversity monitoring verifies there are no significant weed infestations and weeds do not comprise a significant proportion of the species in any stratum (less than 10% increase in exotic species number and cover)	Ecological (2016)	No	Yes	Ongoing
		Records indicate that noxious weeds are controlled in accordance with legislation, the Rehabilitation Management Plan, and the MOP.	Ecological, 2016	No	Yes	Not Commenced
	Ground cover.	Ground cover and / or leaf litter cover is greater than 70% at Year 5.	DECC 2008	No	Yes	Ongoing
	Runoff Water Quality	Receiving waters affected by surface water runoff have contaminant limits of electrical conductivity maximum of 1,300 µS/cm and pH range of 6 to 8.5, consistent with receiving waters.	Mine Closure Plan (2016)	No	Yes	Ongoing
	Site safety	The site has been rehabilitated and left in a clean, tidy and safe condition.	Mine Closure Plan (2016)	No	No	Not commenced
Domain D - Rehabilitation Area - Pasture						
Soil stability and profile development is self-sustaining	Soil Quality	Salinity (EC), pH, and Cation Exchange Capacity (CEC) down the soil profile is within two standard deviations of mean values analogue sites at year 5.	Mine Closure Plan (2016)	No	Yes	Not commenced

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	Link to TARP	Progress at MOP start
Agricultural Rehabilitation Areas maintain Class III Agricultural land suitability with only the typical land management actions	Agricultural land suitability assessment.	Agricultural Rehabilitation Areas are demonstrated to be capable of grazing and cropping in accordance with the general limitations that apply to Class III agricultural land.	Mine Closure Plan (2016)	No	No	Not commenced
Domain E - Rehabilitation Area – Woodland; and Domain F – Rehabilitation Area – State Forest						
Open woodland and riparian rehabilitation areas are on a trajectory to forming self-sustaining ecosystem function equivalent to appropriate analogue sites	Vegetation health index.	Percentage of healthy shrubs and trees (when ranked healthy, sick or dead.) is within the range of the mean percentage across analogue sites	Tongway D, and Hindley, L. 2004	No	Yes	Not commenced
	Tree height and girth	Minimum tree height and girth standards for selected indicator species of the vegetation association is within the range of the mean within analogue site benchmarks at 1, 5 and 15 years.	EFA Annual Monitoring Reports	No	No	Not commenced
	Flowering specimen density / second generation presence	Species are capable of setting viable seed, flowering or otherwise reproducing. Second generation of at least four vegetation community species recorded.		No	No	Not commenced
	Species composition	Forested rehabilitation areas contain an appropriate diversity of flora species for each stratum (canopy, mid-story, ground cover) comparable to analogue sites at Year 10.	Mine Closure Plan (2016)	No	No	Not commenced
	Reproduction	Second generation tree seedlings are present or likely to be, based on monitoring in comparable older rehabilitation sites.	Mine Closure Plan (2016)	No	No	Not commenced
	Habitat	Native vegetation rehabilitation areas provide a range of structural habitats (e.g. eucalypts, shrubs, ground cover, developing litter layer etc.).	Mine Closure Plan (2016)	No	No	Not commenced
	Native fauna presence	Native fauna species diversity and abundance is trending toward analogue site at Year 10.	Mine Closure Plan (2016)	No	Yes	Not commenced

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	Link to TARP	Progress at MOP start	
Soil stability and profile development is self-sustaining	Litter biomass (depth, total mass)	Depth and mass of litter varies by less than 10% in consecutive surveys by Year 15.	CSIRO 2008 EFA Annual Monitoring Reports	No	No	Not commenced	
Domain J –Biodiversity Offset Area							
Restrict unauthorised access	Public Access	The incidence of unauthorised personnel entering the BOA is reduced due to the construction of barriers and erection of signage.	On-Site BOMP p.25	No	No	Not commenced	
Open woodland and riparian rehabilitation areas are on a trajectory to forming self-sustaining ecosystem function equivalent to appropriate analogue sites	Vegetation health index.	Percentage of healthy shrubs and trees (when ranked healthy, sick or dead.) is within the range of the mean percentage across analogue sites.	Tongway D, and Hindley, L. 2004	No	Yes	Not commenced	
	Tree height and girth	Minimum tree height and girth standards for selected indicator species of the vegetation association is within the range of the mean within analogue site benchmarks at 1, 5 and 15 years.	EFA Annual Monitoring Reports	No	No	Not commenced	
	Flowering specimen density / second generation presence	Species are capable of setting viable seed, flowering or otherwise reproducing. Second generation of at least four vegetation community species recorded.		No	No	Not commenced	
	Threatened species		Regular monitoring reveals that management measures have been successful in protecting Red Ironbark-Brown Bloodwood Shrubby Woodland which provides habitat for EPBC listed <i>Bertya opposens</i> and for the White Box Grassy Woodland which provides habitat for the EPBC listed Superb Parrot.	EPBC 2009/5003 Condition 14	No	Yes	Not commenced
			Monitoring reveals that management measures have been successful in protecting the Inland Grey Box EEC, <i>Bertya opposens</i> , and foraging habitat for the Superb Parrot.	PA 08_0144 MOD 5 Schedule 5, Condition 6	No	Yes	Not commenced
Fauna diversity		Monitoring data provides evidence of a range of structural habitats similar to baseline survey results within BOA.	On-Site BOMP p.24	No	No	Not commenced	

Domain Objective	Performance Indicator	Completion Criteria	Justification / Source	Complete (Yes/No)	Link to TARP	Progress at MOP start
	Percent canopy cover	Native plant species richness, and native canopy, mid-storey and grass cover has been restored to within 75% of benchmark condition within specified timeframes (canopy 15 years, mid-storey 10 years, groundcover 5 years).	On-Site BOMP p.24	No	No	Not commenced
	Weed Management	Exotic ground cover has been reduced to <10% by Year 10 and maintained at less than 5% thereafter. Woody weeds have been maintained at less than 1% after year 5.	On-Site BOMP p.25	No	Yes	Not commenced
	Feral animal density	If monitoring of the BOA reveals feral animals are having a significant impact on conservation objectives, then appropriate feral control measures will be implemented in co-ordination with those of adjacent land managers such as State Forests and private landowners.	MOP Section 3.2.4	No	Yes	Not commenced
The area does not present an extreme bushfire hazard to surrounding areas	Fire Management	Bushfire risk is managed in accordance with a Bushfire Management Plan prepared in consultation with the RFS as required.	MOP Section 3.2.7	No	No	Not commenced
No adverse impacts of runoff or hydrological changes on the BOA	Water quality	Regular monitoring reveals that water management measures have been successful in protecting natural systems from adverse impacts.	MOP Section 8.1	No	No	Not commenced
Soil stability and profile development is self-sustaining	Litter biomass (depth, total mass)	Depth and mass of litter varies by less than 10% in consecutive surveys by Year 15.	CSIRO 2008 EFA Annual Monitoring Reports	No	No	Not commenced

Table 20 Relinquishment

Domain Objective	Performance Indicator	Completion Criteria	Justification/ Source	Complete (Yes/No)	Link to TARP	Progress at end of MOP
All Domains						
Site will be restored to a landform capable of sustaining the post-mining land uses	Completion Criteria	All relevant completion criteria for the land proposed for relinquished (Rehabilitation Phases) are acknowledged to be met by the DRG (or contemporary equivalent).	MOP Section 4.3	No	No	Not commenced
	Access Tracks	Access tracks not required in the final landform are decommissioned and rehabilitated.	MOP Section 7.3.1	No	No	Not commenced
	Monitoring Points	Any ancillary disturbance or equipment associated with surface water and rehabilitation monitoring points is removed and/or rehabilitated.	MOP Section 7.3.1	No	No	Not commenced
	Visual Assessment	Sign off from DRG that the landforms developed are compatible with the surrounding landscape and they approve such landform as part of the MOP approval.	MOP Section 4.3	No	No	Not commenced
	Runoff water quality from rehabilitation areas	Water quality monitoring data provides evidence that runoff water quality from rehabilitation areas is within the range of baseline surface water.	MOP Section 8.1	No	Yes	Not commenced
	Public Safety	Long term subsidence monitoring inspections identify that are no public safety risks attributable to NCOPL which require the implementation of remedial actions.	MOP Section 8.1	No	No	Not commenced
	Rubbish	There is no rubbish equipment at the location of any completed subsidence remediation works.	MOP Section 7.3.1	No	No	Not commenced
	Vegetation	Vegetation is naturally regenerating or active revegetation is establishing and no further active revegetation measures are required.	MOP Section 8.1	No	Yes	Not commenced
Domain J –Biodiversity Offset Area						
Post mining conservation of offsets	Conservation Covenant	A legally binding conservation covenant has been placed on the title of the on-site 422 ha BOA following the cessation of mining.	EPBC Approval 2009:5003	No	No	Not commenced

7 REHABILITATION IMPLEMENTATION

7.1 Status at MOP Commencement

Rehabilitation activities to date have comprised:

- Cover crop establishment in areas no longer required by operational activities, including the amenity bund, dam walls and drainage lines;
- Establishment of over 1,100 tubestock trees and shrubs along the perimeter amenity bund and in strategic locations across site to improve the visual amenity for surrounding landholders and local road users; and
- Ongoing rehabilitation of areas disturbed by drilling and gas drainage activities.

At MOP commencement, an area of 9.4 ha has been rehabilitated to pasture and woodland. **Table 21** describes the status of each domain at the commencement of this MOP period. This information is also presented in **Plan 2**. The asset register (**Section 2.2**) provides a summary of the total area and key features of each domain in the MOP period.

Table 21 Rehabilitation Status at MOP Commencement

Domain	Status at MOP Commencement
Primary Domains	
Domain 1 - Infrastructure Area	This domain occupies 212.1 ha which is currently active and subject to ongoing operations.
Domain 3 - Water Management Area	This domain occupies 52.2 ha and is currently active and subject to ongoing use.
Domain 4 - Reject Emplacement Area	This domain occupies 10.9 ha and is currently active
Domain 5 - Stockpiled Material	This domain occupies 34.5 ha and is currently active and has been temporarily seeded.
Domain 7 – Rehabilitation	This domain occupies 9.4 ha and is currently undergoing rehabilitation to either pasture or woodland.
Domain 8 - Underground Mining Area	This domain occupies 3,247.9 ha and is currently active and subject to ongoing underground mining operations.
Secondary Domains	
Domain B - Water Management Area	This domain is currently active and subject to ongoing use.
Domain D - Rehabilitation Area - Pasture	This domain is currently active and includes the pit top, REA, and infrastructure which is currently in use. Some rehabilitation of gas drainage sites has been undertaken in pasture areas.
Domain E - Rehabilitation Area - Woodland	This domain is currently active. Some rehabilitation of gas drainage sites has been undertaken in woodland areas.
Domain F - Rehabilitation Area - State Forest	This domain has not yet been impacted by mining operations.
Domain J - Biodiversity Offset Area	This domain is currently active. Some rehabilitation of gas drainage sites has been undertaken in areas that will become part of the BOA.

7.2 Proposed Rehabilitation Activities during the MOP Term

Rehabilitation activities to be completed during the term of this MOP will largely be confined to stabilisation, erosion control and revegetation of disturbed areas including:

- Areas disturbed as part of site establishment and construction activities that are not required for ongoing operations (i.e. batters of cut and fill slopes);
- Drill sites and redundant gas drainage infrastructure and any associated infrastructure (access tracks etc.); and
- Areas affected by subsidence.

During the MOP term approximately 29 ha of rehabilitation will be undertaken, over the REA and infrastructure areas about the longwalls. All other rehabilitation activities will be undertaken outside the MOP term.

Table 22 summarises the forecast total disturbance and rehabilitation areas at Narrabri Mine for each year of the MOP term.

Table 22 Rehabilitation and Disturbance Rates during the MOP Term

Year	Total Disturbance Area (ha)	Total Rehabilitation Area (ha)	Cumulative Rehabilitation Area (ha)	Comments
MOP Start - 1 Jan 2017	3,557.7	9.3	9.3	
Year 1 - 31 Dec 2017	3,554.1	3.6	12.9	Progressive rehabilitation of gas drainage infrastructure, subsidence areas and the REA reduces the total disturbance area over the MOP period.
Year 2 - 31 Dec 2018	3,548.6	7.7	20.6	
Year 3 - 31 Dec 2019	3,541.9	8.5	29.1	
Year 4 - 31 Dec 2020	3,543.1	9.2	38.3	

Table 23 summarises the proposed rehabilitation activities in the MOP term for each domain. Rehabilitation methodologies for the proposed activities are described in **Section 7.3**.

Table 23 Proposed Rehabilitation Activities during the MOP Term

Domain	Proposed Rehabilitation Activities
Primary Domains	
Domain 1 - Infrastructure Area	The majority of this domain will remain active in the MOP term. Rehabilitation activities to be completed during the term of this MOP in this domain will be limited to drill sites and redundant gas drainage infrastructure and any associated infrastructure (access tracks etc.). Temporary rehabilitation (stabilisation, erosion control and revegetation) will also be undertaken on areas disturbed as part of site establishment and construction activities that are not required for ongoing operations (i.e. batters of cut and fill slopes).
Domain 3 - Water Management Area	This domain will remain active in the MOP term.
Domain 4 - Reject Emplacement Area	This domain will remain active in the MOP term however it will be progressively rehabilitated over the life of mine.
Domain 5 - Stockpiled Material	This domain will remain active in the MOP term.
Domain 7 - Rehabilitation	This domain will remain active in the MOP term and will incorporate parts of the REA and infrastructure above the longwalls.
Domain 8 - Underground Mining Area	This domain will remain active in the MOP term. Subsidence remediation will be undertaken as required throughout the MOP term.
Secondary Domains	
Domain B - Water Management Area	This domain will remain active in the MOP term.
Domain D - Rehabilitation Area - Pasture	The majority of this domain will remain active in the MOP term. Some gas drainage infrastructure and REA will be rehabilitated to pasture during the MOP term.
Domain E - Rehabilitation Area - Woodland	The majority of this domain will remain active in the MOP term. Some gas drainage infrastructure will be rehabilitated to woodland.
Domain F - Rehabilitation Area - State Forest	This domain will remain active in the MOP term.
Domain J - Biodiversity Offset Area	The majority of this domain will remain active in the MOP term. Some gas drainage infrastructure areas will undergo rehabilitation to form biodiversity offset areas.

7.3 Rehabilitation Methodologies for Activities in the MOP Term

The following sections outline the proposed rehabilitation activities for each of the relevant Domains (see **Table 23** above) throughout the MOP period.

7.3.1 Decommissioning Phase

The Decommissioning Phase encompasses all works required to prepare land for rehabilitation including removal of any unnecessary built infrastructure, foundation and hardstand materials, services, equipment and materials including wastes and contamination.

Domain 1 - Infrastructure Area

During the MOP term decommissioning of ventilation and redundant gas drainage infrastructure will be undertaken. All exploration boreholes will also be decommissioned where they are not required for long term monitoring or future geophysics. All other facilities that are no longer required will be progressively removed and the area rehabilitated. All boreholes will be sealed to meet Condition 17 of ML1609, *Exploration Code of Practice: Rehabilitation* (DP&E, 2015), and the *Guideline for Mineral Exploration Drilling; Drilling and Integrity of Petroleum Exploration and Production Wells* (DRE, 2016).

All Other Relevant Domains

No other decommissioning activities are proposed during the MOP term.

7.3.2 Landform Establishment

Landform establishment is the process of shaping the final landform to a safe, stable and free draining landform that is appropriate for the desired final land use and consistent with the surrounding landscape. The final landform for Narrabri Mine is shown on **Plan 4**. Landform establishment at Narrabri Mine will be primarily associated with filling in the box cut, and capping and shaping the REA.

Domain 1 - Infrastructure Area

During the MOP term decommissioning of ventilation and gas drainage infrastructure, as well as exploration boreholes will be undertaken.

Water retained within the sump(s) adjacent to each borehole/drill site will be allowed to evaporate or removed by pump into a truck for reuse or disposal. Any consolidated drill cuttings and fines will be excavated, and the sump backfilled using consolidated drilling spoil stockpiled during the bore construction phase. Any upstream diversion banks or downstream catch banks will be pushed over and profiled to natural surface level. Where cut and fill works were required, these areas will be re-excavated to return the site to its natural slope.

Unless required for future access to monitor or manage subsidence-related impacts, access tracks constructed to access each drainage site will be progressively closed and rehabilitated. The tracks will be ripped using the tynes of a bulldozer (or similar) and previously cleared topsoil and vegetation (if any) will be pushed over the ripped surface.

The areas will then be regraded and trimmed to make a landform that is consistent with the surrounding topography. The regrading will be such that it will enable the free drainage of surface runoff from the site.

There are no other activities associated with landform establishment in this domain during the MOP term.

Domain 3 - Water Management Area

Where practicable, water management structures such as contour banks, diversion drains or re-established drainage lines will be constructed with longitudinal gradients which permit the transfer of water at non-erosive velocities (e.g. 1:200(V:H)). Consequently, specialised rehabilitation treatments will generally not be required. No flumes are required due to limited heights of any embankments constructed. However, in the event that unacceptable levels of erosion are observed, specialised treatments such as jute meshing or rock lining will be implemented.

Domain 4 - Reject Emplacement Area

During the MOP term approximately 3 ha of the REA will be progressively rehabilitated. The REA will be progressively capped with slopes up to 14°. Each cell will be constructed to a nominated height of 15 m.

Domain 8 - Underground Mining Area

In relation to subsidence, it is expected that natural processes such as wind, water and soil movement will infill many of the cracks that develop as subsidence occurs. Notwithstanding, inspections within the cracking zones will occur during and for a period of two years following the mining of each longwall panel to identify the occurrence of cracks. Where natural processes have not completely filled each crack, ripping or grading to infill the crack will be undertaken where necessary.

Subsidence remediation will be undertaken over the underground mining area as required during the MOP term. For smaller width cracking, the surface would simply be ripped to allow the cracks to be filled in.

Significant surface cracks which may occur and cannot be filled with surface ripping or grading will be filled using subsoil stockpile material from stockpiles maintained at nearby gas drainage or ventilation sites or material from within the footprint of the REA.

In the event that ponding or flow re-direction occurs, unless the ponding significantly affects downstream flows and vegetation, no work would be undertaken. However should ponding significantly affect flow or vegetation, advice will be sought from a qualified geomorphologist so that the most effective way of re-establishing more natural flow patterns is identified (Narrabri Mine Water Management Plan, 2013). Areas of ponding that are identified will be sampled on a monthly basis to test how water salinity changes. This monitoring frequency can then be adjusted, as dictated by the results. Over time, regular water testing will build up a general trend for the condition of the water being collected. Further investigation can then be started, should these trends change during the mining operations.

If little vegetation of significance is impacted and water quality analysis confirms no increase in salinity, the ponding would be left to "self-correct" over time. The continual action of erosion and sedimentation without mitigation measures is likely to 'self-correct' the geomorphic characteristics of the waterways over time.

If important environmental features are impacted (i.e. riparian vegetation, Endangered Ecological Community or archaeological deposits) or water quality analysis indicates an increase in salinity, the ponding will be assessed and remediation options will be developed to protect the affected environmental features and prevent saline water discharging downstream. Stabilisation actions to remediate slope stability and erosion will be undertaken in the unlikely event of large-scale slope instability or erosion. Deep sub-surface drainage trenches would be installed, and catch drains would be constructed along slope crests so that surface run-off is controlled. Stabilisation works would be undertaken along sections of bank which are damaged or steeply eroded. These works would be conducted in accordance with the Erosion and Sediment Control Plan which forms part of the Water Management Plan for the site.

Should impacts to infrastructure occur on properties not owned by NCOPL these structures would be repaired or replaced by NCOPL.

All Other Relevant Domains

There are no activities associated with landform establishment in any other domains during the MOP term.

7.3.3 Growth Media Development

In the context of this MOP, growth medium development encompasses activities to reinstate soils with the initial physical, chemical and biological characteristics required to establish the desired vegetation community.

Domain 1 - Infrastructure Area

During the MOP term decommissioning of ventilation and gas drainage infrastructure, as well as exploration boreholes will be undertaken.

The surface of the backfilled sumps will be covered with the topsoil and subsoil stripped and stockpiled during site establishment, and lightly scarified. Any upstream diversion banks or downstream catch banks will be ripped or lightly scarified. Where cut and fill works were required, these areas will be re-excavated to return the site to its natural slope. This, and the remaining cleared surfaces of the drill site, will be ripped or lightly scarified and the remaining stockpiled soil.

Topsoil will be reused by replacing it back in the appropriate areas and order. When the topsoil is replaced it will be replaced such that it resembles the surrounding landscape. Before the topsoil is spread, the ground will be scarified along the contour to a depth of 50-100 mm to break up any hard setting surfaces and to provide a good bond between the re-spread material and sub-soil. The topsoil will be spread to a minimum depth of 150 mm. The re-spread topsoil will be ripped to a depth of 300 mm along the contour with rip lines being a maximum of 1 m apart.

Domain 4 - Reject Emplacement Area

During the MOP term approximately 3 ha of the REA will be progressively capped and revegetated. Following landform establishment, the REA will be progressively capped with previously stripped subsoil, topsoil and mixed with a competent rock. The soils will be treated with gypsum and the area will be hydro-mulched and watered to establish cover crop. On completion of each cell the top surface would be profiled prior to seeding. Additional contours will be incorporated within the design to limit surface water flows.

Domain 8 – Underground Mining Area

Any ground disturbance indicated by surface cracking caused by subsidence will be progressively rehabilitated. Following subsidence crack remediation, the area will be topsoiled if required, and ripped as outlined above, prior to revegetation.

All Other Domains

No other domains will enter this phase during the MOP term.

7.3.4 Ecosystem and Land Use Establishment

In the context of this MOP, ecosystem establishment includes activities to establish the desired floristic composition (species diversity and density) and habitat features.

Domain B – Water Management Area

In the event that unacceptable levels of erosion are observed, fast growing species identified as having a particular soil conservation application will be planted around water management structures. The planting of trees and other vegetation around some of the water management structures will enhance filtration ability of these structures and surrounding areas and minimise the potential for erosion, as well as encouraging their use by native fauna.

Domain D – Rehabilitation Area – Pasture

Sites located within pasture land will be rehabilitated to the appropriate agricultural land class, sown with a pasture seed mix relevant to the season of planting, with a typical fertiliser application rate (refer **Table 24**).

Table 24 Winter and Summer Pasture Species Seed Mixes

Summer			Winter		
Pasture Species	Rate (kg/ha)	Fertiliser	Pasture Species	Rate (kg/ha)	Fertiliser
Grasses					
Bombasti Panic	1 – 2	Di-ammonium Phosphate (DAP) 250kg/ha	Phalaris (Sirolan or Holdfast)	1 – 2	Di-ammonium Phosphate (DAP) 250kg/ha
	2 – 4		Wallaby Grass	0.3 – 1	
Purple Pigeon Grass	1 – 2				
Legumes²					
Subterranean Clover	4 – 5	-	Subterranean Clover	4 – 5	-
			Barrel (Sephi) medic	2 – 4	-
			Snail (sava) medic ¹	3 – 5	-
			Woolly Pod Vetch	4 – 6	-
			Serradella (Elgara)	1 – 2	-
			Lucerne	0.5	-

1 Specific soil conservation application

2 Inoculated with appropriate rhizobia

Domain E - Rehabilitation Area – Woodland, Domain F – Rehabilitation Area – State Forest, and Domain J – Rehabilitation Area – Biodiversity Offset Area

The sites located within woodlands will be rehabilitated using endemic species to the corresponding vegetation communities that exist immediately adjacent to each site. Each site will be rehabilitated with canopy, mid-storey, shrub, and groundcover species endemic to the vegetation communities (refer **Table 25**).

Table 25 Species to be used for Woodland/Forest Rehabilitation

Vegetation Community	Dominate Canopy Species	Dominate Mid-storey Species	Dominant Shrub Species	Dominant Groundcover Species
Brown Bloodwood/Piliga Box Woodland	<i>Corymbia trachyphloia</i> <i>Eucalyptus pilligaensis</i> <i>Eucalyptus fibrosa</i>	<i>Callitris glaucophylla</i> <i>Acacia homalophylla</i> <i>Acacia harpophylla</i>	<i>Calytrix tetragona</i> <i>Phebalium squamulosum</i> <i>Acacia burrowii</i> <i>Persoonia sericea</i> <i>Allocasuarina diminuta</i>	<i>Pomax umbellata</i> <i>Eragrostis brownii</i> <i>Dianella revoluta</i> <i>Microlaena stipoides</i> <i>Goodenia hederacea</i>
Callitris Forest	<i>Callitris glaucophylla</i>	-	-	<i>Eragrostis cilianensis</i> <i>Goodenia rotundifolia</i> <i>Aristida benthamii</i> <i>Austrostipa aristiglumis</i> <i>Cleistochloa rigida</i>
Inland Grey Box Woodland	<i>Eucalyptus microcarpa</i> <i>Eucalyptus populnea</i> <i>Eucalyptus blakelyi</i>	<i>Geijera parviflora</i> <i>Callitris glaucophylla</i> <i>Casuarina cristata</i> <i>Capparis mitchellii</i>	<i>Geijera parviflora</i> <i>Maytenus cunninghamii</i> <i>Acacia homalophylla</i>	<i>Aristida benthamii</i> <i>Solanum ferocissimum</i> <i>Austrostipa ramosissima</i> <i>Austrostipa verticillata</i> <i>Chrysocephalum apiculatum</i>
Riparian Forest	<i>Casuarina cunninghamiana</i> <i>Casuarina cristata</i> <i>Eucalyptus populnea</i> <i>Eucalyptus microcarpa</i>	<i>Eremophila mitchellii</i> <i>Myoporum montanum</i>	<i>Geijera parviflora</i> <i>Acacia penninervis</i> <i>Notelaea microcarpa</i>	<i>Aristida benthamii</i> <i>Austrostipa aristiglumis</i> <i>Austrostipa ramosissima</i> <i>Bothriochloa decipiens</i> <i>Cyperus gracilis</i>

Any ground disturbance indicated by surface cracking caused by subsidence will be seeded if necessary or covered with available leaf litter or broken vegetation. No seeding is considered necessary for access tracks as natural regeneration of vegetation from seed in the topsoil and the surrounding environment is expected, however, in the event that natural regeneration does not adequately establish within 3 months of ripping, the site will be seeded as appropriate.

All Other Domains

No other domains will enter this phase during the MOP term.

7.3.5 Ecosystem and Land Use Sustainability Phase

For the purposes of this MOP the Ecosystem Sustainability phase represents those activities required to develop sustainable ecosystems that have characteristics comparable to similar undisturbed vegetation associations in the area.

All Domains

Activities associated with the ecosystem sustainability phase of rehabilitation are generally ongoing maintenance and land management activities and rehabilitation monitoring. Maintenance at rehabilitated areas will include, but not be limited to:

- Ongoing environmental management to minimise risks to rehabilitation;
- Inspection and monitoring, comparing specific ecosystem characteristics such as soil profile development, floristic composition and structure and faunal diversity and abundance with the characteristics of appropriate analogue sites; and
- Undertaking adaptive management and remedial works where characteristics of the rehabilitation are not trending toward desired outcomes.

Rehabilitation monitoring will be undertaken throughout the ecosystem sustainability phase until it can be demonstrated that rehabilitation areas have met all conditions for relinquishment. Rehabilitation monitoring for the MOP term is discussed in **Section 8.1**.

7.4 Summary of Rehabilitation Areas during this MOP term

Table 26 summarises the rehabilitation status for each domain at the start of the MOP and anticipated status at the end of the MOP period.

Table 26 Summary of Rehabilitation Proposed during the MOP Term

Primary Domain	Secondary Domain	Code	Rehabilitation Phase	Total Area at MOP start (ha)	Area at end of MOP (ha)
Domain 1 Infrastructure	Domain D - Rehabilitation Area - Pasture	1D	Active	134.9	136.1
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth Medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
			Total	134.9	136.1
	Domain E - Rehabilitation Area - Woodland	1E	Active	5.7	9.2
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth Medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
			Total	5.7	9.2
	Domain F - Rehabilitation Area - State Forest	1F	Active	1.5	6.7
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth Medium Development	0	0

Primary Domain	Secondary Domain	Code	Rehabilitation Phase	Total Area at MOP start (ha)	Area at end of MOP (ha)
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
			Total	1.5	6.7
	Domain J - Biodiversity Offset Area	1J	Active	70.0	70.2
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth Medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
			Total	70.0	70.2
Domain 1 Total				212.1	222.2
Domain 3 - Water Management Area	Domain B - Water Management Area	3B	Active	21.2	21.1
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth Medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
			Total	21.2	21.1
	Domain D - Rehabilitation Area - Pasture	3D	Active	31	39.6
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth Medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
			Total	31.0	39.6
Domain 3 Total				52.2	60.7
Domain 4 - Reject Emplacement Area	Domain D - Rehabilitation Area - Pasture	4D	Active	10.9	15.2
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0

Primary Domain	Secondary Domain	Code	Rehabilitation Phase	Total Area at MOP start (ha)	Area at end of MOP (ha)
			Total	10.9	15.2
Domain 4 Total				10.9	15.2
Domain 5 - Stockpiled Material	Domain D – Rehabilitation Area - Pasture	5D	Active	34.5	34.5
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
			Total	34.5	34.5
Domain 5 Total				34.5	34.5
Domain 7 - Rehabilitation	Domain D – Rehabilitation Area - Pasture	7D	Active	0	0
			Decommissioning	0	0
			Landform Establishment	0	0.6
			Growth Medium Development	4.4	2.0
			Ecosystem and Land Use Establishment	5	15.3
			Ecosystem and Land Use Sustainability	0	0
			Total	9.4	17.9
	Domain E - Rehabilitation Area - Woodland	7E	Active	0	0
			Decommissioning	0	0
			Landform Establishment	0	0.1
			Growth Medium Development	0	0
			Ecosystem and Land Use Establishment	0	0.9
			Ecosystem and Land Use Sustainability	0	0
			Total	0	1.0
	Domain J – Biodiversity Offset Area	7J	Active	0	0
			Decommissioning	0	0
			Landform Establishment	0	8.5
			Growth Medium Development	0	6.5
			Ecosystem and Land Use Establishment	0	4.4
			Ecosystem and Land Use Sustainability	0	0
			Total	0	19.4
Domain 5 Total				9.4	38.3
Domain 8 -	Domain D -	8D	Active	1395.5	1387.0

Primary Domain	Secondary Domain	Code	Rehabilitation Phase	Total Area at MOP start (ha)	Area at end of MOP (ha)
Underground Mining Area	Rehabilitation Area - Pasture		Decommissioning	0	0
			Landform Establishment	0	0
			Growth medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
			Total	1395.5	1387.0
Domain E - Rehabilitation Area - Woodland	8E		Active	451.7	447.4
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
Total	451.7	447.4			
Domain F - Rehabilitation Area - State Forest	8F		Active	289.6	284.4
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
Total	289.6	284.4			
Domain J - Biodiversity Offset Area	8J		Active	1111.1	1091.6
			Decommissioning	0	0
			Landform Establishment	0	0
			Growth medium Development	0	0
			Ecosystem and Land Use Establishment	0	0
			Ecosystem and Land Use Sustainability	0	0
Total	1111.1	1091.6			
Domain 8 Total				3247.9	3210.4
Overall Total				3567.0	3581.3

7.5 Relinquishment Phase Achieved During MOP Period

No areas within the MOP boundary are anticipated to be relinquished during the current MOP period.

8 REHABILITATION MONITORING AND RESEARCH

8.1 Rehabilitation Monitoring

NCOPL undertakes annual rehabilitation monitoring to provide quantitative and qualitative data which is used to assess rehabilitation progress against completion criteria; and to further assist in refining rehabilitation methods across the site. A summary of rehabilitation monitoring is provided in **Table 27** and further detail is provided in the following sections.

Table 27 Multi-scale Monitoring Program Summary (EcoLogical, 2016)

Data Source	Type	Scale / frequency	Purpose	Performance Criteria
Visual Inspection	Visual assessment of cracking	Area immediately behind longwall face	Immediate consequences of subsidence particularly surface cracking, landslip and erosion	Permanent cracks (which do not self-close within one month of longwall face passing) are remediated as soon as practicably possible (and safe to do so) Surface cracking is remediated to prevent erosion and slope instability issues within 6 months of each longwall pass
Remote sensing	Lidar	Entire site Every 3 years	Topographic form and change	Subsidence across landscape does not exceed subsidence predictions for LW101-LW106 No identifiable change to overall drainage pattern
	Multi-spectral imaging	Entire site Annually	Agricultural pasture cover / biomass Erosion monitoring	Identified areas of NDVI change (greater than 1 standard deviation from the mean change) investigated in the field to determine the source of the change. Site specific management report prepared and recommendations implemented where necessary.
	EM38	Agricultural areas Every 3 to 5 years	Soil moisture and nutrient zones	Identified areas of EM mapping change (greater than 1 standard deviation from the mean change) investigated in the field to determine the source of the change. Site specific management report prepared and recommendations implemented where necessary.
Direct field survey as a result of remote sensing assessment	Field inspection and sampling/testing as required	Areas of change identified using remote sensing techniques	Confirm changes in pasture, biomass or soil characteristics and areas of erosion to identify cause and management requirements	As above in Remote Sensing

Data Source	Type	Scale / frequency	Purpose	Performance Criteria
Agricultural survey	Pasture survey	Within agricultural zones Annually	Pasture biomass and composition	Less than 20% reduction in pasture biomass in impact zones in comparison to control zones. Weed species identified and managed according to the weed management measures provided in the Rehabilitation MP. Less than 10% increase in weed cover in impact zones in comparison to the control zone.
	Soil survey	Within agricultural zones Every 3 years	Soil nutrient status	pH remains within +/- 0.5 pH unit of baseline pH. If soil amelioration is undertaken, pH is to remain within recommended pH range for pasture (5.2-8.0). Less than 20% increase in EC in comparison to baseline values. Less than 20% reduction in organic matter in comparison to baseline values. Less than 20% reduction in total nitrogen in comparison to baseline values. Less than 20% reduction in phosphorus in comparison to baseline values.
Creekline survey	Geomorphic survey	Along creeklines Annually	Creek stability and condition	Less than 20% increase in creek erosion (bank and bed) in comparison to control
	Cross-sections	Targeted pools Annually	Bank and bed stability	Less than 20% increase in cross-sectional area in comparison to control cross-sectional area (unless stabilisation works have been undertaken)

8.1.1 Remnant Vegetation and Fauna Habitat Monitoring

The effective management of habitat and minimisation of impacts on fauna will be monitored by the production of vegetation maps and photo monitoring points. The vegetation maps will document the extent of remnant vegetation across the Pit Top Area and Underground Longwall Area through time to illustrate that no vegetation has been cleared outside of the development footprint on a yearly basis. At the closure of the mine, the extent of remnant vegetation along the Kurrajong Creek will be at least the same as the pre mining landscape or in improved condition.

Associated with this will be the establishment and subsequent monitoring of photo monitoring points. Appropriate numbers of photo monitoring points will be established across the areas of remnant vegetation (Kurrajong Creek and vegetated subsidence areas) to demonstrate that the remnant vegetation and habitat is being managed and that impacts to fauna are being minimised. At the closure of the mine, the condition of the remnant vegetation along Kurrajong Creek and the vegetated subsidence areas are to be similar to the pre-mining landscape.

A standard photo monitoring point will include:

- Two six foot star droppers 10 m apart, the second star picket will be in a south east direction from the first star picket;
- Tag the star droppers with flagging tape and replace flagging tape on an annual basis;
- The location of the first star picket will be recorded with a GPS;
- Use a range pole as a reference point against the second star dropper, with details of the photo monitoring point marked;
- Take a digital photo of each photo monitoring point from the first star picket in a south east direction to the second star dropper, with the whole length of the range pole in view; and
- Organise the digital photos logically with each image labelled with a unique reference number indicating the location of the photo monitoring point and the date the photo is taken (i.e. "01_2009_09_08" for photo point 1 taken on the 8 September 2009).

Both the vegetation maps and photo monitoring points will be monitored on an annual basis when the mine begins operations, until mine closure is complete.

8.1.2 Topsoil Monitoring

Topsoil stockpiles will be monitored using photo monitoring points as described above in **Section 8.1.1**. Ten photo monitoring points will be established to monitor topsoil stockpiles across the Pit Top Area. At each topsoil stockpile associated with the longwall mine ventilation shafts and gas drainage sites, monitoring will be undertaken utilising the same method mentioned above, until the stockpile is used to cap and backfill. The topsoil will be considered stable after five consecutive years showing the growth of pasture grass. This information will be reported in the Annual Review.

8.1.3 Weed Control Monitoring

All areas where weed control is undertaken will be recorded using a GPS and details will be recorded on field data sheets identifying the species being controlled, the method of control, numbers of plants controlled and growth stage of the plant. This will provide a record of actions undertaken on a yearly basis which will assist in verifying the effectiveness of control treatments.

Quarterly surveys will be undertaken across the Pit Top Area and Longwall Area to survey for new infestations of weeds. Any new infestations will be subject to an appropriate weed control program.

Completion criteria for weed control will involve the demonstration that there is less than a 10% increase in weed cover in rehabilitation areas in comparison to the control sites.

8.1.4 Feral Animal Control Monitoring

The Wild Dog is the only feral animal species that currently requires control across the site. The number of baits placed, the number of baits taken, and any dead animals observed will be recorded. This will be undertaken for each baiting period as recommended by the local North-West LLS officer. This will be undertaken for the duration of the mining lease.

8.1.5 Landform Stability

Point intercept transects will be established to monitor landform stability. A number of transects will be established for monitoring purposes in each domain and each transect will be a minimum of 50 m apart. Each transect will be 100 m in length and will run in an east-west direction, roughly perpendicular to the contour. The beginning and end of each transect will be permanently marked with a star dropper.

Along each transect at every 1 m interval the following information will be recorded:

- Pasture species touching the point;
- The presence/absence of bare ground; and
- Erosion occurring at the point.

While implementing the monitoring program, if the key monitoring objectives (i.e. soil erosion, new weed species) are observed adjacent to the transect (i.e. not directly on the transect), the location will be recorded and included in the report as occurring outside of the monitoring transects.

Ten monitoring transects have been established across the pit top, however other transects will not be established until mine closure is initiated. The final landform will be considered stable when for five consecutive years >85% of pasture grasses are established, there is <15% bare ground and there are no visible signs of erosion for each domain.

A multi-scale, multi-data source monitoring approach has been developed to monitor the consequences of longwall mining on land above LW101 to LW106 (ELA 2015). A summary of the monitoring program is provided in **Table 27**. Whole-of-site monitoring includes remote sensing data (multi-spectral imaging and Lidar), while field surveys focus on agricultural and creekline areas at the local scale. Monitoring is directed into control and impact areas to allow comparison through time and space.

Subsidence monitoring cross-sections currently exist across Pine Creek and its tributaries, and Kurrajong Creek. This monitoring is undertaken annually to assess bank and bed stability, and the results will be reported in the Annual Review.

8.1.6 Revegetation

Areas where woodland revegetation has occurred will be monitored by counting the survival rate of trees that have been planted from 50% of areas planted. The number of trees planted in each area will be recorded when they are planted and the survival rate will be monitored on a 6-monthly basis for the first two years and a yearly basis after that. If the survival rate of trees falls below 50% additional plantings will be undertaken to reflect a minimum of 80% of the initial plantings of each area.

Pasture rehabilitation areas will be monitored by undertaking agricultural surveys that will incorporate annual pasture surveys that assess pasture biomass and composition, as well as three yearly soil surveys that assess soil nutrient status. Performance Criteria are listed in **Table 27**.

8.1.7 Subsidence Rehabilitation Monitoring

Both modelled and empirical studies indicate that longwall mining at the site will create a series of surface troughs on the landscape (DGS 2011).

For impact monitoring the surface zones have been classified as:

- The zone of maximum subsidence (longwall);
- The zone of maximum stress and tilt (transition) and
- The zone above the pillar with minimal subsidence (pillar).

Control zones (no impact) will also be selected from sites located outside of any predicted subsidence zone. Given the size of the target area and the multiple land uses and key environments a multi-scale, multi-data source monitoring approach has been developed. It is proposed to use remote sensing data (LiDAR, multi-spectral imaging) to monitor across the entire target area including control areas and EM38 remote sensing to survey the soil in the agricultural areas. The remotely sensed data will provide for quantitative comparison of key land surface condition parameters in agricultural, woodland and creek line environments. Repeat capture and analysis of the multi-spectral imagery will also highlight areas of changes in land cover beyond those found in control areas. Targeted field work will be implemented to examine the causes of any change highlighted.

At the local scale a program of field survey based on a stratified random and targeted design will be implemented for agricultural, woodland and creek line areas. Surveys will be directed into control areas and at each of the three impact areas (longwall, transition, and pillar) and will allow direct comparison between these areas through time and space. Quantitative methods will include statistical techniques that permit comparisons between treatment zones and through time. At this stage ANOVA (Analysis of Variance) and time series analysis are considered sufficient for these comparisons.

Reporting of all survey results and comparative analysis should take place annually in summer following the spring survey and subsequent analysis.

8.2 Research and Rehabilitation Trials and Use of Analogue Sites

8.2.1 Use of Analogue Sites

Monitoring at control sites will be undertaken during the MOP term to provide baseline data for comparison with rehabilitation sites. Baseline data will be used to quantify indicators and completion criteria and will be documented in future MOPs. Woodland control sites have been established and are known as Flora monitoring sites Plot 5 and Plot 6 (**Figure 3**) and fauna monitoring sites CC, CW and CW2 (**Figure 4**).



Figure 3 Flora Monitoring Plots (EcoLogical, 2016)

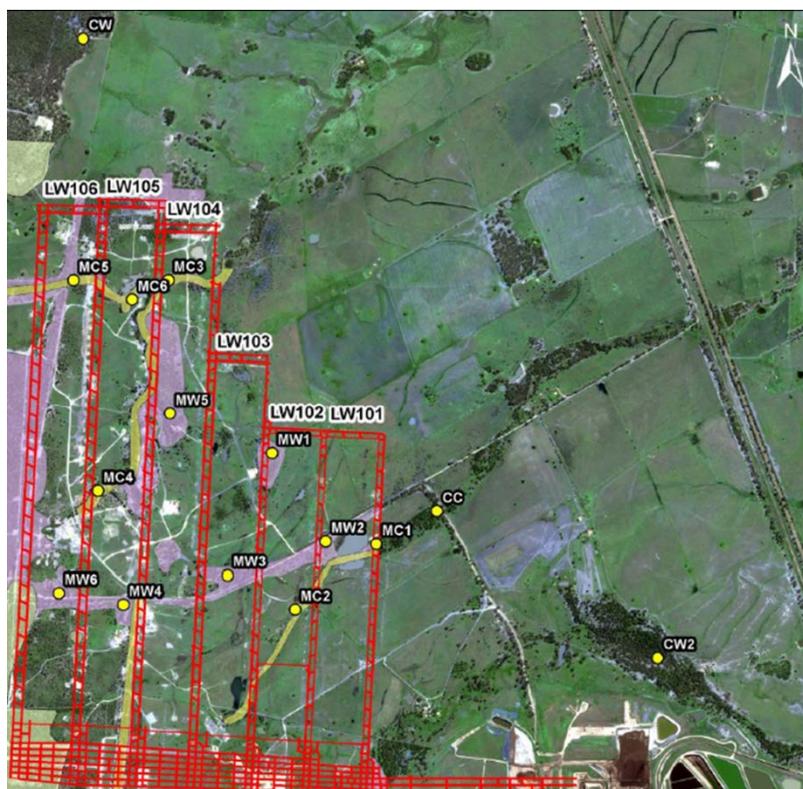


Figure 4 Fauna Monitoring Plots (EcoLogical, 2016)

NCOPL uses remote sensing (LiDAR, multi-spectral imaging and EM38) to monitor the rehabilitation areas against control areas. The remotely sensed data will provide for quantitative comparison of key land surface condition parameters in agricultural and creek line environments. Repeat capture and analysis of the multi-spectral imagery will also highlight areas of changes in land cover beyond those found in control areas. Targeted field work will be implemented to examine the causes of any change highlighted.

Woodland control sites have been selected from control zones (zones of no impact located outside of any predicted subsidence zone) with similar characteristics and biological condition that lie beyond the predicted impact zone. A program of field surveys based on a stratified random and targeted design will be implemented for agricultural and creek line areas. Surveys will be directed into control and impact areas and will allow direct comparison between these areas through time and space.

Monitoring at the pasture control sites will be used to develop baseline data for pasture species densities and diversity, total biomass per hectare and agricultural soil physical-chemical data at representative productive pastoral control sites. Similarly, surveys in the woodland/forest analogue sites will be undertaken to build baseline data for soil profiles, vegetation features and presence of fauna and habitat features.

8.2.2 Research and Rehabilitation Trials

Continuous Improvement

Narrabri Mine adopts a continuous improvement approach to rehabilitation. Results from rehabilitation monitoring surveys and opportunistic monitoring observations are used to refine rehabilitation methodologies on an on-going basis.

Future Research

No additional research is proposed for rehabilitation during the term of this MOP. Should suitable research/trial opportunities be identified they will be investigated and implemented.

9 INTERVENTION AND ADAPTIVE MANAGEMENT

Where rehabilitation monitoring indicates that rehabilitation outcomes are not trending toward the nominated completion criteria NCOPL will instigate early intervention and adaptive management to minimise the potential for rehabilitation failure. Identification of threats to rehabilitation and the subsequent intervention is discussed in the sections below.

9.1 Threats to Rehabilitation

Unpredictable events such as bushfires, droughts and floods may present risks to rehabilitation both during the life of mine and post closure. These events generally have significant consequences for rehabilitation quality and are likely to require adaptive management in order to mitigate risks and achieve relinquishment of affected rehabilitation areas within a satisfactory timeframe.

Although these events may have a high degree of unpredictability, monitoring the status of contributing factors enables an assessment of the likelihood of a major impact to rehabilitation occurring. For example, measuring fuel loads in and adjacent to woodland rehabilitation areas informs a periodic assessment of the likelihood of a bushfire event.

Other major risks to rehabilitation may not present as sudden events, but as an increasing impact over an extended period of time. For example evolution of regulator or community expectations regarding post mining land-uses may present a risk to achieving relinquishment, or increasing feral pest numbers may increase pressure on native fauna and vegetation communities.

Key threats to rehabilitation were identified in the Risk to Rehabilitation Broad Brush Risk Assessment (**Appendix C**) and are listed in **Table 28** below.

Table 28 Key Threats to Rehabilitation

Threat	Caused By
Spontaneous Combustion	Spontaneous combustion in REA impedes rehabilitation due to poor management of materials with propensity for spontaneous combustion. Less than adequate caveats on land management requirements post closure (in the REA specifically). NCOPL plans to review spontaneous combustion management effectiveness during the MOP term once a portion of the REA has been completed to specifications. Where spontaneous combustion potential exists, a revised approach to capping will be developed.
Soil Type(s) and Suitability	Poor topsoil quality due to time required to stockpile soil, weed infested topsoil, poor management, site conditions Inadequate volume of topsoil to achieve the rehabilitation outcome prescribed in the MOP due to limited additional stripping opportunities due to full disturbance footprint, and/or poor recovery of topsoil in dehab areas (visual bund). Unsuitable soil characteristics (grading, sodicity, ESP etc) for cover construction and/or pasture land development.
Erosional Stability of Final Capping Layer (REA)	Soil characteristics regardless of direct amelioration techniques.
Seepage from REA Landform	Infiltration of stormwater through capping layer formed across landform; and/or saline or metalliferous drainage potential from coarse reject through contact with stormwater infiltrating through capping surface.
Flora and Fauna	Loss of, or alteration to existing habitats due to subsidence, erosion, weed and/or pests. Adverse impact on threatened species due to failure to manage pests and/or subsidence. Failure to establish revegetation density and diversity.
Drought	Failure of rehabilitation sites due to drought.

Threat	Caused By
Mine Subsidence	Failure to achieve the rehabilitation outcome prescribed in the MOP and or alteration of local drainage due to mine subsidence.
Contaminated Land	Contaminated land occurring on the site at closure due to fuel use at the site and/or spills, leaks etc.
Greenhouse Gas	Ongoing greenhouse gas emissions post-closure due to less than adequate sealing of bores/mine entries/ventilation system.
Agricultural Resources	Loss of agricultural resources (Class III land) due to mining disturbance, possible soil contamination, erosion and sedimentation, and/or less than adequate rehabilitation.
Surface Water	Discharge of saline or contaminated water due to leaking/spilt hydrocarbon and/or leachate from the REA.
Final Land Use	Landform batter slopes are too steep for livestock access.
Closure Performance	Poor design, poor material selection and treatment and/or poor construction and vegetation.
Closure Costs	Available cover materials are not adequate to cover the final landform.

Where rehabilitation monitoring indicates that there is a significant threat to rehabilitation, NCOPL will undertake adaptive management in accordance with the Rehabilitation Trigger Action Response Plan (TARP) described in **Section 9.2**.

9.2 Trigger Action Response Plan

The following TARP for rehabilitation has been developed to identify required management actions in the event of impacts to rehabilitation, or where rehabilitation outcomes are not achieved in an acceptable timeframe. Where necessary, rehabilitation procedures will be amended accordingly with the aim of continually improving rehabilitation standards. NCOPL will notify the DRG and other relevant stakeholders of any incident resulting in major impacts to rehabilitation.

The responses specified within the TARP have been based upon the rehabilitation completion criteria developed during the preparation of the MOP and the current rehabilitation monitoring program. Monitoring of the TARP will be undertaken as outlined in the rehabilitation monitoring program (refer to **Section 8.1**). The rehabilitation monitoring program will trigger response actions, as specified in the TARP to ensure that threats to rehabilitation do not become unmanageable.

The TARP is provided as **Table 29**, and will be reviewed and may be revised as conditions at NCOPL change or new threats to rehabilitation are identified.

9.2.1 First Tier Triggers

First tier triggers are intended to detect early indications that rehabilitation is not trending toward desired completion criteria. As described in **Section 8.1.3** NCOPL is trialling use of remote sensing techniques to establish and monitor first tier triggers to identify:

- Deteriorating vegetation health in rehabilitation and offset areas;
- Variability in total biomass and vegetation density in each strata of vegetation communities; and
- Changes in soil properties without disturbance.

A statistical variation in monitoring results, or a statistically significant overall decline in vegetation health, will trigger further on-ground assessments to confirm any adverse impacts, and early intervention management responses.

Remote sensing monitoring enhances early intervention since instances where rehabilitation indicators are trending toward trigger values can be identified from desktop assessments independent of scheduled on-ground monitoring campaigns. Additionally, adjacent vegetation health can be assessed using remote sensing without requiring access arrangements or disturbance, and can assist to identify external risks to rehabilitation.

9.2.2 Second Tier Triggers

Quantitative and qualitative trigger values for key indicators have also been developed and documented for the site. Trigger values have been developed based on monitoring program outcomes, including rehabilitation areas, biodiversity offset areas and selected analogue sites.

These are monitored annually and the results reported in the Annual Review.

Table 29 Trigger Action Response Plan

Aspect/ Category	Key Element	Element Number	Trigger Response	1 st Level Trigger	2 nd Level Trigger
Spontaneous Combustion	Evidence of Spontaneous Combustion in REA	1	Trigger	Isolated incidence of heating in REA	Multiple incidences of ignition in REA
			Response	Investigate sources of potential ignition. Excavate material with propensity for spon com in proximity to rehabilitated surface. Review reject emplacement practices.	Consult with regulators to develop remediation plan to mitigate spontaneous combustion such as increased capping depth. Review spontaneous combustion management and reject emplacement practices.
Soil Type(s) and Suitability Quality	Salinity	2	Trigger	Increasing trend in soil/water salinity levels	Presence of salt scalds
			Response	Undertake soil testing to verify EC and recommend further soil amelioration	Engage a specialist consultant to develop a site specific management report to be implemented to remediate salinity scalds. Undertake works as required.
	Soil biophysical and chemical characteristics	3	Trigger	Soil nitrogen, potassium and phosphorous levels are not in the range of analogue sites by Year 5	Soil physical, chemical and biological characteristics are not able to sustain the desired final land use.
			Response	Engage a consultant to recommend appropriate soil amelioration. Undertake amelioration and re-vegetation in accordance with the consultant recommendations.	Engage a consultant to recommend appropriate soil amelioration. Undertake amelioration and re-vegetation in accordance with the consultant recommendations.
Topsoil Depth		4	Trigger	Topsoil is not reinstated to, at least, the minimum depth specified for the proposed final land use.	Sufficient suitable topsoil cannot be identified for reinstatement at the minimum specified depth for the proposed final land use
			Response	Top dress with additional suitable topsoil resource. If additional suitable material is not immediately available stabilise the area with cover crop until additional suitable topsoil is sourced and re-emplaced.	Undertake a review of the topsoil balance to confirm sufficient material to meet minimum depth requirements. Investigate suitable topsoil resource substitutes and introduce if required.

Aspect/ Category	Key Element	Element Number	Trigger Response	1 st Level Trigger	2 nd Level Trigger
Erosional Stability of Final Capping Layer (REA)	Slope gradient in REA	5	Trigger	<70% of the rehabilitated REA has slopes within the limits stipulated in the MOP.	<55% of the rehabilitation area has slopes within the limits stipulated in the MOP.
			Response	Undertake re-grading and revegetation of the REA.	Undertake a review of the landform design, including survey if required. Undertake re-grading and revegetation of the area.
	Erosion control	6	Trigger	Minor gully or tunnel erosion present and/or minor rilling (rilling up to 200 mm in depth or width).	Slumping and/or significant gully or tunnel erosion present and/or significant rilling (>200mm), which is compromising landform.
			Response	An inspection of the site will be undertaken by a suitably trained person. Investigate opportunities to install water management infrastructure to address erosion. Remediate as appropriate.	Engage a consultant to assist with the management of erosion and sedimentation at the site and provide recommendations to appropriately remediate the erosion. Remediate as soon as practicable.
	Free Draining Landforms	7	Trigger	Landforms exhibiting ponding in excess of design	Landforms exhibiting significant drainage issues, threatening or causing material harm to the environment.
			Response	An inspection of the site will be undertaken by a suitably trained person. Investigate opportunities to address issues. Remediate as appropriate.	Undertake a review of the landform design, including survey if required. Undertake re-grading and re-vegetation of the area.
Water management Structures	8	Trigger	Water management structures (sediment dams, channels, contour banks) minor erosion and/or scouring as determined by monitoring.	Water management structures fail or display significant scouring / erosion as determined by monitoring.	
		Response	An inspection of the site will be undertaken by a suitably trained person. Identify remedial actions such as amelioration, re-vegetation or alternative scour protection	Engage specialist consultant to develop a site specific remediation plan and review water management structure design criteria. Provide for physical works on the basis of design review.	
Seepage from REA Landform	Seepage from REA Landform	9	Trigger	Isolated incidence of seepage from REA	Landform exhibiting seepage issues, threatening or causing material harm to the environment.

Aspect/ Category	Key Element	Element Number	Trigger Response	1 st Level Trigger	2 nd Level Trigger
			Response	An inspection of the site will be undertaken by a suitably trained person. Investigate opportunities to address issues. Remediate as appropriate.	An inspection of the site will be undertaken by a suitably trained person. Identify remedial actions. Consult with regulators to remediate REA.
Flora and Fauna	Ground cover percent	10	Trigger	Minimum of 60% ground cover is not present within six months of seeding initial pasture mix.	Vegetative cover is 50% or less at year 1.
			Response	Undertake a field survey to identify likely causes of unsatisfactory germination rates. Re-seed areas with unsatisfactory cover. Review seeding procedures incl. seasonal mixes, timing and seed rate per hectare.	Engage a suitably qualified specialist to investigate causes for germination failure and recommend remedial actions. Implement appropriate management actions including revising rehabilitation procedures if required.
	Noxious weed Presence	11	Trigger	Six months following seeding, species composition comprises <75% desired species mix.	Six months following revegetation, species composition comprises <50% desired species mix.
			Response	Engage weed management contractor to remove / spray introduced weed species.	Engage weed management contractor to remove introduced weed species. Investigate management measures to improve native plant establishment and weed suppression including additional soil amelioration, establishment and retention of cover crops until weed presence is at acceptable levels. Implement recommendations as appropriate.
	Vegetation Health	12	Trigger	Vegetation health index not in the range of analogue sites.	Long term declining trend in vegetation health index.
			Response	Engage ecologist to undertake preliminary investigations.	Engage ecologist to undertake investigation to determine the cause of change. Prepare a site specific management plan and implement recommendation actions.

Aspect/ Category	Key Element	Element Number	Trigger Response	1 st Level Trigger	2 nd Level Trigger
	Tree Death	13	Trigger	Tree heath observed to be deteriorating above recently subsided area.	Tree deaths observed above recently subsided area.
			Response	Engage ecologist to undertake preliminary investigations.	Engage ecologist to undertake investigation to determine the cause of change. Engage subsidence engineer to review predictions. Prepare a site specific management plan and implement recommendation actions.
	Pest animal species presence	14	Trigger	Pest animal species presence and density increased in annual monitoring events.	Significant numbers of pest animals causing widespread damage to rehabilitation.
			Response	Consult with North-West LLS to recommend and implement appropriate pest animal control campaign.	Consult with North-West LLS to recommend and implement appropriate pest animal control campaign. Engage a suitably qualified specialist to prepare a site management plan and implement recommendations such as augmenting pest animal exclusion fencing and re-vegetation.
	Native Fauna Presence	15	Trigger	Loss or deterioration of rehabilitation sites.	Decline in trend in recorded fauna numbers and/or presence and abundance (allow for natural variation occurring in analogue sites).
			Response	Undertake remediation works to increase rehabilitation quality.	Engage ecologist to undertake investigation to determine the cause of change. A site specific management report to be prepared and implemented where necessary that aligns with the RMP.
Drought	Drought affecting rehabilitation areas	16	Trigger	Drought results in vegetation health index not in the range of analogue sites during inspections.	Inspections identify long term declining trend in vegetation health index due to drought.

Aspect/ Category	Key Element	Element Number	Trigger Response	1 st Level Trigger	2 nd Level Trigger
			Response	Engage ecologist to undertake preliminary investigations. Prepare a site specific management plan and implement recommendation actions.	Engage ecologist to undertake investigation to determine the cause of change and recommend actions. Prepare a site specific management plan and implement recommendation actions in consultation with regulators.
Mine Subsidence	Mine Subsidence in rehabilitation areas	17	Trigger	Vegetation health index for subsidence rehabilitation areas not in the range of analogue sites, and/or survey data shows that subsidence has reached upper limit of EIA predictions (but not exceeded).	Subsidence exceeds EIA predictions and/or inspections identify long term declining trend in vegetation health index in subsidence areas.
			Response	Engage ecologist to undertake preliminary investigations. Engage subsidence engineer to review predictions. Prepare a site specific management plan and implement recommendation actions.	Engage subsidence engineer to review model and ecologist to undertake investigation to determine the cause of change. Prepare a site specific management plan and implement recommendation actions.
Contaminated Land	Contaminated Land	18	Trigger	Water/soil monitoring results identify presence of hydrocarbons that exceed baseline levels	Rehabilitation inspections and/or monitoring results identify a hydrocarbon contamination that exceeds EPL criteria or presents a risk of material harm to the environment
			Response	Engage specialist to undertake preliminary investigations. Implement remediation strategy.	Engage specialist to undertake investigation to determine the cause of the incident. Report incident as per PIRMP. Prepare a site specific management plan and implement recommendation actions.
Greenhouse Gas	Greenhouse Gas	19	Trigger	Inspections identify that former ventilation shafts/boreholes/mine entries have not been sealed in accordance with required standards.	N/A

Aspect/ Category	Key Element	Element Number	Trigger Response	1 st Level Trigger	2 nd Level Trigger
			Response	Engage specialist to undertake investigations and develop sealing strategy. Implement actions in consultation with regulators.	N/A
Agricultural Resources	Loss of agricultural Resources	20	Trigger	Vegetation health index not in the range of analogue agricultural sites.	Long term declining trend in vegetation health index in agricultural land.
			Response	Engage ecologist/agronomist to undertake preliminary investigations. Implement remedial actions.	Engage ecologist/agronomist to undertake investigation to determine the cause of change. Prepare a site specific management plan and implement recommendation actions.
Surface Water	Water quality in Pine Creek and Kurrajong Creek	21	Trigger	Water quality exceeds baseline values	Long term upward/downward trend outside ANZECC quality guideline limits values
			Response	Review and investigation of water quality monitoring and management where appropriate. Implement relevant remedial measures where required.	Hydrologist (or similar specialist) to review sampling and climate data and review likely cause(s). If mine related, undertake assessment to identify sources of water quality degradation and recommend remedial actions Implement specialist recommendations
	Discharge water quality at licenced discharge points	22	Trigger	Sediment basin discharge exceeds EPL criteria for pH, TSS and/or oil/grease	Long term upward/downward trend outside ANZECC quality guideline limits
			Response	Re-sampling will be undertaken during the next discharge event to confirm results exceed limits, and investigate potential causes.	Review sediment basin maintenance and discharge procedures, and sediment basin capacity requirements. Undertake required corrective actions.
Final Land Use	Steepness of landform batter slopes	23	Trigger	Ongoing surveys of REA during construction identifies that slopes are not being constructed to design specifications	Rehabilitation monitoring identifies failures/deficiencies in final landform design that require external reporting
			Response	Re-profile areas of REA to ensure final landform is meeting design criteria.	Engage specialist to undertake investigation and implement recommended remedial actions in consultation with regulators

Aspect/ Category	Key Element	Element Number	Trigger Response	1 st Level Trigger	2 nd Level Trigger
Closure Performance	Poor closure design	24	Trigger	Rehabilitation monitoring identifies failures/deficiencies in final landform design	Rehabilitation monitoring identifies failures/deficiencies in final landform design that require external reporting
			Response	Engage specialist to undertake investigation and implement recommended remedial actions (refer to specific section of this TARP).	Engage specialist to undertake investigation and implement recommended remedial actions (refer to specific section of this TARP) in consultation with regulators.
Closure Costs	Insufficient cover material	25	Trigger	Annual update of the material balance identifies minor shortfall for closure (<10%)	Annual update of material balance identifies major shortfall for closure (>10%)
			Response	Identify alternative options for obtaining cover material.	Identify alternative options for obtaining cover material and or modifying capping depth in consultation with regulators.

10 REPORTING

Results of rehabilitation monitoring will be reported in the Annual Review. The Annual Review will record monitoring results and discuss rehabilitation performance against key performance measures/indicators, as well as report compliance with regulatory requirements and NCOPL commitments. The Annual Review will also discuss identified trends and instances where potential rehabilitation failure has been identified triggering intervention in accordance with a Rehabilitation TARP (**Section 9.2**).

The Annual Review will be submitted to relevant government agencies and made publically available via the Whitehaven Coal website (www.whitehavencoal.com.au).

11 PLANS

The MOP Plans have been provided as **Appendix D**.

12 REVIEW AND IMPLEMENTATION OF THE MOP

12.1 Review of the MOP

The MOP may be revised in the event of the following:

- Project Approval modification or mining title changes;
- Deficiencies being identified;
- Changes to environmental requirements due to (for example) changed legislation or regulatory requirements;
- Changes in the activities described in this MOP; and
- Where risk assessment identifies the requirement to alter the MOP.

Any major amendments to the MOP that affect its application will be undertaken in consultation with the appropriate regulatory authorities and stakeholders. Any amendments would be completed in accordance with the latest MOP guidelines.

12.2 Implementation

WCL personnel are responsible for monitoring, review and implementation of this MOP, as listed in **Table 30**.

Table 30 Responsibilities for MOP Implementation

Position	Responsibility
General Manager	Overall site-based responsibility for all activities and all personnel at the mine-site, including their compliance with all applicable laws, regulations, licences, approvals, the conditions of consent and achievement of the desired environmental outcomes.
Technical Services Manager	Ensuring all operations are undertaken in accordance with relevant environmental legislation; Providing the final sign-off and/or authorising distribution of, all environmental reports / management plans etc.; and Communication with statutory authorities and the community.
Technical Services Superintendent	Assist with the implementation, monitoring and review of programs and procedures associated with this plan.
Environmental Superintendent	Assist and advise management with the requirements of the relevant environmental laws and regulations, consents, licences, approvals and environmental management systems and plans; Assist with the implementation, monitoring and review of programs and procedures associated with this plan; Consult with regulatory authorities as required; Undertake site based actions to implement this plan in cooperation with the Technical Services Manager/Superintendent; and Report the progress of rehabilitation and biodiversity monitoring in the Annual Review.

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SCHEDULE OF LANDS

Appendix A – Schedule of Lands

Lot	Deposited Plan	Owner
7	DP757104	Freehold - NCO Owned
67	DP757104	Freehold - NCO Owned
1	DP811171	Freehold - NCO Owned
2	DP811171	Freehold - NCO Owned
63	DP757114	Freehold - NCO Owned
1	DP254523	Freehold - NCO Owned
1	DP659899	Freehold - NCO Owned
64	DP757114	Freehold - NCO Owned
25	DP757104	Freehold - NCO Owned
2	DP1124652	Freehold - NCO Owned
842	DP1134385	Freehold - NCO Owned
3	DP757104	Freehold - NCO Owned
10	DP757104	Freehold - NCO Owned
60	DP757124	Freehold - NCO Owned
3	DP1005608	Freehold - NCO Owned
61	DP757124	Freehold - NCO Owned
115	DP757124	Freehold - NCO Owned
83	DP757124	Freehold - NCO Owned
382	DP1028753	Freehold - NCO Owned
381	DP1028753	Freehold - NCO Owned
152	DP816020	Freehold - NCO Owned
841	DP1134385	Freehold - NCO Owned
8	DP757104	Freehold - NCO Owned
151	DP816020	Freehold - NCO Owned
65	DP757114	Freehold - NCO Owned
68	DP757104	Freehold - Privately Owned
57	DP757114	Freehold - Privately Owned
1	DP798487	Freehold - Privately Owned
81	DP757124	Freehold - Privately Owned
1	DP1124652	Freehold - Privately Owned
58	DP757114	NSW Government - State Forest
-	-	Various Crown Land (road reserves)

Appendix B – O'KANE REPORT RECOMMENDATIONS

Recommendation	NCOPL Comment	Timeframe
<p>Sampling and Testing of Rejects Materials</p> <p>Based on the limited number of samples initially tested for the design of the REA, it is recommended that further sampling be conducted of the material currently in place, and of future rejects material to ensure that the design and modelling assumptions are consistent with the operations.</p> <p>1) Review and assessment of the available coarse reject material geotechnical and geochemical properties since material deposition started at the REA;</p>	Will complete during the MOP term	12 months
<p>2) Completion of a sampling campaign to ensure a representative cross-section of the material within the REA, including;</p> <p>a. Geotechnical laboratory testing of collected samples to determine material specific geotechnical parameters required for the stability analysis;</p>	Will complete during the MOP term	12 months
<p>b. Geochemical laboratory testing</p> <p>i. Routine ABA testing of rejects material should be implemented to provide a more representative ABA database. It is unclear whether the current 21 sample database is representative of the REA material, furthermore some data appeared erroneous with sulfide sulfur data being higher than total sulfur data (sample 7A);</p>	Will complete during the MOP term	12 months
<p>ii. An additional ABA sampling programme should be undertaken in alignment with the MENb (1997) guidelines or similar with -60 more samples being analysed from across the REA;</p>		
<p>iii. The geochemical risks posed by non-rejects material disposed in the REA should be quantified.</p>		
<p>c. Spontaneous Combustion</p> <p>i. Given that spontaneous combustion related issues have already been observed in the REA and no testing has been undertaken in regards to spontaneous combustion propensity it is recommended further work be undertaken to quantify such risks.</p>	Will complete during the MOP term	12 months
<p>ii. Particular focus should be given to areas in the REA with higher fines/carbonaceous materials .</p>		
<p>iii. Confirmation that the proposed cover system is suitable and that no reject material will be exposed in the longer term by erosion is needed.</p>		
<p>Comprehensive Water Quality Monitoring Programme for the REA</p> <p>A comprehensive water quality monitoring programme specific to the REA should be developed from a geochemical risk management perspective to ensure ongoing environmental risk management. This monitoring programme should :</p> <p>1) Review and assess water quality data for drainage from the REA, both for surface runoff and toe seepage, provided segregation of the two streams is possible;</p>	Will complete during the MOP term	Water quality reviewed annually by a hydrogeologist and reported in the Annual Review

O'KANE REPORT RECOMMENDATIONS

Recommendation	NCOPL Comment	Timeframe
a.The potential for neutral mine drainage (metalliferous I saline drainage) should be considered in greater detail particularly considering As and Se elemental abundance is elevated compared to average crustal abundance ;		
2) Determine the flow rates for the different water balance streams from the REA, and the associated water quality, including contaminant loads and potential effects on the environment;	Will complete during the MOP term	2 years
3) Determine the expected trends in water quality from the REA to the receiving environment, during operations and post closure once the cover system has been completed; a.Forecasts should be provided on what the long term water quality will be and whether this is acceptable to stakeholders . High EC values have been determined at SB3 .	Will complete during the MOP term	2 years
4) Combine long-term water quality with flow rates to understand any potential effect I impacts on the environment, including any issues associated with evaporation I salinity;	Will complete during the MOP term	2 years
5) Account for relevant climate change scenarios for the area; and	Will complete during the MOP term	2 years
6) Be reviewed by an independent professional proficient in environmental geochemistry.	Will complete during the MOP term	Water quality reviewed annually by a hydrogeologist and reported in the Annual Review
Current Construction Methodology		
1) Recommended that guidelines are developed for development and construction of the basal liner with respect to: a. the clay materials to be utilised, with specific detail on their required geotechnical parameters and material properties;	Will complete during the MOP term	12 months
b.placement methods required for the clay in order to achieve the required parameters for the low permeability unit; and		
c.QAIQC procedures to provide a check for the low permeability unit and ensure that it meets the construction requirements proposed.		
Closure Cover System and Landform Design for the REA		
A review of the proposed rehabilitation for the REA was performed as part of this scope. In order to ensure the long-term stability of the REA, OKC recommends that further comprehensive closure cover system and landform design specific to the REA be developed. Depending on the results from the geochemical assessment of the rejects material found in the REA, and on the comprehensive water quality monitoring program, some of the recommendations below may not be required should the initial assessment show future seepage from the REA to have acceptable impact on the surrounding environment. The development of such a design should include: 1) Development of site specific closure design objectives and closure performance criteria for the cover system and	Will complete during the MOP term	12 months

O'KANE REPORT RECOMMENDATIONS

Recommendation	NCOPL Comment	Timeframe
landform design;		
2) Geotechnical analysis of the proposed inert I benign waste rock and growth medium materials for construction of the cap to ensure suitability;	Will complete during the MOP term	12 months
3) Geochemical analysis of the proposed inert I benign waste rock and growth medium materials for construction of the cap to ensure suitability;	Will complete during the MOP term	12 months
4) Erosion modelling using material specific parameters under proposed embankment conditions in order to determine likely erosion depth on the embankment; a. Development of site specific erosion protection features should erosion modelling determine these to be required to ensure long term stability of the facility;	Will complete during the MOP term	12 months
5) Development of a SPA model of the proposed cover system to determine net percolation and oxygen diffusion into the waste mass under closure conditions. This model should: a. use site-specific material properties and climate data; b. take into account relevant climate change scenarios for the area; and c. determine if the intended closure cover system will meet the proposed closure design objectives;	Will complete during the MOP term	12 months
6) Development of a contaminant loading model using results from the geochemical analysis of rejects material, and expected water and oxygen fluxes through the waste mass developed as part of the SPA modelling;	Will complete during the MOP term	12 months
7) Development of a closure surface water management system that; a. incorporates channel size, storm design criteria and erosion I scour prevention/protection features, both for the plateau and embankments; b. incorporates relevant climate change scenarios for the area; and c. is reviewed by an independent hydrologist.	Will complete during the MOP term	12 months

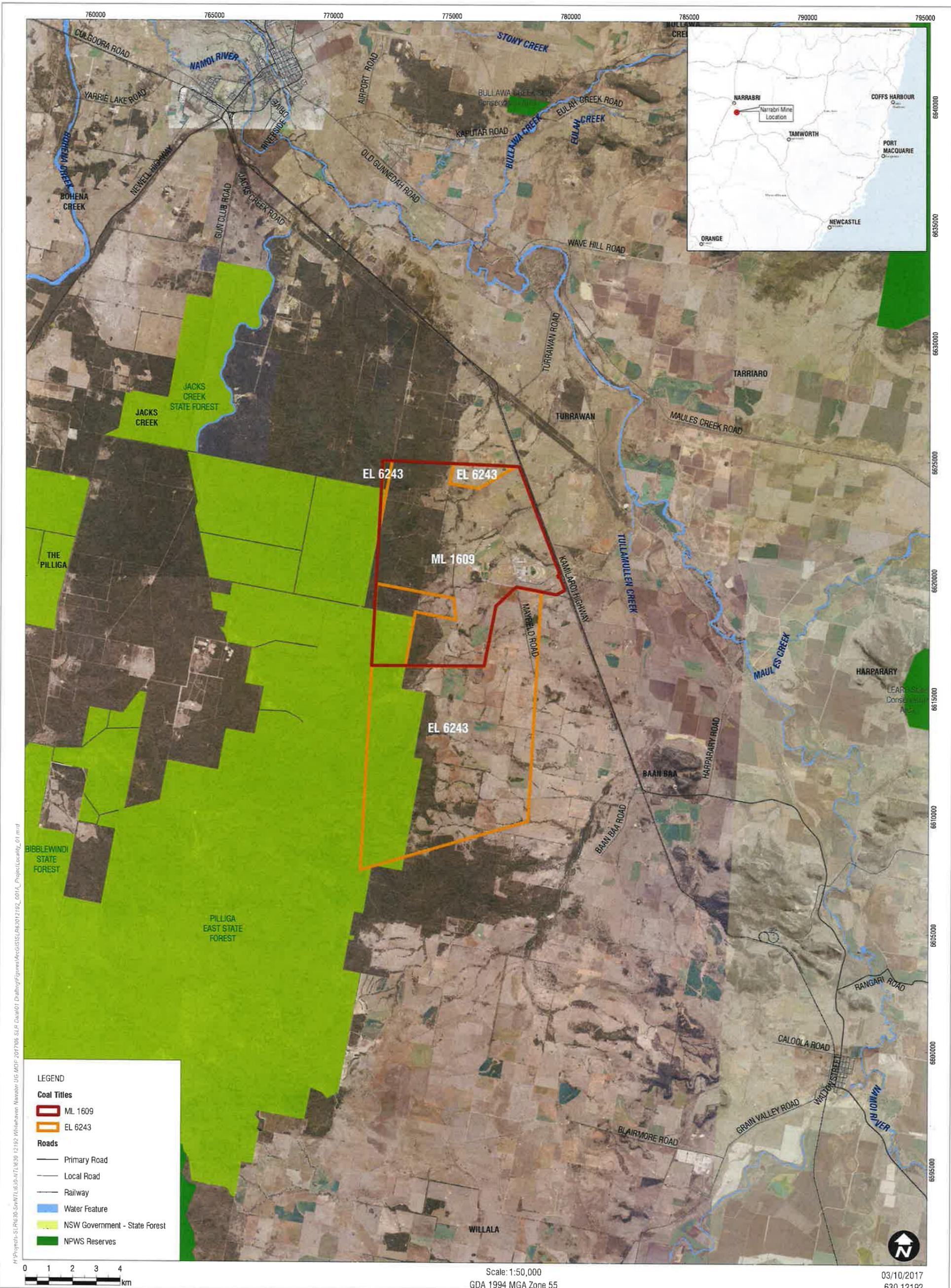
Appendix C - Risks To Rehabilitation Broad Brush Risk Assessment

NARRABRI RISKS TO REHAB - MOP

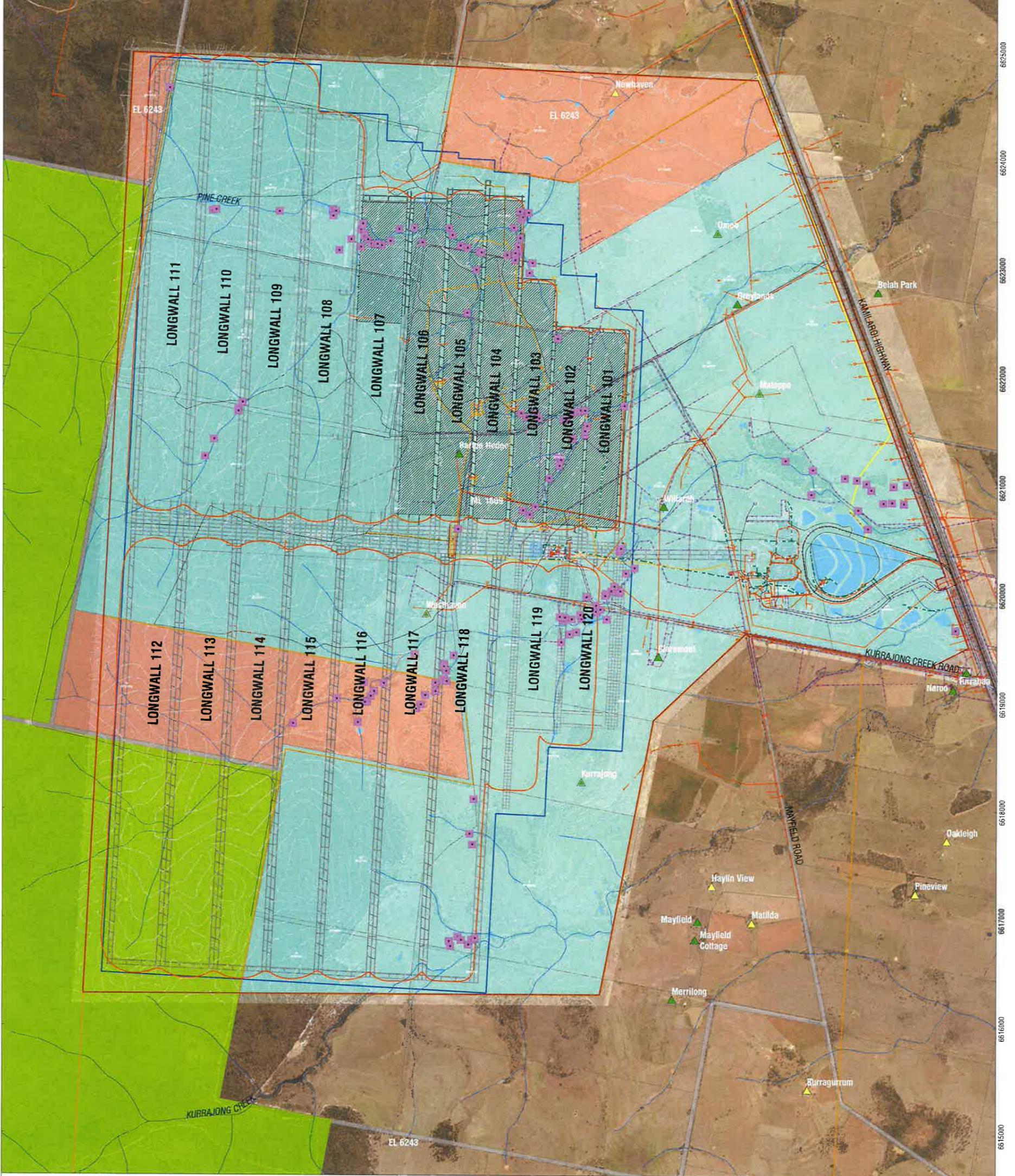
RISK ID	KEY ELEMENT	RISK/OPPORTUNITY EVENT	LIKELY CAUSE	POTENTIAL CONSEQUENCE/IMPACT	EXISTING PREVENTATIVE AND/OR MITIGATIVE CONTROLS	ADEQUACY OF EXISTING CONTROLS	RISK OPPORTUNITY (RISK)	CONSEQUENCE CATEGORY	CONSEQUENCE LEVEL (1 TO 5)	POTENTIAL MAXIMUM CONSEQUENCE LEVEL (A TO E)	RISK RANK (1 TO 25)	CURRENT RISK RATING (LOW, MEDIUM)	ADDITIONAL CONTROLS	RISK OWNER/ RESPONSIBLE MANAGER	DUE DATE	
1	Erosion and Sediment Control	Erosion and sediment on disturbed areas. Uncontrolled discharge offsite of sediment laden water.	Failure to undertake progressive rehab during operations. Failure of areas already rehabilitated. Less than adequate (LTA) water management system and/or design. LTA caveats on land management requirements post closure (REA).	Impact on rehabilitation. Pollution event offsite. Decrease in water quality.	1. Water Management Plan (inc ESCP) 2. Visual observations. 3. Water quality monitoring 4. LDP monitoring.	Requires Improvement	Risk	Environment	2	2	D	5	Low	Consider specific areas of the post mining landform that may require additional land management requirements attached to land tenure	Steve Farrar	Aug-2020
2	Spontaneous Combustion	Spon-com in reject emplacement area impedes rehabilitation	Poor management of materials with propensity for spon-com. LTA caveats on land management requirements post closure (REA)	Inability to complete rehab. Impact on established rehab. Cost of managing spon-com outbreak. Potential risk of bushfire. Air quality/odour impacts and inability to relinquish lease.	1. Spon Com TARP 2. Stockpile Management Plan. 3. REA design specs.	Requires Improvement	Risk	Environment	3	3	E	6	Moderate	1. Review spon com management effectiveness once a portion of the REA has been completed to specifications. 2. Where spon com potential exists, a revised approach to capping will be developed, as the current capping approach assumes no spontaneous combustion issues exist.	1. Chris Bedggood 2. Steve Farrar	Dec-2016
3	Geology and Geochemistry	Failure to achieve the rehabilitation outcome prescribed in the MOP	LTA knowledge of material and its geochemistry Inappropriate placement of materials	Inability to reach closure and relinquishment of the lease.	1. Testing of material in REA	Requires Improvement	Risk	Environment	2	2	D	5	Low	Review requirement for additional sampling during operations.	Steve Farrar	Dec-2016
4	Geotechnical	Geotechnical stability of final landform LTA	LTA rehabilitation and/or design	Inability to reach closure and relinquishment of the lease. Additional costs for rework. Safety concerns.	1. Slope Stability Management Plan.	Satisfactory	Risk	Environment	2	2	D	5	Low			
5	Soil Type(s) and Suitability	Poor topsoil quality	Time required to stockpile soil, weed infested topsoil, poor management, site conditions	Inability to reach closure and relinquishment of the lease. Cost of sourcing ameliorants and alternates	1. Rehab Management plan. 2. Weed management activities.	Satisfactory	Risk	Financial Impact	3	3	E	6	Moderate			
6	Soil Type(s) and Suitability	Inadequate volume of topsoil to achieve the rehabilitation outcome prescribed in the MOP	Limited additional stripping opportunities due to full disturbance footprint. Poor recovery of topsoil in dehab areas (visual bund)	Inability to reach closure and relinquishment of the lease. Cost of sourcing ameliorants and alternates.	1. Topsoil balance in AEMR 2. Topsoil stockpiles surveyed and shown on a plan.	Satisfactory	Risk	Financial Impact	3	3	E	6	Moderate			
7	Soil Type(s) and Suitability	Dispersive soils/ topsoil material	Unsuitable soil characteristics (grading, sodicity, ESP etc) for cover construction and/or pasture land development.	Erosion of soil/topsoil placed as cover, with potential for exposure of coarse reject	1. Selective sourcing of suitable materials, or application of appropriate soil ameliorative techniques (e.g. use of lime, gypsum, etc).	Satisfactory	Risk	Financial Impact	3	3	E	6	Moderate			
8	Erosional Stability of Final Capping Layer	Available soils erosionally unstable on final landform.	Soil characteristics regardless of direct amelioration techniques.	Erosion of capping layer with potential exposure of coarse reject.	1. Enhance erosional stability of soil by adding rocky component (10 to 20% rocks between 50 and 150mm size).	Satisfactory	Risk	Financial Impact	3	3	E	6	Moderate			
9	Seepage from REA Landform	Saturation around landform toe.	Infiltration of stormwater through capping layer formed across landform. Saline or metalliferous drainage potential from coarse reject through contact with stormwater infiltrating through capping surface.	Local instability of capping layer around toe. Impact on receiving environment through impacted seepage water quality	1. Landform design.	Requires Improvement	Risk	Financial Impact	3	3	E	6	Moderate	1. Provision for controlled seepage discharge 2. Testing and water balance analysis to confirm that seepage water quality from coarse reject will be acceptable for discharge.	Steve Farrar	Dec-16
10	Flora and Fauna	Loss of, or alteration to existing habitats	Subsidence, erosion, weed and pests	Inability to reach closure and relinquish lease. Impacts to habitat.	1. Excavation & Penetration permit 2. Disturbance permit 3. Land management plan (extraction plan) 4. Landscape management plan 5. Biodiversity management Plan	Satisfactory	Risk	Financial Impact	3	3	D	9	Moderate			
11	Flora and Fauna	Adverse impact on threatened species	Failure to manage pests, subsidence	Inability to reach closure and relinquish lease. Impacts to local populations	1. Excavation & Penetration permit 2. Disturbance permit 3. Land management plan (extraction plan) 4. Landscape management plan 5. Biodiversity management Plan 6. Subsidence Management Plan (EP)	Satisfactory	Risk	Environment	3	3	E	6	Moderate			
12	Bushfire	Damage to rehab	Bushfire from external (not owned by WHM) Bushfire from spon com/land owned by WHM, LTA fuel management, fire caused by site activities/equipment failure	Loss of established rehabilitation Additional costs for rework of rehab Exposed areas (erosion, sediment, dust) Damage to offset areas.	1. Landscape management plan 2. Bushfire prevention standard 3. Bushfire emergency response procedure 4. Consultation with RFS 5. Fire fighting procedures 6. Hot work permit process	Satisfactory	Risk	Financial Impact	2	2	D	5	Low			
13	Mine Subsidence	Failure to achieve the rehabilitation outcome prescribed in the MOP	Mine subsidence	Damage to structures and/or infrastructure following mining (roads, fencing, power lines). Additional costs.	1. Extraction plan	Requires Improvement	Risk	Financial Impact	3	3	D	9	Moderate	Review opportunities to remove infrastructure during operations (powerlines)	Chris Bedggood	Dec-2016
14	Mine Subsidence	Alteration of local drainage	Mine subsidence	Ponding, cracking, altered hydrological flows, altered drainage, erosion, changes to vegetation, impacts to arch sites, changes to creek bed profile.	1. Extraction plan 2. Ripping, ploughing and seeding 3. Earthworks 4. Pumping and dewatering (during operations)	Requires Improvement	Risk	Environment	3	3	D	9	Moderate	Develop ponding management plan for life of mine.	Steve Farrar	Dec-2015
15	Contaminated Land	Contaminated land occurring on the site at closure	Fuel use at the site Spills, leaks etc.	Impact on environment Constraint for future land use	1. Above ground storage 2. Incident reporting system 3. Bioremediation area 4. Spill kits	Requires Improvement	Risk	Environment	3	3	E	6	Moderate	Phase 1 and 2 studies at mine closure	Steve Farrar	Dec-2026
16	Air Quality	Increased air borne dust resulting in non-compliance with consents	Dust created from earthworks during rehabilitation	Complaints Prosecution and fines, health impacts	1. Air quality management plan/monitoring program 2. Surface transport management plan. 3. Dust TARPs	Satisfactory	Risk	Legal and Compliance	2	2	E	3	Low			

RISK ID	KEY ELEMENT	RISK/OPPORTUNITY EVENT	LIKELY CAUSE	POTENTIAL CONSEQUENCE/IMPACT	EXISTING PREVENTATIVE AND/OR MITIGATIVE CONTROLS	ADEQUACY OF EXISTING CONTROLS	RISK OR OPPORTUNITY (RISK)	CONSEQUENCE CATEGORY	CONSEQUENCE LEVEL (1 TO 5)	POTENTIAL MAXIMUM CONSEQUENCE LEVEL (A TO E)	RANK (1 TO 25)	CONTROL RATING (LOW, MEDIUM)	ADDITIONAL CONTROLS	RISK OWNER/ RESPONSIBLE MANAGER	DUE DATE	
17	Greenhouse Gas	Ongoing greenhouse gas emissions post-closure	LTA sealing of bores/mine entries/ventilation system.	Greenhouse gas emissions. Community complaints.	1. Borehole sealing procedure 2. Survey records 3. DRE guidelines	Satisfactory	Risk	Financial Impact	3	3	E	6	Moderate			
18	Noise	Increased noise resulting in non-compliance with consents	Earthworks during rehabilitation	Complaints Prosecution and fines	1. Noise Management Plan 2. Noise Monitoring 3. SPL for new and introduced equipment	Requires Improvement	Risk	Legal and Compliance	2	2	E	3	Low	Daytime works preferred during closure	Steve Farrar	Dec-2026
19	Visual Amenity	Impacts on the effectiveness of the Siding Springs Observatory	Lighting plant visible during bulk earthworks. Exposed areas visible and identifiable change to the landscape	Complaints	1. Aust std for lighting 2. Lighting impacts reduced during closure	Requires Improvement	Risk	Legal and Compliance	2	2	D	5	Low	Daytime works preferred during closure	Steve Farrar	Dec-2026
20	Aboriginal Cultural Heritage	Disturbance of known/unknown Aboriginal sites	Unintended interaction with Aboriginal site due to lack of awareness	Prosecution Loss of culturally significant site Loss of reputation with stakeholders	1. ACHMP 2. Disturbance permit 3. Training/awareness (TBT)	Satisfactory	Risk	Legal and Compliance	2	2	D	5	Low			
21	European Heritage	No registered European heritage sites	Nil	-	-		Risk	Environment	1	1	E	1	Low			
22	Agricultural Resources	Loss of agricultural resources (Class 3 land)	Mining disturbance Possible soil contamination Erosion and sedimentation LTA rehab	Reduced amount of land available suitable for agricultural production Inability to relinquish lease.	1. Landscape management plan 2. Rehab Management Plan 3. MOP	Satisfactory	Risk	Financial Impact	3	3	D	9	Moderate			
23	Groundwater	Groundwater pollution	Leaking/spill hydrocarbon Contamination during operations Stored mine water on site/brine pumped back into old workings.	Deterioration of groundwater quality.	1. Modelling of groundwater 2. Groundwater impact assessment 3. Product selection considers environment as far as practical (LW hydraulic fluid)	Satisfactory	Risk	Environment	2	2	D	5	Low			
24	Groundwater	Drawdown of groundwater	Dewatering	Reduced water levels within aquifers.	1. Modelling of groundwater 2. Groundwater impact assessment 3. Land ownership 4. Groundwater monitoring (SWL & quality)	Satisfactory	Risk	Environment	2	2	D	5	Low			
25	Drought	Failure to establish rehab at closure	Drought conditions when completing final rehab	Delay rehab Increased cost for rework	1. Access to river water under licence 2. Bores 3. Water treatment plant 4. Rehabilitation planning	Satisfactory	Risk	Financial Impact	2	2	D	5	Low			
26	Surface Water	Reduction in surface water flows due to ponding on mine subsidence areas	Ponding as a result of subsidence	Erosion resulting in increases suspended solids Community complaints by users dependent on surface water flows	1. Extraction plan 2. Ripping, ploughing and seeding 3. Earthworks 4. Pumping and dewatering (during operations)	Requires Improvement	Risk	Environment	2	2	D	5	Low	Ponding action plan	Steve Farrar	Dec-2026
27	Surface Water	Discharge of saline or contaminated water	Leaking/spill hydrocarbon Leachate from REA	Deterioration of water quality Non-compliance with consents Impacts to areas downstream	1. Oil-water separator 2. Engineering design dams 3. Contact and clean water diversions 4. Sediment dams 5. Brine is pumped back underground	Satisfactory	Risk	Environment	3	3	D	9	Moderate			
28	Public safety	Public access to the site prior to final closure	LTA fencing/gates Deliberate entry to property	Personal injury	1. Controlled access 2. Signs 3. No voids or major excavations that are unmanaged 4. Ongoing subsidence rehabilitation	Satisfactory	Risk	Health and Safety	1	1	E	1	Low			
29	Hazardous Materials and Dangerous Goods	Hazardous materials and dangerous goods remaining on the site at closure.	Failure to identify HAZMAT at closure Requirement to demolish farmhouses	Breach of licence Health and safety hazard Financial cost to remedy	1. Radiation management plan 2. Cheralert system 3. Procurement/stock management 4. Explosive management plan 4. Emergency services manifest	Satisfactory	Risk	Legal and Compliance	2	2	D	5	Low			
30	Acid Mine Drainage	Failure to achieve the rehabilitation outcome prescribed in the MOP	LTA knowledge of material that may result in AMD.	Inability to reach closure and relinquishment of the lease. Requirement to treat water long term. Impact on environment.	1. Testing of material in REA	Satisfactory	Risk	Environment	1	1	E	1	Low			
31	Final Land Use	Landform profile is excessive	Landform batter slopes are too steep for livestock access	Landform becomes unavailable for livestock access	1. Fencing of landform to actively prevent access	Satisfactory	Risk	Financial Impact	3	3	E	6	Moderate	1. Prohibit access to the rehabilitated area within the first reproductive cycle of the grass or until access can be safely provided for cattle and humans. 2. Placement of 'Rocky mulch' on slopes to allow access.	Steve Farrar	Aug-2020
32	Closure Performance	Closure performance monitoring indicate suboptimal results	Poor design, poor material selection and treatment and/or poor construction and vegetation	Erosional instability of capping layer with potential exposure of coarse reject	1. Engage experienced designer 2. Employ appropriate techniques to ensure material quality. 3. Apply effective QA techniques for material preparation and construction activities 4. Develop and implement effective monitoring program 5. Engage regulators to achieve consensus on approach	Satisfactory	Risk	Financial Impact	3	3	E	6	Moderate	1. Apply effective QA techniques for use of 'Rocky mulch' as suggested by ATC to reduce the erosion risk	Steve Farrar	Aug-2020
33	Closure Costs	Additional cover materials are needed increasing closure costs	Available cover materials are not adequate to cover the final landform	Closure provisions are not adequate Additional cover materials are not available on-site requiring longer haul distances	1. Annual updates to closure costs.	Requires Improvement	Risk	Financial Impact	3	3	E	6	Moderate	1. Review RCE and increase closure provisions if required. 2. Identify a potential source for additional cover materials and include in closure provisions	Steve Farrar	Dec-2016

Appendix D – MOP Plans



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LEGEND	
Coal Titles	Aboriginal Heritage Sites
ML 1609	Residence
EL 6243	Non-Project Related Residence
Mining Footprint	Project Related Residence
Contour (5m)	Mine Workings and Extraction
Watercourse	Existing Mine Workings
Railway	Proposed Mine Workings
Dam	Existing Extraction
	Limit of Subsidence to 20mm
	Infrastructure
	Infrastructure - Fence
	Infrastructure - Namoi River Pipeline
	Infrastructure - Railway Line
	Infrastructure - Road
	Subsidence - Survey Monitoring Marks
	Services - Air
	Services - Electrical
	Services - Gas
	Services - Sewer
	Services - Water
	Land Ownership
	Freehold - NCO Owned
	Freehold - Privately Owned
	NSW Government - State Forest
	Crown Land



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LEGEND		Primary Domain		Secondary Domains	
ML 1609	Services - Electrical	1 - Infrastructure Area	B - Water Management Area	D - Rehabilitation Area - Pasture	E - Rehabilitation Area - Woodland (Existing)
EL 6243	Cross Section Location	3 - Water Management Area	J - Conservation and Biodiversity Offset Area	F - Rehabilitation Area - State Forest (Existing)	
Mining Footprint	Mine Workings and Extraction	4 - Reject Emplacement Area	8 - Underground Mining Area		
Contour (5m)	Existing Mine Workings	5 - Stockpiled Material			
Watercourse	Proposed Mine Workings	7 - Rehabilitation			
Railway	Existing Extraction				
Cadastral	Limit of Subsidence to 20mm				
Road Corridor					



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Title Holder: Narrabri Coal Pty Ltd
Prepared By: SLR Consulting

I, Steven Bow, Holder of Mine Managers Certificate of Competency, certify that the information on this plan is a true indication of the proposed development.
Steven Bow
Steven Bow, General Manager - Narrabri Mine
6-11-17
Date

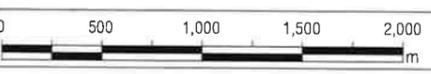
Narrabri Mine MOP
Mine Domains at Commencement of MOP
PLAN 2

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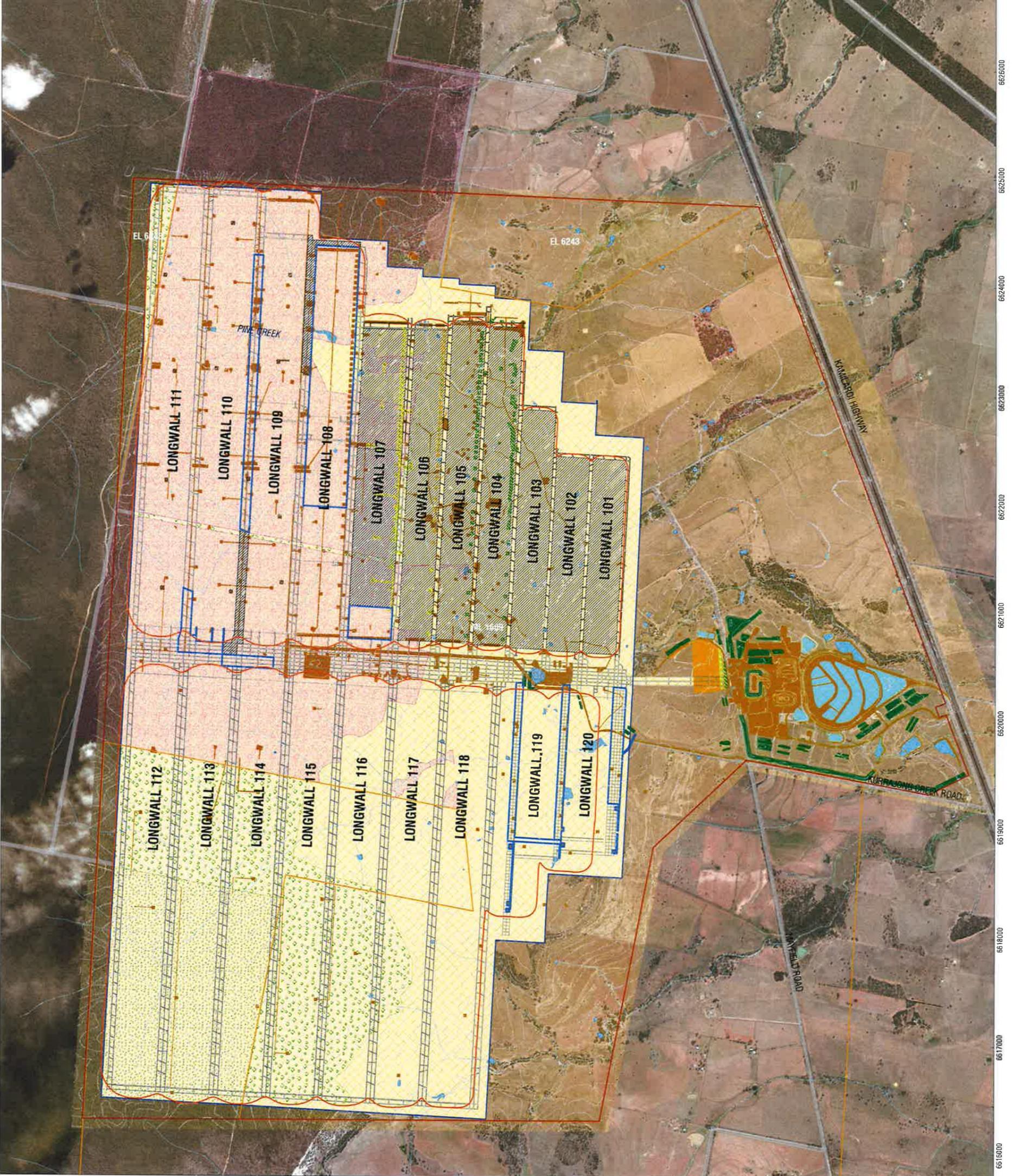
Coal Titles	Mine Workings and Extraction	Primary Domain	Secondary Domains	Rehabilitation Phase
ML 1609	Existing Mine Workings	1 - Infrastructure Area	B - Water Management Area	Phase 2
EL 6243	Proposed Mine Workings	3 - Water Management Area	D - Rehabilitation Area - Pasture	Phase 3
Mining Footprint	Existing Extraction	4 - Reject Emplacement Area	E - Rehabilitation Area - Woodland (Existing)	Phase 4
Contour (5m)	Active Mining Area	5 - Stockpiled Material	F - Rehabilitation Area - State Forest (Existing)	
Watercourse	Limit of Subsidence to 20mm	7 - Rehabilitation	J - Conservation and Biodiversity Offset Area	
Railway		8 - Underground Mining Area		
Road Corridor				



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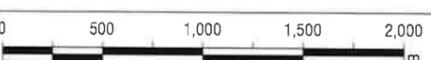
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LEGEND				
Coal Titles	Mine Workings and Extraction	Primary Domain	Secondary Domains	Rehabilitation Phase
ML 1609	Existing Mine Workings	1 - Infrastructure Area	B - Water Management Area	Phase 2
EL 6243	Proposed Mine Workings	3 - Water Management Area	D - Rehabilitation Area - Pasture	Phase 3
Mining Footprint	Existing Extraction	4 - Reject Emplacement Area	E - Rehabilitation Area - Woodland (Existing)	Phase 4
Contour (5m)	Active Mining Area	5 - Stockpiled Material	F - Rehabilitation Area - State Forest (Existing)	
Watercourse	Limit of Subsidence to 20mm	7 - Rehabilitation	J - Conservation and Biodiversity Offset Area	
Railway		8 - Underground Mining Area		
Road Corridor				



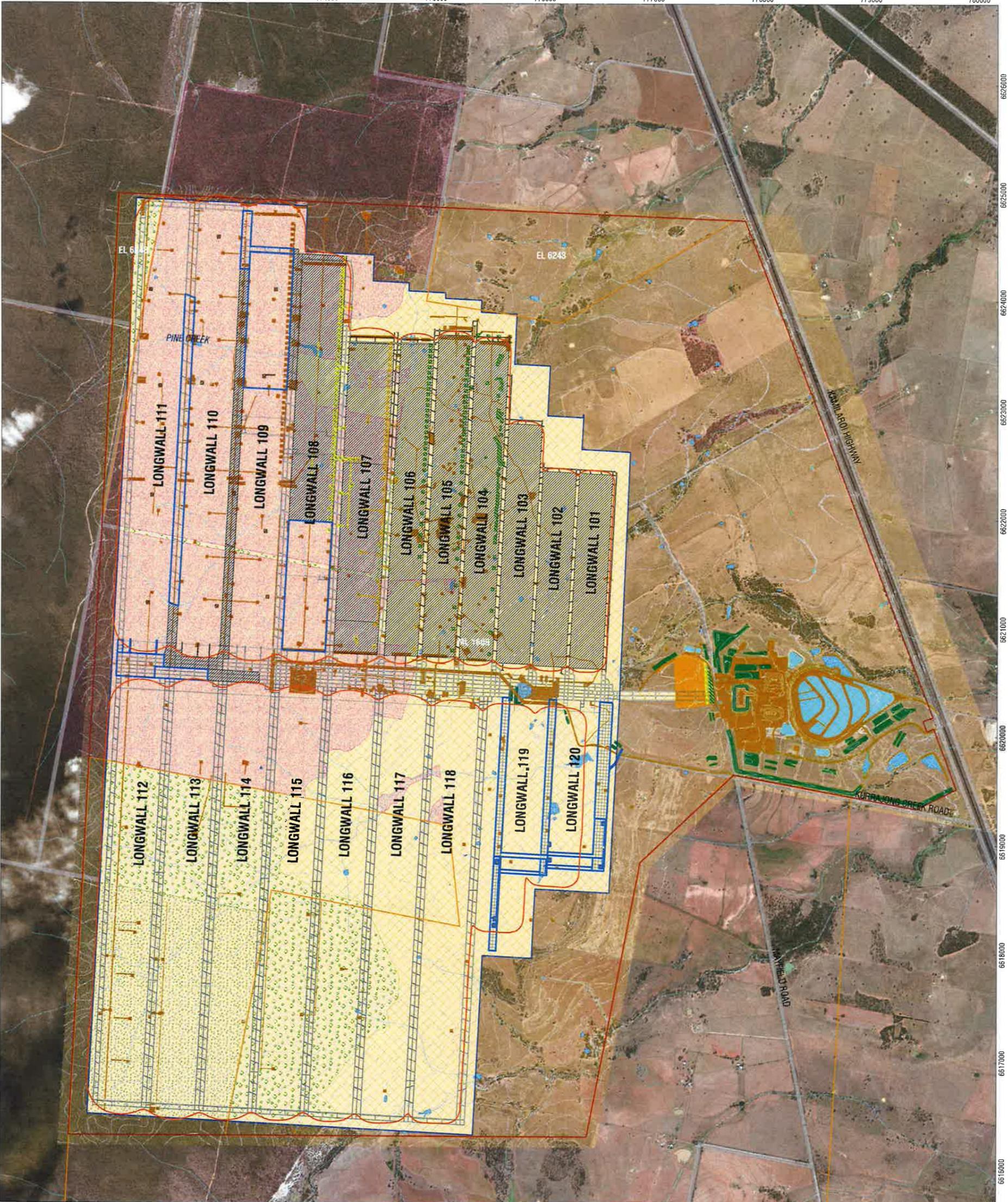
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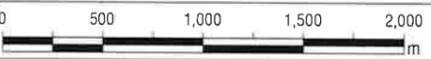
I, Steven Bow, Holder of Mine Managers Certificate of Competency, certify that the information on this plan is a true indication of the proposed development.
Steven Bow
Steven Bow, General Manager - Narrabri Mine
Date: 6-11-17

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LEGEND				
Coal Titles	Mine Workings and Extraction	Primary Domain	Secondary Domains	Rehabilitation Phase
ML 1609	Existing Mine Workings	1 - Infrastructure Area	B - Water Management Area	Phase 2
EL 6243	Proposed Mine Workings	3 - Water Management Area	D - Rehabilitation Area - Pasture	Phase 3
Contour (5m)	Existing Extraction	4 - Reject Emplacement Area	E - Rehabilitation Area - Woodland (Existing)	Phase 4
Watercourse	Active Mining Area	5 - Stockpiled Material	F - Rehabilitation Area - State Forest (Existing)	
Railway	Limit of Subsidence to 20mm	7 - Rehabilitation	J - Conservation and Biodiversity Offset Area	
Road Corridor		8 - Underground Mining Area		



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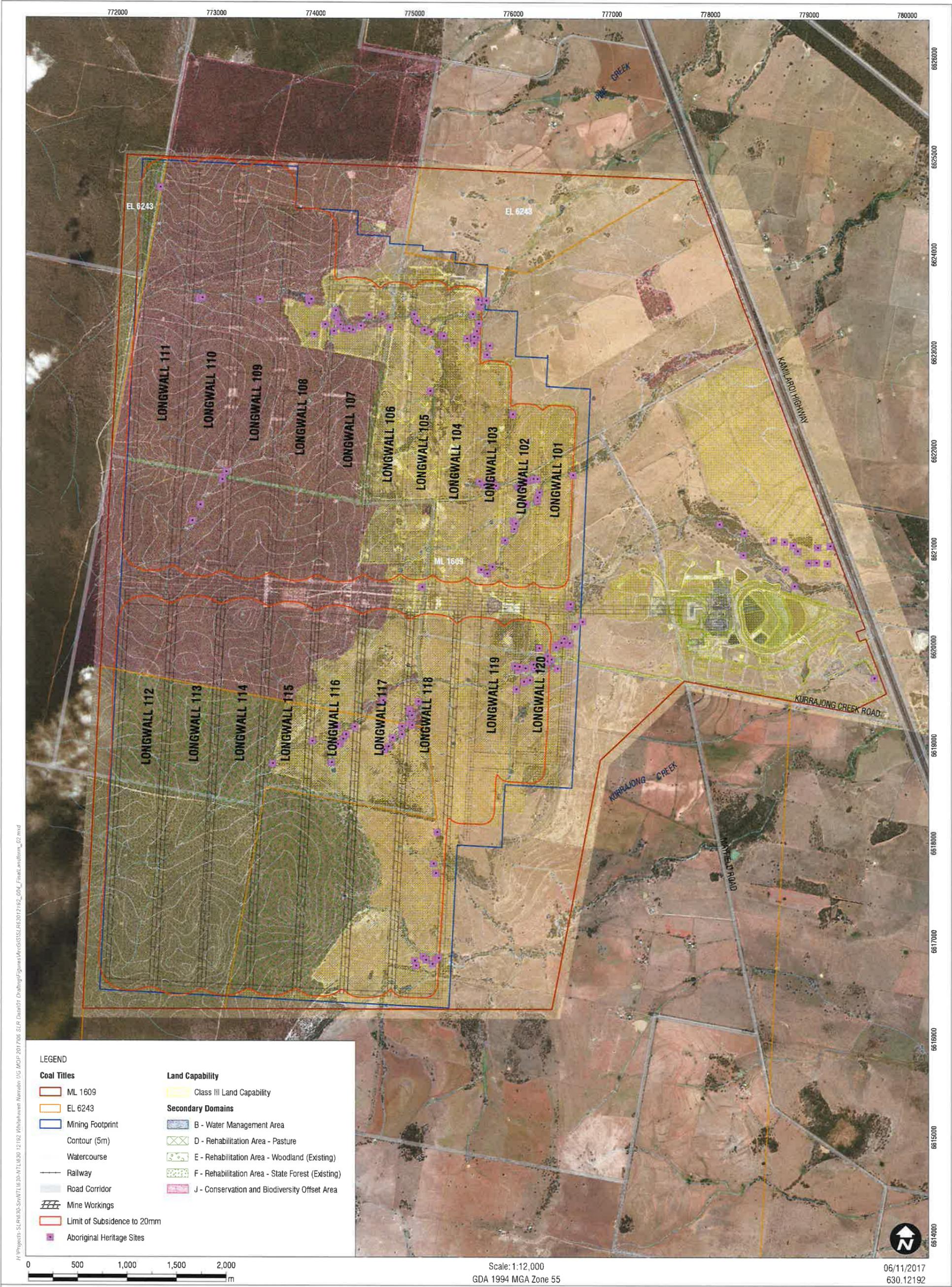
LEGEND		Primary Domain	Secondary Domains	2020
Coal Titles	Mine Workings and Extraction	1 - Infrastructure Area	B - Water Management Area	Phase 2
ML 1609	Existing Mine Workings	3 - Water Management Area	D - Rehabilitation Area - Pasture	Phase 3
EL 6243	Proposed Mine Workings	4 - Reject Replacement Area	E - Rehabilitation Area - Woodland (Existing)	Phase 4
Contour (5m)	Active Mining Area	5 - Stockpiled Material	F - Rehabilitation Area - State Forest (Existing)	
Watercourse	Existing Extraction	7 - Rehabilitation	J - Conservation and Biodiversity Offset Area	
Railway	Limit of Subsidence to 20mm	8 - Underground Mining Area		
Road Corridor				



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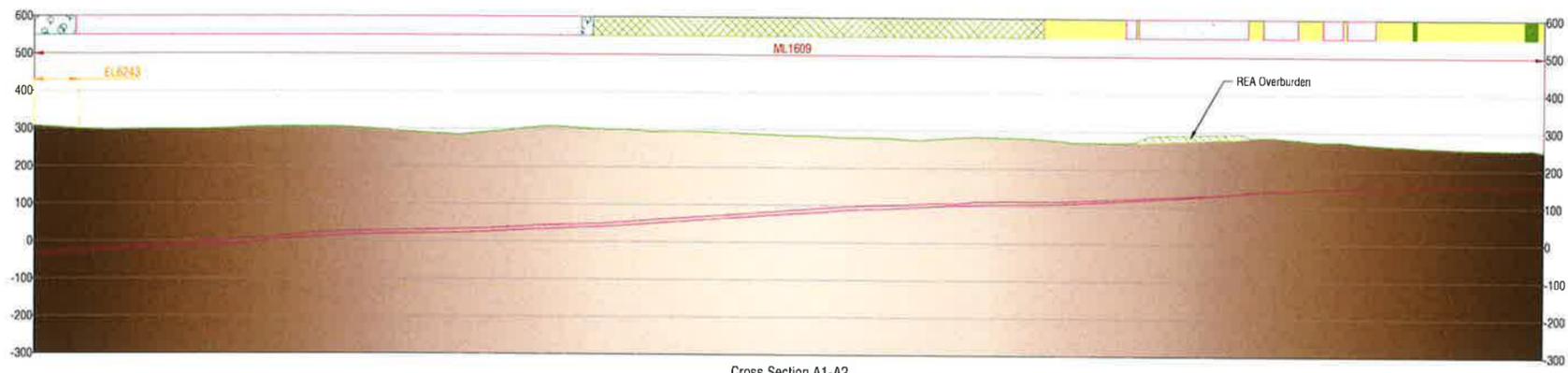
LEGEND

Coal Titles	Land Capability
ML 1609	Class III Land Capability
EL 6243	Secondary Domains
Mining Footprint	B - Water Management Area
Contour (5m)	D - Rehabilitation Area - Pasture
Watercourse	E - Rehabilitation Area - Woodland (Existing)
Railway	F - Rehabilitation Area - State Forest (Existing)
Road Corridor	J - Conservation and Biodiversity Offset Area
Mine Workings	
Limit of Subsidence to 20mm	
Aboriginal Heritage Sites	

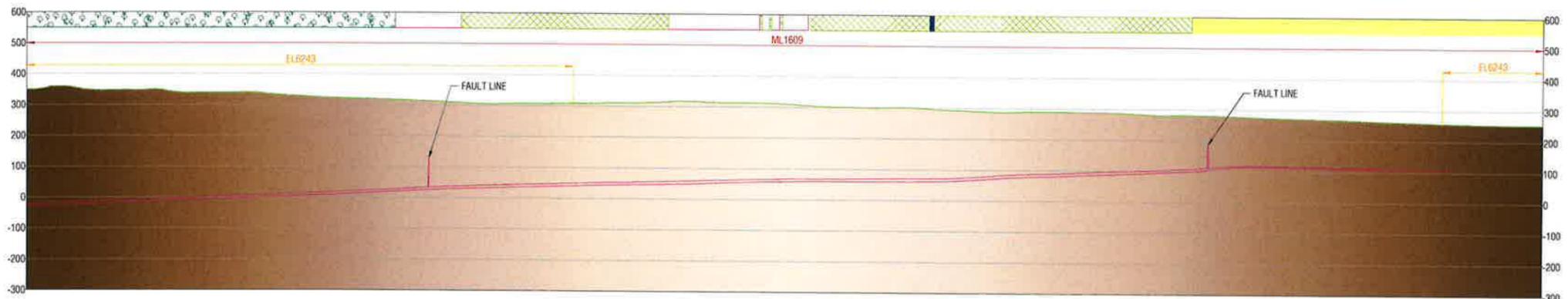


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Cross Section A1-A2
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1:6000 V



Cross Section B1-B2
1:12000 H
1:6000 V

- LEGEND**
- Current Landform
 - Final Landform
 - Hoskissons Seam
 - B - Water Management Area
 - D - Rehabilitation Area - Pasture
 - E - Rehabilitation Area - Woodland (Existing)
 - F - Rehabilitation Area - State Forest (Existing)
 - J - Conservation and Biodiversity Offset Area
 - Other Lands



Scale: 1:12,000 (H) 1:6000 (V)
GDA 1994 MGA Zone 55



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Client: Narrabri Coal Pty Ltd
Prepared By: SLR Consulting

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Steve Bow, General Manager - Narrabri Mine
Date: 6-11-17

**Narrabri Mine MOP
Rehabilitation Post Mining Land Use
Cross Sections**