APPENDIX Q

Rehabilitation and Mine Closure Strategy

global environmental solutions

Tahmoor South Project

Rehabilitation and Mine Closure Strategy for the Amended Project

Report Number 634.10066

February 2020

Tahmoor Coal Pty Ltd

Version: Final V6

Tahmoor South Project

Rehabilitation and Mine Closure Strategy

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DOCUMENT CONTROL

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Executive Summary

Tahmoor Coal is seeking development consent for the continuation of mining at Tahmoor Mine to extend the life of underground mining for an additional 13 years, until approximately 2035 (the Tahmoor South Project).

In accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act), an Environmental Impact Statement (EIS) was prepared to assess the potential environmental, economic and social impacts of the Project. The EIS for the Project was placed on public exhibition by the Department of Planning, Industry and Environment (DPIE) (formerly the Department of Planning and Environment (DPE)) from 23 January 2019 to 5 March 2019.

As a result of ongoing mine planning and issues raised relating to the project in submissions received during the public exhibition, several amendments have been made to the proposed development, so as to further reduce the predicted environmental impacts of the Tahmoor South Project.

The key amendments to the Project since public exhibition of the EIS are:

- A revised mine plan;
- A reduction in the total amount of run-of-mine (ROM) coal to be extracted over the Project life, from approximately 48 million tonnes (Mt) to approximately 43 Mt of ROM coal;
- A revised extended REA, including:
  - A reduction in the additional capacity required to accommodate the Project;
  - A reduction in the REA extension footprint, from 43 ha to 11.06 ha; and
  - An increase in the final height of the REA (from RL 305 m to RL 310 m);
- Confirmation of the location and footprint of ancillary infrastructure associated with the ventilation shaft sites (eg the power connection easement for ventilation shaft site TSC1); and
- A continuation of the use of the existing upcast shaft (T2); although, operation will reduce from two fans during Tahmoor North operations to one fan once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South.

This Rehabilitation and Mine Closure Strategy has been updated to assess the amended project (in particular the amended REA design), and supports the Amended Project Report (AECOM, 2020), and to respond to issues raised in submissions relating to rehabilitation and closure.

To effectively address the various land uses at the Tahmoor South Project, the Project Area has been divided into six management 'domains'. The domains identified within this strategy are defined as:

- Domain 1: Mine infrastructure area (MIA);
- Domain 2: Stockpiles;
- Domain 3: Reject emplacement area (REA);
- Domain 4: Mine ventilation;
- Domain 5: Roads; and
- Domain 6: Other lands.

Executive Summary

As the proposed development is over 15 years from closure, a preliminary closure land use option analysis was undertaken. The preliminary options analysis identified a number of potential land use options for each of the Domains within the Project Area. A comprehensive analysis of closure land use options is proposed to be undertaken during detailed closure planning, which is typically undertaken no later than five years out from permanent closure of the site.

In view of this, this strategy has been prepared on the basis that at closure, all existing mine-related infrastructure and associated aspects will be entirely removed and the affected land returned to as close to pre-mining land use as possible. A summary of the proposed final land uses is outlined in **Table 1**.

Table 1 Summary of Proposed Final Land Uses

Domain	Land Use
Domains 1, 2, 3 and 4	Native Bushland
Domain 5	Return to native bushland Some roads remain for access to existing properties
Domain 6	Commensurate with the surrounding land use Some areas protected for biodiversity offsets

The changes to this strategy as a result of the amended project, compared to the Plan prepared for the EIS, primarily relate to the revised REA design and the reduced REA extension area from approximately 43 ha to 11 ha.

Rehabilitation success criteria have been developed to provide long-term performance goals for rehabilitation activities.

An indicative closure timeline has also been developed for the proposed development. The key rehabilitation and decommissioning activities include closure planning, decommissioning and rehabilitation, maintenance and monitoring, relinquishment and post relinquishment activities.

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1 INTRODUCTION

1.1 Background

Tahmoor Coal is seeking development consent for the continuation of mining at Tahmoor Mine, extending underground operations and associated infrastructure south, within the Bargo area (refer to **Figure 1**). The proposed development seeks to extend the life of underground mining at Tahmoor Mine for an additional 13 years until approximately 2035.

In accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), an Environmental Impact Statement (EIS) was prepared to assess the potential environmental, economic and social impacts of the Project. The EIS for the Project was placed on public exhibition by the Department of Planning, Industry and Environment (DPIE) (formerly the Department of Planning and Environment (DPE)) from 23 January 2019 to 5 March 2019.

Key issues raised in submissions included concerns relating to the proposed extent of longwall mining, the magnitude of subsidence impacts and the extent of vegetation clearing required for expansion of the reject emplacement area (REA). In response to these and other issues raised in Government agency, local Council, stakeholder and community submissions, and as a result of ongoing mine planning, several amendments have been made to the proposed development, so as to also further reduce the predicted environmental impacts of the Tahmoor South Project.

The key amendments to the Project since public exhibition of the EIS are:

- A revised mine plan (refer to **Figure 2**), including:
  - An amended longwall panel layout and the removal of LW109;
  - A reduction in the height of extraction within the longwall panels from up to 2.85 metres (m) to up to 2.6 m; and
  - A reduction in the proposed longwall width, from up to 305 m to approximately 285 m;
- A reduction in the total amount of Run-of-Mine (ROM) coal to be extracted over the Project life, from approximately 48 million tonnes (Mt) to approximately 43 Mt of ROM coal, comprising:
  - 30 Mt of coking coal product (reduced from 35 Mt);
  - 2 Mt of thermal coal product (reduced from 3.5 Mt); and
  - 12 Mt of rejects;
- A revised extended REA; including:
  - A reduction in the additional capacity required to accommodate the Project;
  - A reduction in the REA extension footprint, from 43 ha to 11.06 ha;
  - An increase in the final height of the REA (from RL 305 m to RL 310 m);
- Confirmation of the location and footprint of ancillary infrastructure associated with the ventilation shaft sites (eg the power connection easement for ventilation shaft site TSC1); and
- A continuation of the use of the existing upcast shaft (T2); although, operation will reduce from two fans during Tahmoor North operations to one fan once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South.

No amendments have been made to other key aspects of the Project for which development consent is being sought, such as the proposed annual coal extraction rate, mining method, traffic movements and employee numbers. A detailed description of the amended development is provided in the Amended Project Report (AECOM, 2020).

1.2 Purpose of report

This Rehabilitation and Mine Closure Strategy has been prepared to outline the process for rehabilitation of the land following completion of mining, including dismantling and removal of infrastructure and earthworks to achieve a safe, sustainable final landform and land use. The strategy includes amendments based on the proposed development changes and additional information in relation to final landform details and management of impacts to subsidence of watercourse and drainage lines. In this way, it serves as an update to the original conceptual mine closure plan (SLR, 2018) (Appendix V of the Tahmoor South EIS).

1.3 Amended Project

The amended development will use longwall mining to extract coal from the Bulli seam within the bounds of CCL716 and CCL747. Coal extraction of up to 4 million tonnes of ROM coal per annum is proposed as part of the development with extraction of up to 43 Mt of ROM coal over the life of the Project. The project will produce approximately:

- 30 Mt coking coal product;
- 2 Mt thermal coal product; and
- 12 Mt of rejects.

These approximate market mix volumes include moisture and are, therefore, an estimate only. Once the coal has been extracted and brought to the surface, it will be processed at Tahmoor Mine's existing Coal Handling and Preparation Plant (CHPP) and coal clearance facilities, and then transported via the existing rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway to Port Kembla and Newcastle (from time to time) for Australian and international markets. Up to 200,000 tonnes per annum of either product coal or reject material is proposed to be transported to customers via road.

The amended development will use the existing surface infrastructure at the Tahmoor Mine surface facilities area. Some upgrades are proposed to facilitate the extension.

The amended development also incorporates planning for rehabilitation and mine closure once mining ceases.

In summary, the key components of the amended development comprise:

- Longwall mining in the Central Domain;
- Mine development, including underground development, vent shaft construction, pre-gas drainage and service connection;
- Upgrades to the existing surface facilities area, including:
    - Upgrades to the CHPP;
    - Expansion of the existing REA;
    - Additional mobile plant for coal handling;
    - Additions to the existing bathhouses and associated access ways; and
    - Upgrades to onsite and offsite service infrastructure, including electrical;
- Rail transport of product coal to Port Kembla and Newcastle (from time to time);
- Up to 200,000 tonnes per annum of either product coal or reject material is proposed to be transported to customers via road;
- Mine closure and rehabilitation; and
- Environmental management.

1.4 Submissions on the EIS and Summary of Changes to the Rehabilitation and Mine Closure Strategy

A summary of the issues raised in Government Agency submissions following public exhibition of the EIS that are relevant to this Rehabilitation and Mine Closure Strategy, and how they have been addressed in this updated strategy, are outlined in **Table 2**.

Table 2 Issues Raised Relevant to Rehabilitation in Submissions on the Project

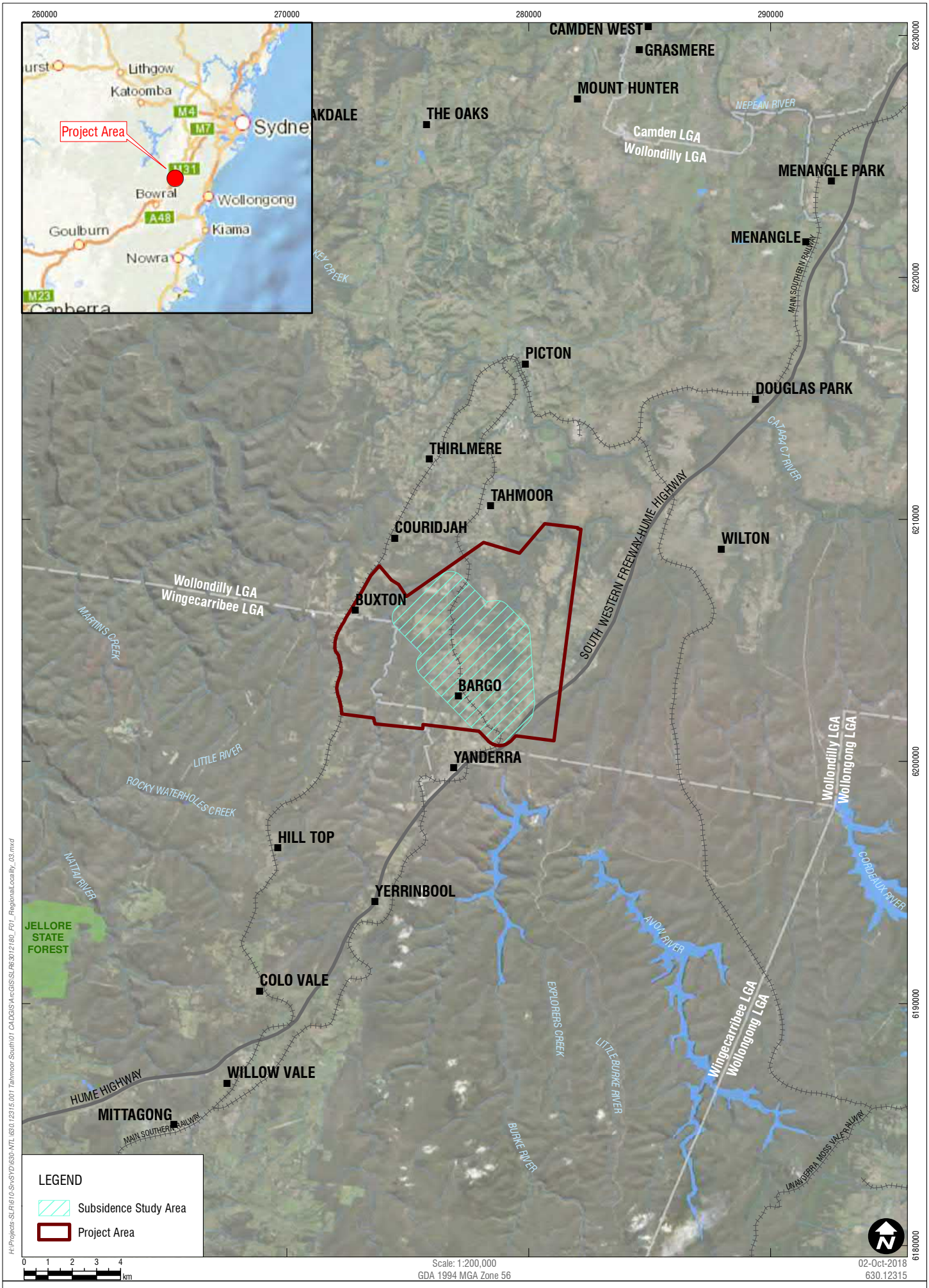
Required Additional Information	Response
Resources Regulator	
The "Final Landform" Plan (Figure 9 of the Rehabilitation and Mine Closure Strategy) has no contours and no indication of the Final Landform. The Plan also only covers the Reject Emplacement Area, not Domains 1, 2, 4 and 5 which would also be applicable. A more detailed "Final Landform" Plan, covering all applicable Domains is required.	Figure 9 has been revised to include: • Contours to indicate the final landform; and • Domains 1, 2, 4 and 5.
There is inadequate commitment to rehabilitation of impacts to watercourses. Section 11.7.1 (Subsidence of Watercourse and Drainage Lines) refers to existing Management Plans regarding "potential impacts to streams resulting from the mining of longwalls" but these are not provided as part of the EIS and there is inadequate information provided to give confidence that remediation will occur to a satisfactory standard. At minimum, general commitments and completion criteria regarding remediation of impacts to watercourses and drainage channels should be included in the EIS.	Now Section 11.8.1 Subsidence of Watercourse and Drainage Lines has been revised to include general commitments and completion criteria regarding impacts to watercourses and drainage lines, including specific reference to reports and management plans these have been drawn from.
In Table 8, "Preliminary Rehabilitation Success Criteria": • It is noted there is a 'Slope Gradient' indicator for Domains 1 and 2, but no equivalent for Domains 3, 4, 5 or 6. It is recommended that Phase 2 of this Table be expanded to cover all Domains. • For Infrastructure, Domains 1 and 2, the Land Use in the Indicator Column is 'proposed industrial'. This is inconsistent with the default position of returning all lands to native bushland and should be changed. • There are no criteria specified for watercourses and drainage channels in terms of ensuring flows are maintained and/or reinstated. Table 8 should be updated to address these 3 points.	Table 8 (now Table 12) Preliminary Rehabilitation Success Criteria has been revised to: • Include an indicative, average slope gradient for all Domains in Phase 2; • Change the Land Use in the Indicator column to Native Bushland; and • Include criteria for ensuring flows are maintained and/or reinstated for watercourses and drainage lines.
Department of Industry – Lands and Water Division	
The Rejects Emplacement Area covers waterfront land and should be rehabilitated in accordance with the Guidelines for Working on Waterfront Land (https://www.industry.nsw.gov.au/water/licensing-trade/approvals/controlled-activities). The Rehabilitation Management Plan is to be developed in consultation with the Natural Resources Access Regulator	Section 10.3.1 Rejects Emplacement Area has been revised to include reasoning on how and why the Guidelines for Working on Waterfront Land have been applied by this project and that Tahmoor Coal will implement the guidelines by consulting with the relevant regulator at that time and applying the objectives of the guidelines.

A summary of the changes to the strategy, as a result of the amended project, are outlined in **Table 3**.

Table 3 Summary of the Changes to the Strategy as a Result of the Amended Project

Additional Information	Response
Revised Rejects Emplacement Area (REA) changes to other sections of the strategy:	
Executive Summary	Updated to reflect reduction in the REA extension footprint
Section 10.3.1 Reject Emplacement Area	Amendment of stages of progression of REA from 15 to 6
Section 11.1 Landform Design and Planning	Now Section 11.2 Amended with inclusion of reference to revised REA design
Section 11.4 Topsoil Mass Balance	Now Section 11.5 REA extension area amended to 11 ha from 43 ha
Section 11.4.3 Soils Assessment	Now Section 11.5.3 Section on Earthy Sands removed as no longer represented within REA extension area
Section 11.4.4 Topsoil Stripping Assessment and Balance, Table 7 Soil Stripping Recommendations and Figure 8 Recommended Topsoil Stripping Depths	Now Section 11.5.4 Table 6, now Table 8, removed Earthy Sands row as no longer represented within REA extension area Paragraph 3, removed reference to Earthy Sands Paragraph 4, total maximum disturbance area and topsoil balance figures amended Table 7 removed soil types no longer within REA extension area and updated areas and volumes for each remaining soil type based on reduced REA extension area Figure 8 amended to show the reduced disturbance area and reduced number of soil units impacted
Section 11.4.5 Summary.	Now Section 11.5.5 Dot point 2 amended to show only three major soil types with removal of Earth Sands Dot point 3 amended to show reduced topsoil balance and disturbance area
Other amendments to the strategy:	
Executive Summary	Updated to include summary of proposed final land uses
Section 3.4 Land and Soil Capability and Agricultural Suitability	Addition of final land and soil capability (LSC) class for each Domain Confirmatory sentence that the Tahmoor South project does not extend into the MSA
Section 3.6 Subsidence	Update reference to MSEC subsidence report Amended Table 4 based on amended MSEC 2020 subsidence report Update paragraph following Table 4 based on new data in Table 4
Section 7 Preliminary Land Use Option Analysis	Period until mine closure reduced from 17 to 13 years Addition of exception to removal of all infrastructure for heritage items under the Wollondilly LEP Amend Table 6 to include additional column for proposed final land use and reasoning against each Domain
Section 9.1 Heritage Management	Update reference to Niche historic heritage assessment report
Section 9.6 Site Infrastructure and Services	Include reference to any heritage preservation requirements
Section 9.10 Risk to Rehabilitation	New section summarising the assessment of risks from existing and potential acid and metalliferous drainage (AMD) and spontaneous combustion on rehabilitation by GeoTerra
Section 10.6.1 Subsidence Areas	Amendment of subsidence distances to final topography based on updated MSEC 2020 subsidence report

Additional Information	Response
Section 11.1 Proposed Post-mining Land Classification	New section describing the proposed post-mining land classification based on the landform design and soil
Section 11.4.6 Topsoil Stripping and Handling	Now Section 11.5.6 Last dot point amended to reflect Tahmoor MOP which states soil spreading up to 300 mm, which includes subsoil
Section 11.4.7 Topsoil Respreading and Seedbed Preparation	First paragraph amended to include soil spreading of up to 0.3 m, including subsoil
Section 11.9 Rehabilitation Monitoring	Now Section 11.10 Amended to reflect monitoring program in MOP
Section 11.10 Rehabilitation Maintenance	Now Section 11.11 Amended to reflect maintenance commitment in MOP
Section 12, Rehabilitation Success Criteria	Table 9, now Table 12 Preliminary Rehabilitation Success Criteria amended as follows: • Phase 1 – Decommissioning, Rehabilitation Element: Infrastructure – consolidation of Domains 1, 2, 3 and 4 due to now consistent Indicators and Criteria; • Phase 2 – Landform Establishment, Landform Stability Element: Domain 3 Capping amended to reflect MOP specification of 300 mm • Phase 3 – Growth Media Development: Topsoil – consolidation of Domains 1, 2, 3, 4, 5 and 6 due to now consistent Indicators and Criteria; • Phase 4 – Ecosystem Establishment: Vegetation – inclusion of Domains 1 and 2 due to consistency of final land use Indicator now Native Bushland; • Phase 5 – Ecosystem Development: Vegetation, Fauna and Land Use – inclusion of Domains 1 and 2 across all Indicators due to consistency of final land use Indicator now Native Bushland.



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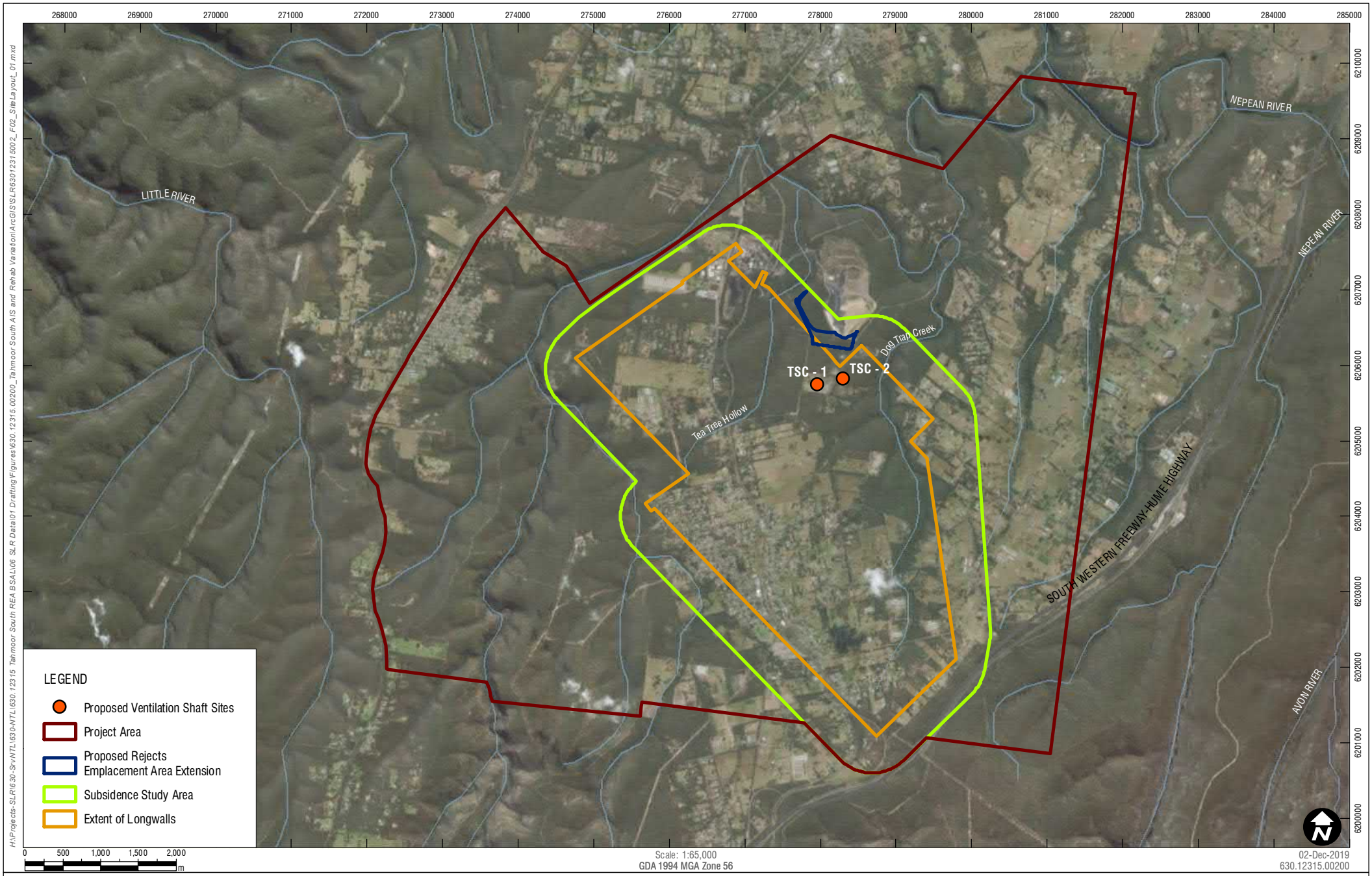
Regional Locality

FIGURE 1



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Site Layout

FIGURE 2

1.5 Secretary's Environmental Assessment Requirements

In preparing this Rehabilitation and Mine Closure Strategy the relevant components of the Secretary's Environmental Assessment Requirements (SEARs), issued for the Tahmoor South Project (SSD 17_8445) on 9 June 2017 and revised SEARs issued on 20 June 2018, were addressed. The key matters raised in the SEARs for consideration in the Rehabilitation and Mine Closure Strategy, and where this report addresses the SEARs is outlined in **Table 4**.

Table 4 SEARs Applicable to the Rehabilitation and Mine Closure Strategy

Rehabilitation and Final Landform – Including:	
an assessment of the likely impacts of the development on existing landforms and topography, including justification of the final landform design of the reject emplacement area expansion and its long term geotechnical stability;	Sections 10 and 11
a detailed description of the progressive rehabilitation measures that would be implemented for the development;	Sections 9, 10 and 11
a detailed description of the proposed rehabilitation and mine closure strategies for the project, having regard to Resources Regulator's (RR) requirements (see Attachment 2) and the key principles in Strategic Framework for Mine Closure, and the:	Sections 10 and 11
• rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria;	Sections 4, 5, 9, 10, 11 and 12
• decommissioning and management of surface infrastructure;	Section 10.1
• nominated final land uses, having regard to any relevant strategic land use planning or resource management plans or policies; and	Section 7
• potential for integrating the rehabilitation strategy with offset strategies proposed for the development; and	Sections 6.6 and 10.6
the measures which would be put in place for the long-term protection and management of the site, any biodiversity offset areas following the cessation of mining, and	Section 11
measures to avoid the propagation of acid sulphate soils.	Section 11.5

1.6 Responsibilities

The key responsibilities with regard to the Rehabilitation and Mine Closure Strategy are outlined in **Table 5**.

Table 5 Key Responsibilities

Personnel	Responsibility
Operations Manager	Provide sufficient resources to facilitate development, implementation and periodic review of this strategy.
Environment and Community Manager	Manage the review process to ensure this strategy is reviewed as required and monitor progress with the necessary actions.
Environment and Community Coordinator	Facilitate the continued development and on-going review of this strategy, co-ordinate the resources required to complete the necessary actions, and to plan and execute the progressive rehabilitation program.

Personnel	Responsibility
Commercial Manager	Ensure there are adequate provisions available for mine closure by implementing and updating an accrual system over the life of mine.

1.7 Report Structure

This report is structured as follows:

Section 1.0 Introduction – outlines the proposed development and the purpose of the report.

Section 2.0 Regulatory Framework – describes the legislation and guidelines considered during preparation of the Rehabilitation and Mine Closure Strategy.

Section 3.0 The General Environment – provides an overview of the environment prior to the proposed development commencing.

Section 4.0 Environmental Performance Objectives

Section 5.0 Risk Based Approach to Rehabilitation and Closure – outlines the risk-based approach to be adopted for closure.

Section 6.0 Assigning Rehabilitation and Closure Domains – describes the infrastructure within each of the six domains.

Section 7.0 Preliminary Land Use Option Analysis – provides a summary of potential post-mining land use options.

Section 8.0 Stakeholder Engagement – describes the proposed stakeholder engagement.

Section 9.0 Planning for Decommissioning – provides a summary of the proposed activities to be undertaken during planning for decommissioning.

Section 10.0 Decommissioning and Rehabilitation Works – provides an outline of the proposed decommissioning and rehabilitation works for each domain.

Section 11.0 Rehabilitation and Revegetation Strategy – outlines the proposed rehabilitation and revegetation works.

Section 12.0 Rehabilitation Success Criteria – describes the proposed rehabilitation success criteria.

Section 13.0 Indicative Closure Timeline – provides an indicative timeframe for closure activities.

2 LEGISLATION AND REGULATORY REQUIREMENTS

2.1 Legislation

2.1.1 Mining Act 1992

The *Mining Act 1992* regulates environmental protection, rehabilitation and closure conditions included in all mining leases. Tahmoor Mine currently holds a number of mining leases and exploration licences issued under the *Mining Act 1992* over the Project Area. New mining leases will be required to support the proposed development; specifically to accommodate the expanded REA over Crown Land as well as additional surface mining leases for the proposed ventilation shafts. Lease conditions relevant to mine closure will be incorporated into the Rehabilitation and Mine Closure Strategy when a new lease is granted.

2.1.2 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal piece of legislation overseeing the assessment and determination of development applications in NSW. The objectives of the EP&A Act, EP&A Regulation, the SEARs and all relevant policies and guidelines were taken into consideration in developing this strategy, including, but not limited to the following key objects from the EP&A Act:

> *"(a) to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,*
>
> *(c) to promote the orderly and economic use and development of land,*
>
> *(e) to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats".*

2.1.3 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) establishes the State's environmental regulatory framework and includes licensing requirements for certain scheduled activities. The objects of the POEO Act that relate to decommissioning and rehabilitation include protecting, restoring and enhancing the environment, reducing risks to human health, and preventing degradation of the environment were taken into consideration in the preparation of this strategy.

2.2 Environmental Planning Instruments and Planning Policies

2.2.1 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of NSW. The SEPP provides that development for the purpose of underground mining may be carried out with development consent on any land. It also defines mining developments that are prohibited, exempt from the need for consent or can be undertaken provided they comply with pre-determined criteria/standards (complying development).

Development listed under the Mining SEPP as being exempt from the need for planning approval, which specifically relates to the decommissioning process, includes the demolition of a building or structure. Such demolition needs to be carried out in accordance with *Australian Standard AS2601-2001, Demolition of Structures*. Furthermore, such development is only defined as exempt if the building or structure is not a heritage item, is not within a heritage conservation area and demolition takes place on an approved mine site and is of minimal environmental impact.

2.2.2 Wollondilly Local Environmental Plan 2011

The objectives of the Wollondilly Local Environmental Plan 2011 include:

- *"provide management for the management of natural resources and the protection of the natural landscape character;*
- *to protect, enhance and conserve the build, landscape and Aboriginal cultural heritage;*
- *to protect water quality in land that is situated with water supply catchments;*
- *to encourage development that provides for the integrated transport and infrastructure system and adequate facilities and service provision for future growth;*
- *to recognise, manage and protect rural resource lands for sustainable agriculture and extractive industry practices; and*
- *to maintain the separation between towns and villages to retain their unique character and rural and natural settings".*

The main disturbance area, including the MIA and the REA are zoned RU2 Rural Landscape. Development for the purpose of mining (and related activities) is permissible with development consent under the provisions of the Wollondilly Local Environmental Plan within zone RU2 Rural Landscape.

As stated in **Section 1.1.2**, disturbance as a result of the proposed development, will comprise continuation of subsidence effects from underground mining, expansion of the REA, and augmentation of existing surface infrastructure. Within five years of mine closure the Wollondilly Local Environmental Plan, or equivalent, will be considered when assessing potential final land use options for the site post-closure.

2.3 Other Policies and Guidelines

Strategic Framework for Mine Closure, Minerals Council of Australia (2000)

The Strategic Framework for Mine Closure has evolved as a cooperative development between the Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Australian Minerals Industry (represented by the Minerals Council of Australia). It is designed to provide a broadly consistent framework for mine closure across various Australian jurisdictions.

The objective of the Strategic Framework for Mine Closure is to encourage the development of comprehensive closure plans that return all mine sites to viable and, whenever practicable, self-sustaining ecosystems, and to ensure these plans are adequately financed, implemented and monitored within all jurisdictions.

The Strategic Framework for Mine Closure is structured around a set of objectives and principles under six key areas:

- Stakeholder Engagement: to enable all stakeholders to have their interests considered during the mine closure process;
- Planning: to ensure the process of closure occurs in an orderly, cost-effective and timely manner;
- Financial Provisioning: to ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability;
- Implementation: to ensure there is clear accountability, and adequate resources, for implementation of the closure plan;
- Standards: to establish a set of indicators that will demonstrate the successful completion of the closure process; and
- Relinquishment: to reach a point where the company has met agreed completion criteria to the satisfaction of the responsible authority.

A Guide to Leading Practice Sustainable Development in Mining, Leading Practice Sustainable Development Program for the Mining Industry, Australian Government, 2011

This Guide consolidates a series of handbooks relevant to all stages of a mine's life, being exploration, feasibility, design, construction, operation, closure and rehabilitation. The aim of the Guide is to identify key issues affecting sustainable development in the mining industry and provide information and case studies to enable a more sustainable basis for its operation. This Rehabilitation and Mine Closure Strategy has been developed in accordance with a number of guides generated through the Leading Practice Sustainable Development Program for Mines. These include:

- Mine Closure and Completion;
- Mine Rehabilitation;
- Biodiversity Management;
- Tailings Management;
- Water Management;
- Community Engagement and Development; and
- Hazardous Materials Management.

NSW Department of Planning, Industry and Environment – Resources Regulator (RR) Guidelines

RR also has in place a series of environmental management guidelines that are either directly or indirectly relevant to rehabilitation and mine closure issues. These include:

- ESG3: Mining Operations Plan (MOP) Guideline – September 2013 (ESG3);
- Guidelines for the Preparation of Extraction Plans (Draft V5) – Unpublished)
- Improving mine rehabilitation in NSW: Discussion paper – November 2017;
- Rehabilitation Cost Estimation Tool – May 2019); and
- ESG1: Rehabilitation Cost Estimate Guidelines – June 2017.

It is noted that the former subsidence management plan process was replaced by a consolidated extraction plan process that requires a single extraction plan. The previous subsidence management plan and extraction plan guidelines will no longer apply to the Project, following the grant of development consent and the combined, replacement *Guidelines for the Preparation of Extraction Plans* (Draft V5) currently in draft form will be referenced.

3 THE GENERAL ENVIRONMENT

This section provides a description of the existing environment, which sets the basis on which a number of potential post-mining land uses have been considered as part of this strategy.

3.1 Existing Land Use

The existing land uses in and surrounding the Project Area, identified during preparation of the *Agricultural Impact Statement Tahmoor Mine, Tahmoor South Project* (SLR, 2020), included:

- Existing, naturally vegetated areas;
- Rural residential, including agriculture;
- Market gardens;
- Rail corridor;
- Native grazing; and
- Poultry farming.

3.2 Topography and Hydrology

Topography in the region ranges from gently undulating plateaus, ridges and low hills in the upland areas, to a rugged landscape of deeply dissected valleys and gorges within the Hawkesbury Sandstone.

Topography within the Project Area is generally undulating, with a fall from the south-west to the north-east. The major topographical features are the Bargo and Nepean River valleys. Surface levels within the Project Area vary from a low point of approximately 105 metres Australian Height Datum (AHD), in the base of the Nepean River valley, to a high point of approximately 375 metres AHD, at the southern end of the Project Area.

The proposed development is located in the Bargo River catchment. The Bargo River flows in a generally north-easterly direction to its confluence with the Nepean River, near the Pheasants Nest Weir. The Bargo River consists of a sequence of pools, glides and rock bars across sandstone bedrock, with occasional boulder fields and cobblestone riffles. The Bargo River drains a total catchment of approximately 13,000 hectares at its confluence with the Nepean River.

The Bargo River has ephemeral flow in its upper reaches, which is (to some degree) regulated by the Picton Weir, approximately 14 kilometres upstream of the Nepean River confluence. Downstream of the Tea Tree Hollow confluence, flow of the Bargo River is perennial due to licenced discharges from the Tahmoor Mine pit top. The Bargo River flows into the Nepean River 9 kilometres downstream of the Tea Tree Creek confluence.

The Nepean River rises in the Great Dividing Range to the west of the Project Area. Flows in the upper reaches of the Nepean River are highly regulated by the Upper Nepean Water Supply Scheme, operated by the Sydney Catchment Authority, incorporating four major water supply dams on the Cataract, Cordeaux, Avon and Nepean Rivers. The Nepean Dam is situated approximately 18 kilometres upstream of the Bargo River confluence.

The Nepean River has been extensively modified by construction of a series of in-stream weirs that have created a series of pondages, with the nearest to the Project Area being the Malden Weir.

The central part of the Project Area is predominantly drained by Tea Tree Hollow and Dog Trap Creek, which generally flow north and eastward toward the Bargo River. A small area on the southwest of the central part is drained by headwater tributaries of Hornes Creek, which flows into the Bargo River at Picton Weir. Licensed discharges from the Tahmoor Mine pit top enter Tea Tree Hollow at LDP 1.

The eastern part of the Project Area is predominantly drained by Eliza Creek, which flows northward to the Nepean River.

3.3 Geology and Soil Landscape

The Tahmoor South Project is located within the southern part of the Permo-Triassic Sydney Basin. The main coal bearing sequence is the Illawarra Coal Measure, which contains four workable seams. The proposed development will target the upper most seam, known as the Bulli Seam.

Overlying the Bulli Seam is the Hawkesbury Techtonic Stage, which is comprised of three stratigraphic units, namely the Narrabeen Group, Hawkesbury Sandstone Group and the Wianamatta Group. The Narrabeen Group overlies the Bulli Seam and is comprised of interbedded sandstone and claystone units and is up to 310 metres thick. Above the Narrabeen Group is the Hawkesbury Sandstone Group, which is comprised of a series of bedded sandstones up to 185 metres thick. The Wianamatta Group overlies the Hawkesbury Sandstone, and is comprised of shales and siltstones and is relatively thin.

The Nepean Fault is located within the Project Area and the proposed mine plan has been developed with consideration of the fault location. The Nepean Fault is east of the Tahmoor North operations and runs in an approximate north-south direction.

As reported in the *Agricultural Impact Statement* (SLR, 2020) prepared for the proposed development, there are seven soil landscape units within the Project Area, including the Blacktown, Gymea, Hawkesbury, Lucas Heights, Luddenham and Volcanic as well as disturbed terrain. The Lucas Heights soil landscape unit is the most prevalent, comprising 69% of the Project Area. The majority of the Project Area for the *Agricultural Impact Statement* (SLR, 2020) is highly to severely constrained for cultivation (cropping) enterprises.

The Lucas Heights, Blacktown, Volcanic and Luddenham soil landscape units comprise 86% of the Project Area and have a low to moderate agricultural limitation rating. These soil landscapes represent the land most suitable for grazing.

Four major soil orders are present within the Project Area, namely, Kurosols, Tenosols, Rudosols and Dermosols. The Kurosols have moderately low inherent fertility and are the most prevalent soil type, making up approximately 56% of the Project Area.

3.4 Land and Soil Capability and Agricultural Suitability

An *Agricultural Impact Statement* was undertaken for the Tahmoor South Project Area by SLR (2020). The aim of this assessment was to assess the potential impacts of the proposed development on agricultural resources and/or industries within and surrounding the Project Area. SLR (2020) found that within the Project Area there are three dominant Land and Soil Capability (LSC) classes present, namely LSC Classes 4, 6 and 7. These are summarised below:

- LSC Class 4 is rated as having moderate agricultural capability and has moderate to high limitations for high-impact land uses and comprises 4,615 hectares of the Project Area.

- LSC Class 6 land is rated as having low agricultural capability and has very high limitations for high-impact land uses and covers 1,000 hectares of the Project Area.
- LSC Class 7 land is rated as having very low agricultural capability and has severe limitations that restrict most land uses and covers 509 hectares of the Project Area.

In addition, 374 hectares of land within the Project Area is not classed for agricultural production, this comprises 271 hectares of Metropolitan Special Area (MSA) restricted land, which is part of the catchment for Nepean and Avon Dams and 103 hectares of mine disturbed terrain. Whilst the Project Area, which is defined by the existing Tahmoor Mine lease boundaries, extends into the MSA, no works associated with the Tahmoor South project extend into this area.

Importantly, SLR (2020) concluded that the Project will have economic benefits to the region, whilst having negligible impact on the agricultural resources, enterprises and related industries.

The Strategic Agricultural Land Map – Sheet STA_041 (Map identification number: SEPP_MPEI_STA_041_20130910), which includes the proposed development area, indicates there is no Biophysical Strategic Agricultural Land (BSAL) present within the Project Area.

3.5 Ecology

3.5.1 Flora

A *Biodiversity Assessment Report* was undertaken for the Tahmoor South Project by Niche Environment and Heritage (Niche) (2020b). Eight vegetation communities have previously been mapped within the Project Area as part of the Native Vegetation of Southeast NSW mapping project (Tozer et al., 2006). These vegetation communities include:

- Coastal Sandstone Ridgetop Woodland;
- Cumberland Shale Sandstone Transition Forest;
- Hinterland Sandstone Gully Forest;
- Lower Blue Mountains Wet Forest;
- Sandstone Riparian Scrub;
- Southern Highlands Shale Woodland;
- Sydney Hinterland Transition Woodland; and
- Wingecarribee-Burragorang Sandstone Forest.

The Cumberland Shale Sandstone Transition Forest vegetation community is listed as an Endangered Ecological Community (ECC) under the NSW *Biodiversity Conservation Act 2016* (BC Act). In addition, the Southern Highlands Shale Woodland is listed as an EEC under the BC Act.

Niche undertook vegetation mapping within the proposed surface facilities sites and identified four vegetation communities:

- Shale Sandstone Transition Forest (derived grasslands, shrubland, regenerating);
- Upper Georges Sandstone Woodland (woodland and shrubland);
- Western Sandstone Gully Forest; and
- Exotic pasture.

During the vegetation mapping, Niche identified five threatened flora species, these being *Epacris purpurascens var. purpurascens, Grevillea parviflora subsp. parviflora, Persoonia bargoensis, Persoonia glaucescens and Pomaderris brunnea*. In addition, habitat for *Acacia bynoeana* and *Persoonia hirsute* was also identified.

The proposed surface works for the Tahmoor South Project will include clearing of approximately 24 hectares of native vegetation being Shale Sandstone Transition Forest, which is an ECC under the BC Act and the EPBC Act. The specific locations include: REA (11.06 ha), ventilation shafts (9.5 ha) and power lines (3 ha). Niche concluded that removal of the Shale Sandstone Transition Forest is likely to result in a significant impact on the community.

Given the potential impact on threatened biodiversity as a result of the proposed development, Niche prepared the *Tahmoor South Project – Biodiversity Offset Strategy*, which is part of the *Biodiversity Assessment Report* (Niche, 2020b). The biodiversity offset strategy outlines the approach to securing the required biodiversity offsets and addresses the requirements of the State and Commonwealth legislative biodiversity offsetting requirements.

3.5.2 Fauna

From the terrestrial fauna assessment, undertaken by Niche (2020b) for the Tahmoor South Project, 32 threatened and migratory fauna were either recorded or considered to have a moderate to high likelihood of occurring, given they have habitat within the Project Area. The majority of these species are highly mobile species (such as threatened birds and microbats) whose use of the Project Area would be largely limited to foraging. It is unlikely these species would be solely dependent upon the habitat features within the area to be disturbed by the surface infrastructure works, and are unlikely to be impacted by subsidence. Of these species considered, the Gang-Gang Cockatoo, Koala, Red Crowned Toadlet, and Broad-Headed Snake are the only credit species that have a moderate or greater likelihood of occurrence. However, the likelihood for impacts toward these species from the clearing works, and subsidence related impacts are relatively low to unlikely. As such, no biodiversity offset is proposed for any threatened fauna.

Threatened fauna listed under the EPBC Act with the potential to occur and be impacted include: Swift Parrot, Rainbow Bee-Eater, Satin Flycatcher, Regent Honeyeater, Broad-Headed Snake, Large-Eared Pied Bat and Grey-Headed Flying-Fox. An EPBC Act Assessment of Significance for each of these species has been completed and concluded that a significant impact to any EPBC Act listed threatened fauna is unlikely.

3.6 Subsidence

Mine Subsidence Engineering Consultants (MSEC) undertook a subsidence assessment for the Tahmoor South Project. The results of the assessment are presented in the report *Tahmoor South Project – Amendment Report for Longwalls 101A to 108B, Subsidence Predictions and Impacts Assessment for Natural Features and Surface Infrastructure* (MSEC, 2020). The maximum subsidence predicted by MSEC (2020) is shown in **Table 6**.

Table 6 Maximum Predicted Total Conventional Subsidence, Tilt and Curvature Resulting from the Extraction of the EIS Layout and Amended Layout

Layout	Longwalls	Maximum Predicted Total Conventional Subsidence (mm)	Maximum Predicted Total Conventional Tilt (mm/m)	Maximum Predicted Total Hogging Curvature (km^{-1})	Maximum Predicted Total Hogging Curvature (km^{-1})
Amended Layout (MSEC 1060)	LW101A to LW106A	1,350	8.7	0.13	0.23
	LW101B to LW108B	1,650	10.5	0.16	0.28
EIS Layout (MSEC997)	LW101 to LW108	1,900	13.0	80.19	0.33
	LW109	1,000	8.0	0.09	0.24

Note: Adapted from MSEC (2020).

The maximum predicted total subsidence after completion of the proposed longwalls, is 1,650 millimetres representing approximately 63% of the extraction height. The maximum predicted total conventional tilt is 10.5 millimetres per metre, which represents a change in grade of 1 in 95. The maximum predicted curvatures are o.16 km^{-1} hogging and 0.28 km^{-1} sagging, which represent minimum radii of curvature of 6.3 kilometres and 3.6 kilometres, respectively.

MSEC reported that surface cracking resulting from conventional subsidence movement is not commonly observed where the depth of cover is around 400 metres. In view of this and the depth of cover within the Project Area, observed surface cracking is generally isolated and minor in nature. However, cracking more frequently occurs within the base of valleys.

In the Tahmoor South surface water report (HEC, 2020b), it is reported that, based on past experience, the following effects may be expected where subsidence and upsidence occurs in watercourses formed in the Hawkesbury Sandstone:

- "*capture of a portion of low flows and the diversion of this water downstream via the created underground fracture network;*
- *re-emergence of surface water downstream of the affected area;*
- *reduced frequency of pools overflowing and lower pool water levels during dry weather;*
- *reduced and periodic loss of interconnection between pools during dry weather;*
- *localised and transient increases in iron concentrations and other minerals due to flushing of iron from exposed fractures in the sandstone rocks containing variable iron/manganese mineralisation;*

- *creation and/or enhancement of existing iron rich springs; and*
- *drainage of strata gas".*

HEC (2020b) also stated that "*impacts include localised and relatively isolated cracking of bed sediments; creation of transient and permanent pools in subsidence depressions and/or alteration of existing pools and small scale bed and bank scour due to local increases in bed and bank slope".*

MSEC (2020) state that given the distance from the longwall panels and low predicted ground movements, the Bargo and Nepean Rivers are not expected to experience any noticeable subsidence or upsidence movements.

MSEC also reported a number of potential impacts on local streams, namely Dog Trap Creek, Hornes Creek and Tea Tree Hollow. The potential impacts include:

- Dilation cracking along the stream bed and diversion of water into the dilated strata is likely to occur, resulting in partial or complete diversion of surface water;
- Fracturing and surface flow diversion are likely to occur in the sandstone bedrock, particularly where streams are located above longwalls;
- Fracturing could impact on the holding capacity of standing pools, however, no net loss of water from the catchment is predicted; and
- Gas emissions to the atmosphere.

Based on the typical predicted changes in stream bed grade is less than 0.05%, with a maximum predicted change of 1.2%, MSEC (2020) determined that the potential for increased scouring was insignificant.

4 ENVIRONMENTAL PERFORMANCE OBJECTIVES

Rehabilitation of the Project Area, post-mining, will return a stable landform capable of uses similar to those prior to disturbance (refer to Section 3.1). The objectives of rehabilitating disturbed land include:

- Progressively undertaking rehabilitation on areas that cease to be used for mining or mine-related activities as soon as practicable after the areas become available for rehabilitation.
- Achievement of acceptable post-disturbance land use suitability – mining and rehabilitation will aim to create a stable landform with land use capability and/or suitability similar to that prior to disturbance, unless other beneficial land uses are pre-determined and agreed. This will be achieved by setting clear rehabilitation success criteria and outlining the monitoring requirements that assess whether or not these criteria are being accomplished.
- Cleared native vegetation will be revegetated using existing vegetation communities where appropriate, for example Shale Sandstone Transition Forest or Upper Georges River Sandstone Woodland or other appropriate vegetation communities identified at the Project Area during the pre-mining assessment. The objective of rehabilitation for the post-disturbance land use of native vegetation is to accomplish and remain a sustainable native bushland.
- Creation of stable post-disturbance landform - mine wastes and disturbed land will be rehabilitated to a condition that is self-sustaining or to a condition where maintenance requirements are consistent with an agreed post-mining land use.
- Preservation of downstream water quality – surface and ground waters that leave the mining leases should not be degraded to a significant extent. Current and future water quality will be maintained at levels that are acceptable for users downstream of the site.

Rehabilitation of disturbed land associated with mining will proceed as soon as practicable after the areas become available for rehabilitation. The rehabilitation of disturbed land at the mine site will be conducted so that:

- Suitable vegetation species are used to achieve the nominated post-mine land uses;
- The potential for water and wind induced erosion is minimised, including the likelihood of environmental impacts being caused by the release of dust;
- The quality of surface water released from the site is such that releases of contaminants are not likely to cause environmental harm;
- The water quality of any residual water bodies is suitable for the nominated use and does not have the potential to cause environmental harm; and
- The final landform is stable and not subject to slumping or erosion which would result in the agreed post-mining landform not being achieved.

5 RISK-BASED APPROACH TO REHABILITATION AND CLOSURE

A risk management process will be implemented throughout all phases of the Project, including rehabilitation and closure, in accordance with the relevant regulatory requirements and Tahmoor guidelines and standards.

During operations, rehabilitated areas will be considered in compliance with the requirements of the Extraction Plan and associated guidelines.

In addition, as the mining operations progress through the life-cycle, potential sustainable development risks relating to closure will be continually identified and appropriate mitigation strategies developed to control or eliminate the risk. Where practicable, mitigation strategies will be implemented as early as possible in the project life-cycle to minimise potential risks at closure.

Following approval of the Project, a rehabilitation and closure risk register will be developed for inclusion in the Rehabilitation and Closure Management Plan (or similar). The risk register will be updated regularly and will include, but not be limited to, key elements such as:

- Regulatory requirements;
- Internal corporate standards and expectations;
- Stakeholder expectations and requirements;
- Post-closure land use options and potential end land users;
- Progressive rehabilitation opportunities;
- Demolition and decommissioning;
- Progressive and residual rehabilitation requirements;
- Revegetation; and
- On-going maintenance and monitoring requirements.

6 ASSIGNING REHABILITATION AND CLOSURE DOMAINS

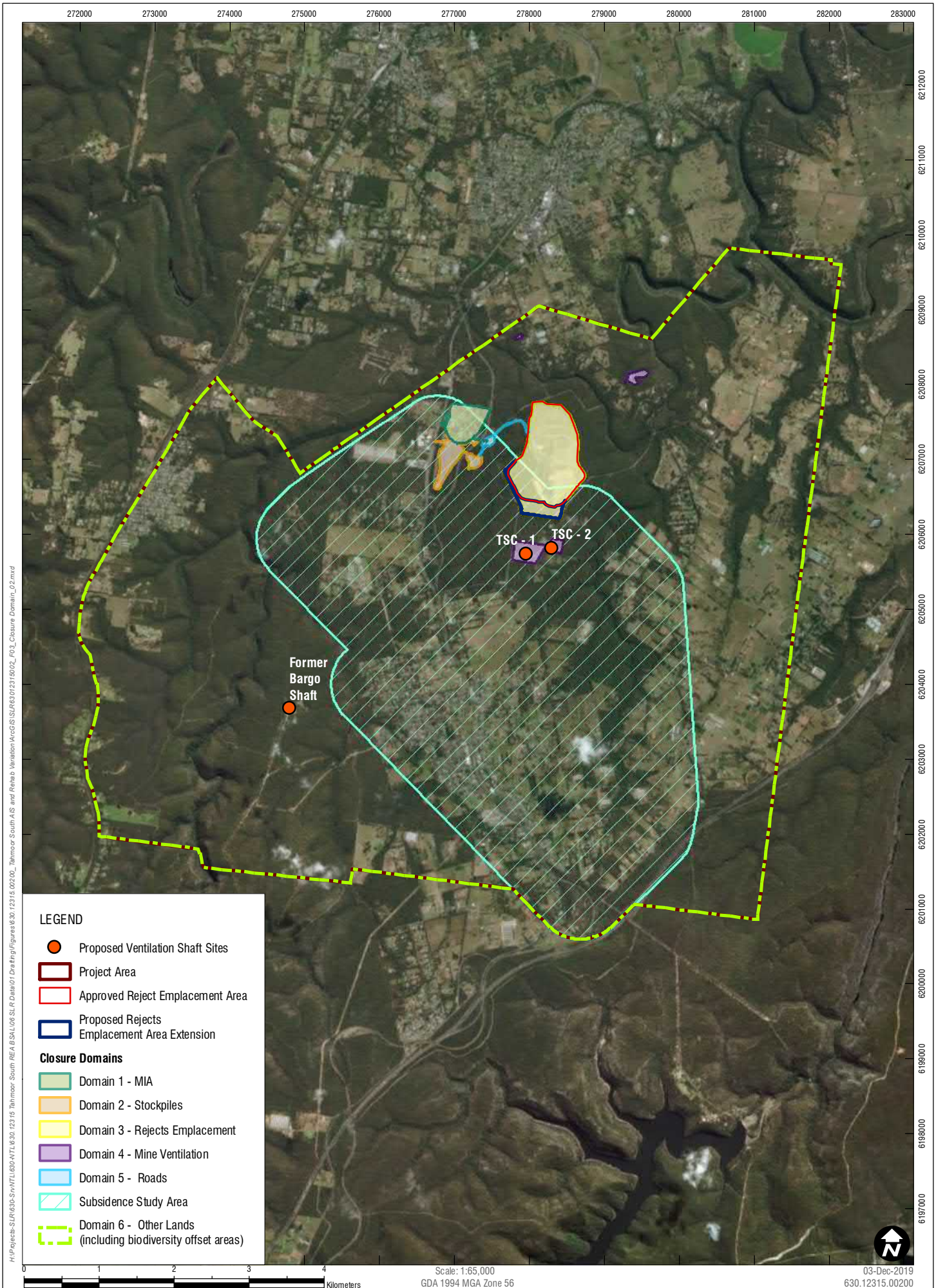
To effectively address the complexity of various land uses at Tahmoor Mine, the Project Area has been divided into six management 'domains'. The domains identified within this strategy are shown in **Figure 3** and are defined as:

- Domain 1: MIA;
- Domain 2: Stockpiles;
- Domain 3: Reject emplacement area (REA);
- Domain 4: Mine ventilation;
- Domain 5: Roads; and
- Domain 6: Other lands (including biodiversity offset areas).

6.1 Domain 1: MIA

The infrastructure to be decommissioned and rehabilitated in Domain 1 includes both the existing CHPP and proposed upgrade. The main features within Domain 1 include:

- The existing CHPP and proposed upgrades to allow for a consistent throughput of 650 tonnes per hour, including:
    - Aerial and ground level conveyors, transfer stations and gantries;
    - Two 1,250 tonne and one 5,000 tonne coal silos; and
    - Thickeners;
- Temporary tailings pond;
- The existing ventilation shaft T3:
- The existing site amenities, including offices and bathhouses, and proposed upgrades, including additional bathhouses;
- Existing workshops;
- A proposed all-weather covered pathway and rail loop bridge to the T3 man lift from the mine amenities and muster area;
- The existing sewerage/water treatment plant;
- The existing car parking area and proposed extension;
- The existing gas plant (and any upgrades as required), cogeneration plant and on-site flare plant;
- The existing drift and a men and material lift within the existing T3 downcast shaft;
- The existing rail load out facility, including a rail loading bin and associated hydraulics, and rail loop;
- The existing water management infrastructure, including siltation ponds; and
- Existing power lines.



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Closure Domains

FIGURE 3

6.2 Domain 2: Stockpiles

The main features within Domain 2 include:

- ROM coal stockpile;
- ROM coal reclaim tunnel;
- Product coal stockpile;
- Product coal reclaim tunnel; and
- Associated water management infrastructure, including dams S2, S3 and S4.

6.3 Domain 3: Reject Emplacement Area

The main features within Domain 3 include:

- The REA; and
- Water management infrastructure.

6.4 Domain 4: Mine Ventilation

The main features within Domain 4 include:

- The former Bargo Shaft;
- Two existing ventilation shafts including, T1 and TS3;
- Two proposed ventilation shafts, including:
    - TSC1 – an upcast ventilation shaft to be located on Tahmoor Coal's Charlies Point Road property; and
    - TSC2 – a downcast ventilation shaft to be located on Crown Land adjacent to Tahmoor Coal's Charlies Point Road property;
- The 66 kV electrical powerline to TSC1 associated substation;
- Buildings to house the fans, including outlet flues approximately 20 m high at upcast shafts;
- Water treatment sedimentation controls;
- Hardstand areas;
- The TSC1 ventilation shaft site will also include additional operational service shafts for ballast and concrete delivery to the mine workings and for access for underground mine services; and
- Surface gas drainage infrastructure adjacent to the Charlies Point Road vent shafts.

6.5 Domain 5: Roads

The main features within Domain 5 are the internal haul roads required for rejects transport.

6.6 Domain 6: Other Lands

The main features within Domain 6 include:

- Subsidence areas;
- Proposed 66 kV power line extension from the REA to the Charlies Point Road vent shaft sites;
- Gas drainage and management infrastructure;
- Exploration boreholes;
- Light vehicle access tracks; and
- Biodiversity offset areas.

7 PRELIMINARY LAND USE OPTION ANALYSIS

Tahmoor Coal proposes a life of mine for the Project until approximately 2035. As the mine is over 13 years from closure, the options presented below are considered to be preliminary and a comprehensive analysis of closure land use options has not been undertaken. It is intended that this would be completed during the detailed closure planning process, which is typically undertaken no later than five years out from permanent closure of the site.

This strategy has been prepared on the basis that all existing and proposed mine-related infrastructure and associated aspects will be entirely removed and the Project Area returned to as close to pre-mining land use as possible. The exception will be any structures listed as heritage items under the Wollondilly LEP. This is considered to be best practice.

A preliminary assessment has been undertaken in the preparation of this strategy, which identified a number of potential land use options for each of the discreet areas within the Project Area. A summary of the preliminary land use options is presented in **Table 7**. It is anticipated that these options will be reviewed in more detail at the detailed closure planning stage which, as advised above, will be no later than five years from permanent mine closure. During the detailed phase of closure planning, Tahmoor will also undertake additional stakeholder consultation to identify the most suitable post-closure land use.

During closure planning, the Wollondilly Local Environmental Plan (or subsequent documents) and any other relevant strategic land use planning and resource management plans or policies will be considered.

The Project proposes to continue underground mining with surface disturbance as a result of subsidence of an equivalent nature to the current Tahmoor operations. As additional data is collected from the remediation of subsidence impacts and rehabilitation of the REA is progressed, the closure risk register (see **Section 5)** will be updated and regularly reviewed throughout the life of the mine to reflect the required works for effective rehabilitation, and ultimately lease relinquishment.

It has been assumed in preparing this strategy that all surface infrastructure will be demolished and removed following closure of the mine, with the exception of heritage listed items.

At the time of mine closure, there may be opportunities for infrastructure, such as roads and buildings, to remain to service future industries on-site and/or neighbouring industries. A number of other opportunities for re-use and/or recycling may also be available; however, these opportunities will be considered during the detailed closure planning phase, which will include extensive stakeholder consultation. Where an alternative arrangement is made by way of formal agreement, this strategy will be amended to incorporate those changes.

Table 7 Preliminary Post Mining Land Use Options

Key Area	Preliminary Final Land Use Options	Proposed Final Land Use and Reasoning
Domain 1 MIA	• Access to future mining areas (additional reserves, subject to potential future approvals) • Re-development of the pit top area for industrial use (coal related) • Re-development of the site for some other industrial use • Re-development of the site for a commercial use • Re-development of the site for residential use • Return to native bushland	• Native bushland as this was the previous land use prior to construction of the MIA and is consistent with the land use objectives for the Rural Landscape zone (RU2) as set out in the Wollondilly LEP
Domain 2 Stockpiles	• Access to future mining areas (additional reserves, subject to potential future approvals) • Re-development of the stockpile area for industrial use (coal related) • Re-development of the site for some other industrial use • Re-development of the site for a commercial use • Re-development of the site for residential use • Environmental value (biodiversity) • Grazing or other agricultural use • Return to native bushland	• Native bushland as this was the previous land use prior to construction of the stockpile areas and is consistent with the land use objectives for the Rural Landscape zone (RU2) as set out in the Wollondilly LEP
Domain Reject emplacement area	• Return to native bushland	• Native bushland as this was the previous land use prior to construction of the REA and is consistent with the land use objectives for the Rural Landscape zone (RU2) as set out in the Wollondilly LEP
Domain 4 Mine ventilation	• Return to native bushland	• Native bushland as this was the previous land use prior to construction of the mine ventilation and is consistent with the land use objectives for the Rural Landscape zone (RU2) as set out in the Wollondilly LEP
Domain 5 Roads	• Return to native bushland • Remain for access to existing properties	• Native bushland as this was the previous land use prior to construction of the roads and is consistent with the land use objectives for the Rural Landscape zone (RU2) as set out in the Wollondilly LEP

Domain 6 Other lands	• Commensurate with the surrounding land use • Protected for biodiversity offsets	• Native bushland, biodiversity offsets and existing land uses as these are the current land uses and are consistent with the land use objectives for the Rural Landscape zone (RU2) as set out in the Wollondilly LEP

8 STAKEHOLDER ENGAGEMENT

The Tahmoor Mine currently undertakes extensive community consultation in accordance with the *Tahmoor Mine Social Involvement Plan* (SIP). The SIP includes a Stakeholder Consultation Program, and a list of stakeholders. Community consultation is currently undertaken through a number of forums including:

- A Face-to-Face Program for local residents;
- Tahmoor Colliery newsletter, which is provided to subscribers on a monthly basis;
- Community information days, which are held at a local Community Centre every six months or as required;
- Quarterly meetings of the Tahmoor Community Consultative Committee; and
- The Tahmoor website.

In addition, AECOM (2018) undertook a Social Impact Assessment as part of the Environmental Impact Statement for the Tahmoor South Project. The findings of this study are presented in the *Social Impact Assessment*, Tahmoor South Project. The objective of the SIA was to identify and assess the potential social impacts of the proposed development.

The proposed development is anticipated to generate both beneficial and adverse social impacts. The recommendations from this study will be incorporated into the existing SIP and forums to provide continuity in the approach to stakeholder consultation. Where required, additional consultation will be undertaken to ensure that effective stakeholder engagement continues throughout the project life cycle.

A social impact assessment will also be undertaken during detailed closure planning. It is anticipated that the social impact study will consider the Tahmoor South Project's expenditure patterns within the local area, community contributions, and location of employees as well as potentially affected local businesses and suppliers. The outcomes of the social impact study will be used to assess feasible final land use options to minimise negative social impacts associated with mine closure.

9 PLANNING FOR DECOMMISSIONING

A decommissioning and demolition plan will form an integral part of the detailed closure planning for the Project. This will be developed for the site prior to closure and will include engaging structural engineers and appropriate technical experts with experience in demolition and the application of relevant Australian Standards and guidelines. A detailed investigation of all structures will be completed to determine the appropriate techniques, equipment required, and the sequence for decommissioning and removal required to execute the demolition activities safely.

9.1 Heritage Management

During detailed closure planning relevant heritage assessments will be undertaken to assess potential heritage items that need to be considered during the detailed closure planning phase. It is anticipated that the heritage assessment will be targeted to specific infrastructure, and the outcomes will be used to ensure that the decommissioning and rehabilitation works are undertaken in accordance with the NSW *Heritage Act 1977*. It is noted that the Historic Heritage Assessment conducted for the Project (Niche, 2020a) found that the existing Tahmoor Colliery is of local heritage significance. This will also be considered during the detailed closure planning phase.

9.2 Hazardous Materials

Prior to the demolition of any structures, a hazardous material assessment will be undertaken to determine whether there are any hazardous materials present, including asbestos. Where hazardous materials are identified, they will be assessed and quantified to enable appropriate safety measures to be implemented during removal by a licensed contractor. All hazardous material removed from the buildings will be recorded and disposed of at an approved waste management facility.

9.3 Investigation of the Site

An investigation of the site when planning for decommissioning and demolition will be conducted to confirm the following:

- The type, location and extent of underground services, such as conduits, cables and pipe work;
- The location and extent of underground structures to be retained and those to be removed;
- The location, type and extent of overhead services and structures, such as power cables, conveyors, light poles and pipe work;
- The location and condition of all tanks and vessels (with emphasis on remaining combustible materials and methods required for their removal);
- The presence of contaminated and hazardous materials and the classification and disposal of these materials;
- The general condition of adjacent structures; and
- Any infrastructure to remain (including roads and tracks) following decommissioning.

9.4 Investigation of Structures

When planning for decommissioning and demolition, an investigation of the structures will be completed to identify the following:

- The structures' current condition with regard to their state of disrepair or deterioration;

- The presence of heavy steel within structures that may require specialised demolition equipment and/or techniques;
- Potential imposed loads or changes in the centre of gravity of structures during demolition works; and
- Confined spaces and/or techniques required to be implemented to avoid entering such spaces.

9.5 Site Preparation

Prior to the commencement of any demolition activities the following tasks will be undertaken:

- All sumps will be dewatered;
- All items will be decommissioned, de-oiled, depressurised and isolated; and
- All hazardous materials will be removed and transported to appropriately licensed disposal facilities.

9.6 Site Infrastructure and Services

All buildings, including the main administration buildings, workshop areas, coal delivery systems (including conveyors and gantries), drift and other surface infrastructure will be demolished and disposed of in a suitable location, subject to any heritage preservation requirements. Opportunities for the sale and/or re-use of assets and recycling of scrap steel will be maximised where possible.

Concrete footings and pads will be broken up to at least 1.5 metres below the surface and removed. Options for the re-use of this material (for example, crushed and used for road and track stabilisation or sold for use as road base) will be investigated as the operation approaches closure. If re-use or recycling opportunities aren't available or viable, all "non-contaminated" waste material will be disposed of in a suitable location on-site (for example, in a shaft or the drift) or taken off-site to an approved waste management facility.

9.7 Contamination

Well in advance of final closure a preliminary investigation into potential sources of contamination, including some Phase 1 sampling and analysis, will be undertaken. This will be used to determine whether a detailed assessment (for example, Phase 2 sampling and analysis) should be conducted to quantify the amount of contaminated material that may require remediation.

Where possible all identified sources of contamination will be remediated during the operational phase of the mine. In some cases, however, this may not be possible (for example, under existing slabs, and workshops) and in these circumstances the remediation will be undertaken following cessation of operations and during decommissioning.

9.8 Waste Management

Prior to the commencement of demolition and/or the removal of waste from the site a detailed assessment will be undertaken to classify the waste into streams. The potential waste streams may include:

- Inert waste (i.e. glass, bricks, steel, iron sheeting, timber, concrete and metal);

- Solid waste (potentially low-level (<1,000 milligrams per kilogram) hydrocarbon contaminated soil, and municipal waste);
- Hazardous waste (potentially contaminated soil); and
- Industrial waste (hazardous materials, including asbestos).

During demolition works, wastes will be segregated and managed in accordance with the relevant waste stream and applicable guidelines at the time.

9.9 Traffic Management Plan

Prior to decommissioning activities commencing, a traffic management plan will be prepared, including implementation of any recommendations to reduce potential impacts. In particular, consideration will be given to areas and times of increased truck movements, such as the off-site disposal of waste or importation of fill material to the mine ventilation sites.

9.10 Risks to Rehabilitation

An assessment was conducted, on behalf of Tahmoor Coal, of the risks to rehabilitation from existing and potential acid and metalliferous drainage (AMD) and spontaneous combustion on the proposed REA. The risk assessment was conducted by GeoTerra Pty Ltd (GeoTerra) (2013). The risk assessment was conducted on the potential sources of AMD and spontaneous combustion from the operation, which include the Bulli Seam, as well as roof and floor rejects from the CHPP. The *Tahmoor South Project Reject Emplacement Area Acid & Metalliferous Drainage and Spontaneous Combustion Assessment* (GeoTerra, 2013) concluded that the risk of acidic or saline runoff and seepage from placement of Tahmoor South CHPP rejects at the REA is anticipated to be low.

Similarly, the GeoTerra report (2013) concluded that the risk of spontaneous combustion of Bulli Seam rejects from the CHPP is unlikely.

10 DECOMMISSIONING AND REHABILITATION WORKS

10.1 Domain 1: Surface Facilities Area

A summary of the infrastructure located within Domain 1 is outlined in **Section 6.1**.

10.1.1 Site Services

All services, including water, data and telephone, that are not required for demolition activities will be safely isolated, disconnected and terminated. Overhead power lines will be removed and the materials, including poles and wire, will be recovered for potential re-sale or recycling, where practicable.

Where also practicable, pipelines and cables with a diameter of approximately 200 millimetres or less will be capped and remain in-situ where they are located greater than 1.5 metres below ground level. This is due to the risk of disturbing the re-established vegetation by excavation and removal.

Pipelines and cables with a diameter greater than 200 millimetres will be removed or filled with an inert material, for example concrete, to avoid the potential for subsidence when the pipe deteriorates and collapses. When assessing the preferred decommissioning methodology, consideration will be given to the environmental significance of the area that the pipeline is to be removed from.

The location of pipelines that are to remain in-situ will be recorded in an abandoned services register and signs will be erected, where appropriate.

Pipelines located in critical locations, for example infrastructure crossings of environmentally sensitive areas and/or riparian zones, will be filled with inert material (such as concrete) to avoid additional disturbance of the environment.

10.1.2 Power Lines

Opportunities for utilisation of the power lines by the surrounding community and/or service providers will be investigated as part of the consultation process undertaken prior to decommissioning. If an alternative use for the infrastructure can be agreed with the relevant stakeholders it will remain in-situ. Alternatively, it will be decommissioned, as outlined below.

Power line infrastructure, including, but not limited to, power poles and transmission lines, will be demolished and disposed of in a suitable approved location. Opportunities for the sale and/or re-use of assets and recycling of scrap steel will be maximised, where possible.

10.1.3 Equipment and Buildings

Prior to commencement of demolition hazardous materials will be identified, and subsequently, removed by a licensed contractor. All hazardous material removed from the buildings will be recorded and disposed of at an approved waste management facility.

All demountable/transportable buildings will be removed from the surface facility sites. All remaining permanent buildings, including the administration buildings and workshops, will then be demolished, with the component materials recycled or re-sold.

Any materials not recycled or re-sold will be disposed of in a suitable location, either on-site or off-site, at a licenced waste management facility. Opportunities for the sale and/or re-use of assets and recycling of scrap steel will be maximised where possible. Material assessed as "not hazardous or contaminated" by a suitably qualified person may be disposed of within the drift or placed as fill into the shafts.

Concrete footings and pads will be broken up to at least 1.5 metres below the surface and removed. Options for the re-use of this material (for example, crushed and used for road and track stabilisation or sold for road base) will be investigated as the mine approaches closure. If re-use or recycling opportunities are not available or viable, all "non-contaminated" waste material will be disposed of in a suitable location on-site or off-site at an approved waste management facility.

All sumps will be de-watered and de-silted prior to the commencement of demolition. In addition, all items of equipment will be de-oiled, degassed, depressurised and isolated, and all hazardous materials removed from the Project Area. All recoverable scrap steel will be sold and/or recycled. Prior to disposal, all wastes will be assessed and classified in accordance with the relevant regulatory requirements.

Once the structures and the associated concrete slabs are removed, all areas would then be reshaped, deep ripped, topsoiled and seeded in accordance with **Section 11** below. Where suitable quantities of topsoil material is not available at the site, the use of other organics, such as bio-solids and/or compost, will be assessed as an appropriate addition to enable the establishment of an appropriate vegetation

10.1.4 Conveyors

All conveyors will be dismantled, removed from site and recycled at an appropriate facility. Opportunities for the sale and/or re-use of assets and recycling of materials will be maximised to the extent practicable. Over-head conveyors will be dismantled and lowered to the ground before being cut up. On ground conveyors will be cut up in-situ. Underground conveyor systems will be left in the mine when it is sealed (where it is not required for another operation). All gearboxes and other vessels will be drained of oil and depressurised prior to sealing of the mine.

The carbonaceous material below and in the vicinity of the surface conveyors will be stripped to a depth of at least 0.5 metres (or where it is totally recovered). Where possible the material will be considered for reprocessing. If this is not possible, it will be pushed up and stockpiled to be used to backfill the portal or shafts.

10.1.5 Men and Materials Drift and Ventilation Shafts

In preparation for decommissioning, a number of activities will be undertaken, including:

- Preparation of an accurate survey plan of the drift or ventilation shaft, including documentation of the conditions at the time of closure;
- Removal of any disused equipment where practicable and any material that has the potential to cause pollution;
- Removal of any hazardous materials and disposal at an approved waste disposal facility;
- Consideration of the potential for accumulation of gas within the workings and any measures required to seal the shaft and/or mitigate the potential risks;
- Liaison with the relevant regulatory bodies regarding the specific decommissioning and rehabilitation requirements; and

- Preparation of detailed plans specifying the proposed engineered seal for the drift.

During design of the engineered seals, consideration will be given to maintaining the integrity of the existing roof supports and bracing, along with the potential need for additional roof support during construction of the seal. Where practicable, the engineered seal will be designed to be explosion proof. The engineered seal will also be designed in accordance with the relevant Resources Regulator (or its equivalent) guidelines at the time of decommissioning.

Prior to commencement of drift decommissioning works, a plan detailing the proposed works and the safety precautions will be developed. This strategy will be approved and signed by a suitably qualified engineer.

All services associated with the drift will be disconnected and made safe. As a minimum, the first 50 metres of the conveyor and services from the surface will be dismantled, removed from site and recycled or disposed of at an appropriate facility.

The drift will be backfilled for a minimum distance of 25 metres (or to a depth of cover of no less than 15 metres) from the surface against an engineered seal. The backfill material will be appropriately compacted to an engineered standard and will be compacted in layers. All face cavities will be backfilled, and the creation of voids will be prevented, where possible.

Construction of the engineered seal will be undertaken by competent personnel under the supervision of a suitably qualified engineer. Inert material, such as concrete and carbonaceous material from around the site, will be backfilled against the seal level with the natural surface. Concrete slabs and/or steel reinforcements used in the works will comply with the relevant construction standards and construction activities will be carried out by competent personnel under the supervision of a suitably qualified engineer. The location will be recorded on an abandoned services register, which will be retained in site records.

Drainage and ventilation pipes will be incorporated into the engineered seal, where required. This may include a blanket drain behind the seal to drain any trapped groundwater. In addition, a 0.1 metre diameter breather pipe may also be installed.

Appropriate drainage infrastructure will be constructed to prevent erosion and to ensure runoff does not enter the mine or cause groundwater contamination. This may include construction of a temporary berm around the drift to divert surface runoff.

It is anticipated that the engineered seals for the ventilation shafts will include construction of two mass reinforced concrete slabs that cover the shaft face and are 0.5 metres thick. One of the slabs will be anchored to competent rock below any weathered material and pinned to the surrounding rock. The second slab will be positioned 1 metre below the surface. In addition, a breather pipe will be installed, if required.

Construction of the engineered seal will be undertaken by component personnel under the supervision of a suitably qualified engineer. Concrete slabs and/or steel reinforcements used in the works will comply with the relevant construction standards and construction activities will be carried out by competent personnel under the supervision of a suitably qualified engineer. The location will be recorded on an abandoned services register, which will be retained in site records.

The final landform will be commensurate with the surrounding land and appropriate water management structures will be installed where required. In addition, a secure fence will be constructed around the drift or shaft and appropriate signage will be constructed. The area of fencing will ensure that heavy vehicular traffic is diverted around the site and does not cause any damage to the seal.

10.1.6 Fuel Farms and Chemical Storage Areas

Prior to closure, a preliminary investigation of potential sources of contamination, including Phase 1 sampling and analysis, will be undertaken to determine whether a more detailed assessment (Phase 2) is required, as outlined in **Section 9.7**. The results of a Phase 2 investigation would be used to quantify the amount of contaminated material requiring bio-remediation on-site or requiring off-site disposal at a licensed facility.

Any remaining fuel and/or chemicals will be recycled or disposed of at an appropriately licensed facility. All items of equipment will be de-oiled, degassed, depressurised and isolated, and all hazardous materials removed from the site. All infrastructure associated with fuel farms and chemical storage areas will be demolished and disposed of off-site at a licenced waste management facility. Opportunities for the sale and/or re-use of assets and recycling of scrap steel will be maximised, where possible.

Concrete footings and pads will be broken up to at least 0.5 metres below the surface and removed. Options for the re-use of this material (for example, crushed and used for road and track stabilisation) will be investigated as the operation approaches closure. If re-use or recycling opportunities are not available or viable, all “non-contaminated” waste material will be disposed of in a suitable location on-site or off-site at an approved waste management facility. Material assessed as “not hazardous or contaminated” by a suitably qualified person can be crushed and disposed of within the drift or placed as fill into the shafts.

10.1.7 Roads and Tracks

Roadways and/or tracks may be required to remain to provide ongoing access for rehabilitation monitoring and maintenance activities. Alternatively, roads and/or tracks may remain on-site, if agreed in writing by the landowner.

All bitumen sealed surfaces, such as access roads, car parks and hardstands, will be scalped to approximately 0.5 metres below the surface to remove stabilised and compacted material. The inert waste will be disposed of in a suitable location on-site or off-site at an approved waste management facility. Material assessed as “not hazardous or contaminated” by a suitably qualified person can be crushed and disposed of within the main drift or placed as fill into the shafts.

Minor reshaping work may be undertaken to ensure surface level consistency with the surrounding areas and rehabilitated. Any creek crossings (such as culverts) will be removed and the pre-existing drainage line re-instated.

10.1.8 Sewage and Water Treatment Plant

Opportunities for utilising the sewage and water treatment plant and associated dams/ponds by surrounding landowners will be investigated as part of the consultation process during detailed closure planning. If an agreed use for the treatment plant or dams is identified, which has been agreed in writing with the future landowner and/or the regulator, the infrastructure may be left on-site following the removal of any residual produce water and sediment (if assessed and determined not to be suitable for the proposed use).

Unless an alternate suitable and agreed use is identified, the sewage and water treatment plant will be decommissioned as outlined below. The water pipelines will be drained and isolated. In addition, tanks and vessels will be pumped dry and services that are not required will be disconnected.

All buildings, and other surface infrastructure, pre-treatment equipment, control rooms, etc, will be dismantled or demolished and recycled or disposed of in a suitable approved location. Opportunities for the sale and/or re-use of assets and recycling of scrap steel will be maximised, where possible.

Concrete footings and pads will be broken up to at least 1.5 metres below the surface and removed. The dams and/or ponds will be decommissioned as follows:

- Draining the water from the dam;
- Sampling and analytical testing of the sediment within the dam, and appropriate treatment or disposal of the sediment based on the analytical results;
- Backfilling of the dam and reshaping to a landform similar to that of the surrounding undisturbed areas;
- If required, topsoiling and/or amelioration of the disturbed area; and
- Revegetating with species that are commensurate with the surrounding vegetation and proposed post-closure land use.

10.1.9 Gas Plant, Cogeneration Plant and On-Site Gas Flare

During detailed closure planning the ongoing requirement for the gas plant, cogeneration plant and on-site gas flare will be assessed. In particular, consideration will be given to ongoing operation to manage gas levels within the underground workings.

Prior to decommissioning activities commencing, the gas pipelines leading into the gas plant, co-generation plant and the on-site flare will be drained, isolated, and flushed with an inert gas. In addition, tanks and vessels will be pumped dry and, where relevant, flushed with an inert gas. Services will be disconnected.

All buildings, and other surface infrastructure, including the compressors, drive engines and/or motors, separators, electrical panels, pipework, control rooms, etc, will be demolished and disposed of in a suitable approved location. Opportunities for the sale and/or re-use of assets and recycling of scrap steel will be maximised, where possible. All associated infrastructure, for example fencing and security systems, will also be removed.

Concrete footings and pads will be broken up to at least 1.5 metres below the surface and removed.

Note that buried services may remain in-situ if they will not impact on the future land use, ie buried cables are at sufficient depth that they will not interfere with the post-closure land use.

10.1.10 Rail Load Out and Rail Loop

Well before closure, a preliminary investigation of potential sources of contamination, including Phase 1 sampling and analysis, will be undertaken to determine whether a more detailed assessment (Phase 2) is required, as outlined in **Section 9.7**. The results of a Phase 2 investigation would be used to quantify the amount of contaminated material requiring bio-remediation on-site or requiring off-site disposal at a licensed facility.

The rail loading facilities and the rail loop will be removed and disposed of in a suitable location, eg disposed of off-site at a licenced waste management facility, unless an alternative purpose has been established through consultation with relevant stakeholders during detailed closure planning. This will include breaking up the concrete pit beneath the rail loading bin. The rail track will be reused or recycled and ballast material will be used to backfill the drift or shafts.

Opportunities, for the sale and/or re-use of assets and recycling of scrap steel will be maximised, where possible.

Carbonaceous material will be stripped and, where possible, the material will be considered for reprocessing. If this is not possible, it will be pushed up and stockpiled to be used to backfill the drift or shafts. Alternatively, it may be placed in the REA.

10.1.11 Water Management Infrastructure

All water management infrastructure will be removed unless it is required for ongoing water management, eg to prevent erosion and to ensure runoff does not enter the mine or cause groundwater contamination. Where practicable and subject to any necessary approvals, underground water management infrastructure will be removed; however, some underground water management infrastructure may be made safe and left buried in-situ. Any concrete to be removed will be broken up and reused, if practical, as outlined in **Section 10.1.3**. The location of water management infrastructure that is to remain in-situ will be recorded in an abandoned services register, and signs will be erected, where appropriate.

10.2 Domain 2: Stockpiles

A summary of the infrastructure located within Domain 2 is outlined in **Section 6.2**.

10.2.1 Site Services

All services associated with the stockpiles that are not required for demolition activities will be safely isolated, disconnected and terminated. Overhead power lines will be removed and the materials, including poles and wire, recovered for potential re-sale or recycling, where practicable.

Where practicable, pipelines and cables with a diameter of approximately 200 millimetres or less will be capped and remain in-situ where they are located greater than 1.5 metres below ground level. This is due to the risk of disturbing the re-established vegetation by excavation and removal.

As outlined in **Section 10.1.1**, pipelines and cables with a diameter greater than 200 millimetres will be removed or filled with an inert material to avoid the potential for subsidence when the pipe deteriorates and collapses.

10.2.2 Stockpile Areas

The carbonaceous material on the base of the ROM and product stockpile areas will be stripped to a depth of at least 1.5 metres. Where possible, the material will be considered for reprocessing prior to the cessation of CHPP operations. Alternatively, the carbonaceous material will be disposed of within the drift or shafts, or placed in the REA.

The stockpile areas will be trimmed and reshaped and, if required, rock raked to remove all surface rocks to a size of less than 0.5 metres and ripped to a depth of at least 1 metre.

10.2.3 Reclaim Tunnels

The conveyors and any associated services will be removed and, where practicable, the material overlying the reclaim tunnels will be removed to expose the roof of the tunnel. Once the roof is exposed the concrete will be broken up (i.e. with a hydraulic jack hammer) and placed back into the tunnel or disposed of in a suitable location on-site, filling the drift of shafts, or off-site at an approved waste management facility. These works will aim to leave minimal cavities prior to backfilling the tunnel. Once the reclaim tunnels are backfilled and compacted, all areas will then be reshaped, deep ripped, topsoiled and seeded.

10.2.4 Conveyors, Transfer Stations and Gantries

All conveyors, transfer stations and gantries will be dismantled and removed from site. Opportunities for the sale and/or re-use of assets and recycling of materials will be maximised to the extent practicable. Over-head conveyors will be dismantled and lowered to the ground before being cut up. On ground conveyors will be cut up in-situ. All gearboxes and other vessels will be drained of oil and depressurised to remove any potential for contamination prior to demolition.

The carbonaceous material below and in the vicinity of the surface conveyors will be stripped. Where possible, the material will be considered for reprocessing. If this is not possible, it will be pushed up and stockpiled to be used to backfill portals or shafts.

10.2.5 Water Management Infrastructure

All water management infrastructure will be removed unless it is required for ongoing water management, e.g. to prevent erosion. Where appropriate, the location of water management infrastructure that is to remain in-situ will be recorded in an abandoned services register and signs will be erected, where appropriate.

As outlined in **Section 10.1.3**, any concrete to be removed will be broken up and reused or recycled, if practicable.

The dams and/or ponds will be decommissioned as follows:

- Draining the water from the dam;
- Sampling and analytical testing of the sediment within the dam, and appropriate treatment or disposal of the sediment based on the analytical results;
- Backfilling of the dam and reshaping to a landform similar to that of the surrounding undisturbed areas;
- If required, topsoiling and/or amelioration of the disturbed area; and
- Revegetating with species that are commensurate with the surrounding vegetation and previous land use.

10.2.6 Roads and Tracks

Roadways and/or tracks may be required to remain to provide ongoing access for monitoring and maintenance activities. Alternatively, roads and/or tracks may remain on-site, if agreed in writing by the future landowner. Access roads and tracks that are not required will be rehabilitated, as outlined in **Section 10.1.7**.

10.3 Domain 3: Reject Emplacement Area

A summary of the infrastructure located within Domain 3 is outlined in **Section 6.3**.

10.3.1 Reject Emplacement Area

10.3.1.1 Rehabilitation to date

The rehabilitated areas of the existing approved REA are monitored for success against the rehabilitation success criteria specified in the MOP. Rehabilitation monitoring was most recently conducted by Eco Logical Australia Pty Ltd (Eco Logical) (2018) in accordance with the Tahmoor EMS-MGP-002 Biodiversity and Land Management Plan. Rehabilitation monitoring was conducted by:

- An annual walkover inspection of all areas within the REA where rehabilitation activities have been completed, including newly established revegetation; and
- Monitoring of permanent monitoring sites within each mine closure Domain. Within the REA (closure Domain 3) permanent plots have been established within each development stage to assess revegetation progress.

The *Tahmoor Colliery Rehabilitation Monitoring 2018* report (Eco Logical, 2018) confirms that "rehabilitation of vegetation within the REA has been carried out since 1993 as each stage of the [rejects] emplacement was constructed. The permanent monitoring sites program began in 2010 with the initial establishment of two permanent plots within each existing section of the REA and two analogue plots established within relatively undisturbed native vegetation nearby. In addition to these initial plots, further plots were established in areas greater than four hectares to address the recommendations for native vegetation monitoring. In future, in accordance with monitoring guidelines, additional permanent plots will be installed as each area of revegetation within the REA reaches an age of 5 years from planting."

Permanent sites monitoring has provided information regarding changes in both vegetation growth, senescence, colonisation and species diversity. Rehabilitation success (or otherwise) is demonstrated by comparison of both vegetation structure and species composition with the analogue sites monitored in nearby bushland. Measuring methods of values include detailed species counts and cover within 2 m x 2 m plots and species diversity, canopy cover, growth rates, reproductive potential and progress within a 20 m x 10 m plot, supported by photographic records.

Walkover inspections record details across each stage and includes a range of information, including, but not limited to:

- Evidence of soil profile development;
- Evidence of erosion and stability and function of erosion and sediment control structures;
- Growth rates and evidence of plant mortality or dieback;
- Evidence of reproductivity potential; and
- Evidence of biological nutrient cycling.

In areas where existing, established revegetation was sparse, native grass species have been trialled and monitored to review their survival and growth.

The key monitoring results from the Eco Logical report (2018) include:

- Soil profile development is occurring in rip lines and areas with high leaf litter. Cover with grass litter is low due to dry conditions.

- Native plant species diversity is consistent with 2016 levels overall. The number of target species, consistent with analogue sites and nearby vegetation, within each monitoring plot remains adequate to good. Species diversity in canopy species is adequate on average in most REA stages, although some sections have limited diversity. Mid-storey species diversity is more limited.
- Native plant cover (over-storey, mid-storey and groundcover) remains variable across the REA. Groundcover varies greatly with some areas devoid of groundcover species. Native plant cover is, otherwise, increasing at a slow rate. Dry conditions is hindering colonisation by groundcover species, such as grasses and sedges. Native covers in more recent revegetation areas is consistent with high numbers of juvenile canopy species.
- Native plant growth rates are variable in newly established revegetation areas but generally better in those areas with low slope, suggesting moisture availability is limiting growth on steeper sections. Canopy species growth rates has remained consistent and senescent acacia mid-storey species present across the REA. Growth rates are adequate but variable, except for sub-shrubs. Second generation recruitment is greatest in acacia species in the canopy with recruitment in other species increasing slowly. Grass species recruitment is delayed, being heavily influenced by the dry conditions.
- Populations of threatened *Grevillea parviflora* subsp. *parviflora* are stable while *Persoonia bargoensis* are increasing with numerous seedlings recorded within areas of early revegetation and along the No 2 shaft 11 kV power line.

Monitoring results to date show that rehabilitation is, in part, achieving the success criteria. On-going maintenance and minor remedial works have been recommended to improve rehabilitation success and ensure rehabilitation achieves the desired success criteria, including, for:

- Maintenance: maintain annual monitoring to detect impacts of other factors other than drought, slashing grasses to provide organic litter, continue to monitor and implement weed control (avoiding off-target damage, which suggests damage is occurring as a result of insufficient care being taken), hand weeding around threatened species, slashing Fountain Grass ahead of seeding then spot spraying with follow-up, control seedlings spread of *Leptospermum laevigatum* outside stages 1 and 2, and continue to monitor for *Acacia saligna* and control; and
- Minor remedial works: infill planting with native grass tubestock in areas of limited groundcover, minor works required to rectify minor gully erosion, ripping and mulching of a seepage area, protection of native grasses from rabbit predation (implement a rabbit control program), and planting of canopy tubestock or brush mulching with canopy trees in sections with no canopy trees).

10.3.2 Proposed REA Expansion

The REA is proposed to be expanded and continued to be used throughout the proposed project life. As part of the EIS, a geotechnical desktop study and investigation report was prepared by Sinclair Knight Merz (SKM) (2017) to support civil design, filling schedule and water management plan for the expanded REA. This report, including the justification of the final landform design of the REA and associated stability assessment results, was appended to the EIS.

Following submissions on the project, the REA has been redesigned to specifically reduce the disturbance footprint proposed. Subsequently, the amended REA will have a final landform height of RL310 m (rather than the previous RL305 m as proposed in the EIS and RL300 m that is currently approved). The expanded footprint comprises an additional 11.06 ha of disturbance compared with the approved REA design (the design in the EIS proposed an additional 43 ha of disturbance).

In its submission, DI – Lands and Water noted that the REA is on waterfront land (i.e. within 40 m of a drainage line. Accordingly, rehabilitation of the REA will be undertaken with consideration of the *Guidelines for Working on Waterfront Lands* (the guideline) and in consultation with the relevant government agency/s.

Rehabilitation planning will address the objectives of the guidelines to establish and preserve the integrity of riparian corridors (RCs). The environmental functions of riparian corridors will be maintained and rehabilitated by applying the relevant and applicable principles from the guidelines, eg:

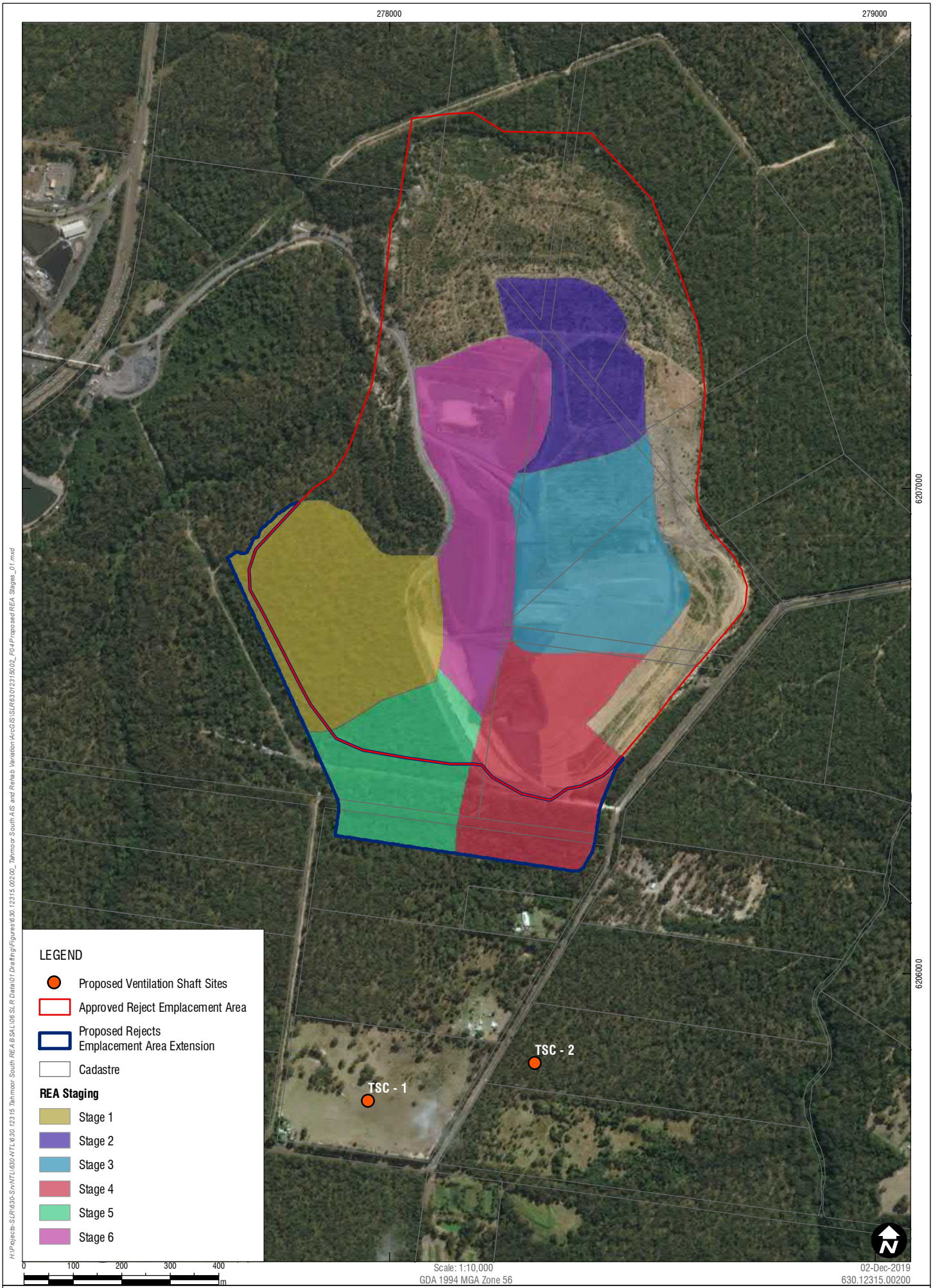
- Identifying whether or not there is a watercourse present and determine its order in accordance with the Strahler System;
- If a watercourse is present, defining the RC/vegetated riparian zone (VRZ) on a map in accordance with Table 1 of the guidelines;
- Seeking to maintain or rehabilitate a RC/VRZ with fully structured native vegetation in accordance with Table 1 of the guidelines;
- Seeking to minimise disturbance and harm to the recommended RC/VRZ;
- Minimising the number of creek crossings;
- Locating services and infrastructure outside of the RC/VRZ. Within the RC/VRZ provide multiple service easements and/or utilise road crossings, where possible; and
- Treat stormwater run-off before discharging into the RC/VRZ.

Progressive rehabilitation of the REA will be undertaken during operations at the site, where possible. Rehabilitation will only start once the portion of the REA to be rehabilitated is sufficiently dry to allow the placement of permanent capping material.

In the EIS, the REA was proposed to be progressed in 15 stages throughout the life of the mine. Based on the proposed project changes, the amended REA is now proposed to be progressed in six stages. Where practicable, each stage of the REA will be progressively rehabilitated when it is no longer in use. The proposed stages of the REA are shown in **Figure 4.**

During detailed closure planning for the REA, a specific long-term management strategy will be developed in consultation with the relevant stakeholders and regulatory guidelines. Key objectives of this strategy will include:

- Maintaining a stable landform;
- Ensuring the landform surface is resistant to erosion;
- Maintaining a surface cover that minimises the risk of infiltration, promotes shedding of surface water and promotes growth of vegetation; and
- Minimises the risk of environmental harm from seepage.



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Proposed REA Stages

FIGURE 4

Capping of the REA will be designed and constructed so that the surface will be free draining. The rejects will be capped with a layer of compacted clay or similar impermeable substance over which a layer of free draining material will be placed. Topsoil will then be used to resurface the area, which will then be revegetated. This will inhibit ponding and infiltration of surface water and minimise the potential for leachate. Rock armouring will also be considered, if required, to prevent excessive slope erosion. Suitable clean fill and topsoil are proposed to be imported on-site, as required, during the life of the project to ensure progressive rehabilitation of the REA. Topsoil will only be imported where there is a deficit from stockpiled soil onsite.

The operational performance of the REA and decant water management will have a significant influence on the final strength and consolidation properties of the materials. Strategies that will be further considered during development of rehabilitation plans will include:

- Ongoing monitoring and maintenance of the final landform to assess the rate of ongoing settlement and to maintain the surface integrity of the landform.
- Design the landform surface to promote sheet flow of surface water to eliminate the need for engineered drainage structures across the final landform surface. This requirement will likely limit the maximum final height of the landform above the original ground surface level. However, it will also limit the impact of ongoing surface settlement on the drainage and integrity of the final landform.

10.3.3 Water Management Infrastructure

The water management infrastructure will be decommissioned, with the component materials being recycled or re-sold. Any materials not recycled or re-sold will be disposed of in a suitable location, either on-site or off-site at a licenced waste management facility. Opportunities for the sale and/or re-use of assets and recycling of scrap steel will be maximised, where possible. Material assessed as “not hazardous or contaminated” by a suitably qualified person may be crushed and disposed of within the drift or placed as fill into the shafts.

10.4 Domain 4: Mine Ventilation

A summary of the infrastructure located within Domain 4 is outlined in **Section 6.4**.

10.4.1 Security

Where practicable, the existing fencing and signage will be maintained around the mine ventilation locations. If required, temporary fencing will be constructed and appropriate signage posted. In addition, during the demolition and rehabilitation works, including filling and capping the ventilation shafts, a security firm is proposed to be engaged to prevent public access to the mine ventilation locations.

10.4.2 Site Services

All services associated with the mine ventilation shafts, that are not required for demolition activities, will be safely isolated, disconnected and terminated. Overhead power lines will be removed and the materials, including poles and wire, recovered for potential re-sale or recycling, where practicable. Refer to **Section 10.1.1** for details regarding decommissioning of site services.

10.4.3 Ventilation Shafts

Refer to **Section 10.1.5** for details on decommissioning of ventilation shafts.

10.4.4 Gas Drainage Infrastructure

Gas drainage bores will be decommissioned in accordance with relevant RR (or its equivalent at the time of decommissioning) requirements. The aim of well decommissioning is to prevent the leakage of gas and water or to ensure that the well is safe to leave for ongoing venting to the atmosphere. The outcomes for the decommissioning of the wells include:

- Disassembling of temporary infrastructure components and transport away from the remote gas well site;
- Modification of the remaining venting infrastructure to achieve long-term objectives that may include removing the well head, sealing and capping wells or venting to the atmosphere unabated; and
- Stabilising and rehabilitation of the well site along with any associated access tracks.

10.4.5 Associated Infrastructure

All associated infrastructure, including fencing, offices, storage sheds, hardstand areas, power lines, substations, etc, will be demolished and disposed of in a suitable approved location. Opportunities for the sale and/or re-use of assets and recycling will be maximised, where possible. Overhead power lines will be removed and the materials, including poles and wire, recovered for potential re-sale or recycling, where practicable.

10.5 Domain 5: Roads

A summary of the infrastructure located within Domain 5 is outlined in **Section 6.5**.

10.5.1 Haul Roads

All haul roads will require rehabilitation, unless an alternative use has been determined through consultation with relevant stakeholders and potential third-party owners during detailed closure planning. Decommissioning and rehabilitation of haul roads involves:

- Remove top layer, including scraping any stabilised material and excess carbonaceous material and dispose of in an appropriate location. Where practicable, the excess carbonaceous material will be reprocessed prior to the CHPP being decommissioned. It is recommended that at least the wearing course, base layer and sub-base layer be removed.
- Reshaping to be commensurate with the surrounding landform.
- Rip and scarify the road alignment, verges and berms, etc.
- Apply soil ameliorants and fertiliser after soil testing.
- Apply topsoil or bio-solids (or similar ameliorant) to achieve the desired land capability.
- Seeding to establish appropriate vegetation.
- Ensure the final profile of the fill is convex so that drainage occurs radially outwards, and erosion deflection berms constructed to prevent erosion.

All crossings, including culverts, will be removed. Where practicable, all associated infrastructure, including fencing and signage and water management infrastructure, will be removed. Re-use and/or recycling opportunities will be investigated or, alternately, all “non-contaminated” waste material will be disposed of in a suitable approved location.

All areas should then be reshaped, deep ripped, topsoiled and seeded in accordance with **Section 11** below.

10.5.2 Roads and Tracks

Roadways and/or tracks may be required to remain to provide ongoing access for rehabilitation monitoring and maintenance activities. Alternatively, roads and/or tracks may remain on-site, if agreed in writing by the prosed future landowner. Refer to **Section 10.1.7** for details on the decommissioning of roads and tracks.

10.6 Other Lands

A summary of the infrastructure located within Domain 6 is outlined in **Section 6.6**.

10.6.1 Subsidence Areas

Subsidence Advisory NSW (SA NSW) is responsible for administering the *Coal Mine Subsidence Compensation Act 2017.* The Act provides for the compensation or repair of services where improvements are damaged by mine subsidence resulting from the extraction of coal.

Subsidence modelling of each of these areas predicts the maximum slope in the final topography over the longwall panels after subsidence to be 8.7 and 10.5 millimetres per metre over longwalls LW101A to LW106A and LW101B to LW108B, respectively. The maximum vertical subsidence predicted is 1,350 and 1,650 millimetres over longwalls LW101A to LW106A and LW101B to LW108B, respectively.

Remedial activities required during operations will include excavations through these areas to remediate cracking. Monitoring and maintenance to ensure long-term stability of these areas will be included in the surface water management plan.

Extraction plans for mining associated with the Tahmoor South Project will include additional information for the management of subsidence, including mitigation details in the following areas:

- Surface ponding;
- Surface cracking;
- Subsidence impacts on natural channels;
- Subsidence impacts on the diversion channel; and
- Subsidence impacts on levees.

There will also be an increased focus on habitat creation around watercourse diversions and riverine areas impacted by subsidence. This includes, but is not limited to, the reinstatement of sandy substrate and placement of logs and large woody debris as in-stream habitat, and the placement of nest boxes in trees along the banks to encourage migrating, nesting or denning birds and mammals.

10.6.2 Subsidence Marker Pegs

It is anticipated that the majority of subsidence marker pegs will be removed during operation of the mine. However, once all subsidence monitoring has been completed suitable personnel will traverse the subsidence monitoring lines to identify any remaining markers. All markers identified will be cut-off at or below ground level to minimise potential risks to public safety.

10.6.3 Gas Drainage and Management Infrastructure

Refer to **Section 10.4.4** for details on the decommissioning of gas drainage and management infrastructure.

10.6.4 Power Lines

Power lines will be removed, unless an alternative purpose has been established through consultation with relevant stakeholders during detailed closure planning. Overhead power lines will be removed and the materials, including poles and wire, recovered for potential re-sale or recycling, where practicable.

10.6.5 Exploration Boreholes

Exploration and groundwater monitoring wells will be decommissioned in accordance with relevant RR (or its equivalent at the time of decommissioning) requirements. The aim of well decommissioning is to prevent leakage of gas and water. The outcomes for decommissioning of the wells include:

- Removal of the well head; and
- Any disturbance associated with historical drill pads, sumps or access roads to drill sites will be reshaped as required and revegetated to be consistent with the surrounding vegetation.

10.6.6 Roads and Tracks

Roadways and/or tracks may be required to remain to provide ongoing access for rehabilitation monitoring and maintenance activities. Alternatively, roads and/or tracks may remain on-site, if agreed in writing by the prosed future landowner. Refer to **Section 10.1.7** for details on the decommissioning of roads and tracks.

10.6.7 Associated Infrastructure

Where practicable, all associated infrastructure, including fencing and signage, will be removed. Re-use and/or recycling opportunities will be investigated or, alternately, all “non-contaminated” waste material will be disposed of in a suitable approved location.

11 REHABILITATION AND REVEGETATION STRATEGY

This rehabilitation strategy provides details on the proposed final landform and planned rehabilitation activities for the entire Tahmoor South project area. This section covers the following key activities relating to mine site rehabilitation:

- Proposed post-mining land classification;
- Landform design and planning;
- Rehabilitation principles;
- Staged/progressive rehabilitation;
- The management of topsoil resources for use in rehabilitation of the Project Area, including a topsoil mass balance;
- Subsidence;
- The proposed revegetation strategy for the Project area;
- Weed management;
- Rehabilitation success criteria; and
- Rehabilitation monitoring and maintenance requirements that will apply.

These aspects are discussed further in the sections below.

11.1 Proposed Post-mining Land Classification

Based on the original LSC classes across the REA extension area and likely LSC classes for previously undisturbed native forest in all other Domains prior to the Tahmoor Mine commencing operations in the 1970s, being dominantly 6 and 7, the proposed final landforms and soil profiles for all domains are to achieve an LSC class of 7. This is land generally incapable of agricultural land use (selective forestry and nature conservation), which is consistent with the proposed final land use being primarily native vegetation across all domains.

11.2 Landform Design and Planning

Rehabilitation planning in the Project Area will aid in minimising the total area of disturbance at any one time, so reducing the potential for wind-blown dust, visual impacts and increased sediment-laden run-off.

Rehabilitation will be designed to achieve a stable final landform compatible with the surrounding environment. This will involve reshaping the majority of REA to 10 degrees (18%) or less. Should slopes exceed 10 degrees (18%) an assessment will be made as to whether additional drainage and revegetation works are required. These control measures will help to prevent erosion and aid in groundcover establishment.

The *Geotechnical Study and Supplementary Investigations* (SKM, 2017) provided technical justification of the proposed final REA landform, including stability assessment of the substrates to be used and water management designs. Subsequently, Australian Mine Design and Development Pty Ltd prepared the revised REA design with consideration for geotechnical stability.

11.2.1 Rehabilitation Principles

Rehabilitation of the disturbed land associated with mining will proceed as soon as practicable after the areas become available for rehabilitation. In some situations, however, rehabilitation may be delayed due to interactions with other nearby areas that are unavailable for rehabilitation. Where this is the case, temporary rehabilitation methodologies may be applied to provide short-term stabilisation of the areas.

Rehabilitation of disturbed land at the mine site will be conducted so that:

- Suitable vegetation species are used to achieve the nominated post-mine land uses;
- The potential for water- and wind-induced erosion is minimised, including the likelihood of environmental impacts being caused by the release of dust;
- The quality of surface water released from the site is such that releases of contaminants are not likely to cause environmental harm;
- The water quality of any residual water bodies is suitable for the nominated use and does not have the potential to cause environmental harm; and
- The final landform is stable and not subject to slumping or erosion which would result in the agreed post-mining landform not being achieved.

11.3 Progressive Rehabilitation

It is noted that the Project proposes to continue underground mining activities at the site. Therefore, due to the relatively small disturbance footprint associated with surface infrastructure, it is considered that there are limited opportunities for progressive rehabilitation.

To the extent possible, rehabilitation will be progressively undertaken on areas that cease to be used for mining or mine-related activities as soon as reasonably practicable. In particular, the REA is proposed to be completed in stages and progressive rehabilitation is proposed to be undertaken once each stage has been completed. The proposed stages are shown in **Figure 4**.

11.4 Topsoil Management

Tahmoor Colliery currently has a Soil & Water Management Plan. This plan will be updated with respect to the proposed development and to ensure industry best practice is maintained and implemented for the Tahmoor South Project.

The Soil & Water Management Plan will specifically address topsoil stripping, stockpiling (including specific locations), the development of topsoil inventories for the Project Area, handling, re-spreading, amelioration, and seedbed preparation.

11.5 Topsoil Mass Balance

As part of preparing this Rehabilitation and Mine Closure Strategy, SLR undertook a soil stripping assessment and topsoil mass balance. The aim of this soil stripping assessment and topsoil balance was to:

- Provide a soil stripping assessment and mapping of the Project Area based on literature review of existing baseline soil information; and

- Provide a topsoil balance of the Study Area based on the soil stripping assessment.

The area subject to the assessment encompasses a portion of the existing REA (**Figure 5**). The total new maximum disturbance area for the proposed REA Extension Area is approximately 11 hectares.

11.5.1 Methodology

A literature review of the following documentation was conducted to identify the dominant soil properties for the Study Area:

- *NSW Natural Resources Atlas* (http://www.nratlas.nsw.gov.au/);
- *Soil Landscapes of the Wollongong – Port Hacking 1:100 000 Sheet* (Hazelton & Tille, 1990);
- *Soil Survey and Materials Management Plan – Tahmoor Colliery* (AECOM, 2010); and
- *Tahmoor South Project REA Expansion Civil Design – Geotechnical Desk Study and Supplementary Investigations Report* (SKM, 2017).

From the available information, a topsoil stripping map has been developed using the *Procedure for the selection of materials for use in topdressing of disturbed areas* (Elliot & Reynolds, 2007). This map can be used as a guide to the depth of topsoil available for stripping and has been used in the calculation of the available topsoil balance.

11.5.2 Background

The area subject to the assessment encompasses two soil landscape units, Lucas Heights and Gymea (**Figure 6**). The Lucas Heights soil landscape unit covers gently undulating crests, ridges and plateau surfaces, with slopes less than 10% and local relief of 10-50 metres. It occurs on the Mittagong Formation geological unit consisting of shale, laminite and quartz sandstone. The dominant soils are typically moderately deep Yellow Podzolic Soils and Yellow Soloths on ridges and plateaus. Lateritic Podzolics are also present on crests, Yellow Earths on shoulders of plateaus and ridges, and Earthy Sands occur in valley flats.

The Gymea soil landscape unit covers undulating to rolling rises and low hills, with slopes between 10-25% and local relief of 10-80 metres. It occurs on the Hawkesbury Sandstone geological unit consisting of sandstone with some shale and laminite. The dominant soils are typically shallow to moderately deep Yellow Earths and Earthy Sands on crests and inside benches, Gleyed and Yellow Podzolic Soils on shale lenses, and shallow to moderately deep Siliceous Sands and Leached Sands along drainage lines.

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Topsoil Stripping Areas

FIGURE 5

11.5.3 Soils Assessment

The previous soil survey of the existing REA, performed by AECOM, determined that the soils within the current REA correlated with the predicted Lateritic Podzolic Soils of the Lucas Heights soil landscape unit, as defined in the *Soil Landscapes of the Wollongong – Part Hacking 1:100 000 Sheet* (Hazelton and Tille, 1990).

The geotechnical survey, performed by SKM, for the Tahmoor South REA Expansion Civil Design included 15 'Test Pit Logs' with basic descriptive soil information and soil depths. These soil descriptions have been correlated with information in the previous soil survey (AECOM, 2010) and soil landscape units (Hazelton and Tille, 1990), as well the topography and slopes, to create a base soils map. The soils within the Project Area are described below.

Yellow Earths

Yellow Earths in the Study Area occur on crests and slopes and are characterised by greyish-brown sand to sandy loam topsoil grading to sandy clay loam subsoil, which may grade to sandy clay. Soil depth is up to 1 metre. Structure is generally apedal and the profile is strongly to slightly acidic (pH 4.0 – 6.5). Limitations include low fertility, acidity and increasing sodicity with depth.

Lateritic Podzolic Soils

Lateritic Podzolic Soils in the Study Area occur on crests and plateau surfaces and are characterised by sandy clay loam overlaying yellowish-brown sandy clay to heavy clay. These soils are distinctive by the abundant presence of iron-coated sandstone fragments and stones. The soil depth is up to 1 metre, and shallower closer to steeper slopes. The structure is generally apedal in the topsoil and strong in the subsoil and the profile is strongly to slightly acidic (pH 4.0 – 6.0). Limitations include low fertility, acidity, increasing sodicity with depth and high percentage of sandstone fragments and stones. The different types of Lateritic Podzolics represented in **Figure 7** differ in depths of topsoil and subsoil.

Lithosols

Lithosols in the Study Area occur on crests and sideslopes and are characterised by shallow (less than 0.3 metres), loamy sand to sandy loam. Structure is typically apedal and the profile is strongly to slightly acidic (pH 4.0 – 6.0). Limitations include low fertility, acidity and presence of sandstone gravel and rock outcrop, particularly on steeper slopes.

11.5.4 Topsoil Stripping Assessment and Balance

Topsoil for the existing approved REA rehabilitation works is stripped from the existing natural, vegetated sections being utilised for rejects emplacement within the approved REA area. Stripping occurs following clearing and prior to emplacement of the reject material. The depth of topsoil stripped is generally sufficient to provide for the depth of topsoil to be re-spread across the rehabilitated REA sections to the specified depth. Where there is insufficient topsoil, topsoil is imported to make up the deficit.

Soils within the REA extension area are limited by strong acidity and sodic characteristics (Hazelton & Tille, 2009; AECOM, 2010). Whilst the topsoils are generally suitable to facilitate germination and revegetation, they will all require appropriate amelioration with gypsum or lime due to the strong acidity found in the topsoil throughout the Study Area and some localised marginally sodic topsoil.

Soil Landscape Units

FIGURE 6

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The soil stripping limitations for each soil unit are summarised in **Table 8**. The stripping depth for each soil unit within the Study Area is limited by strong acidity, sodicity and often the presence of stone fragments.

Table 8 Soil Stripping Limitations

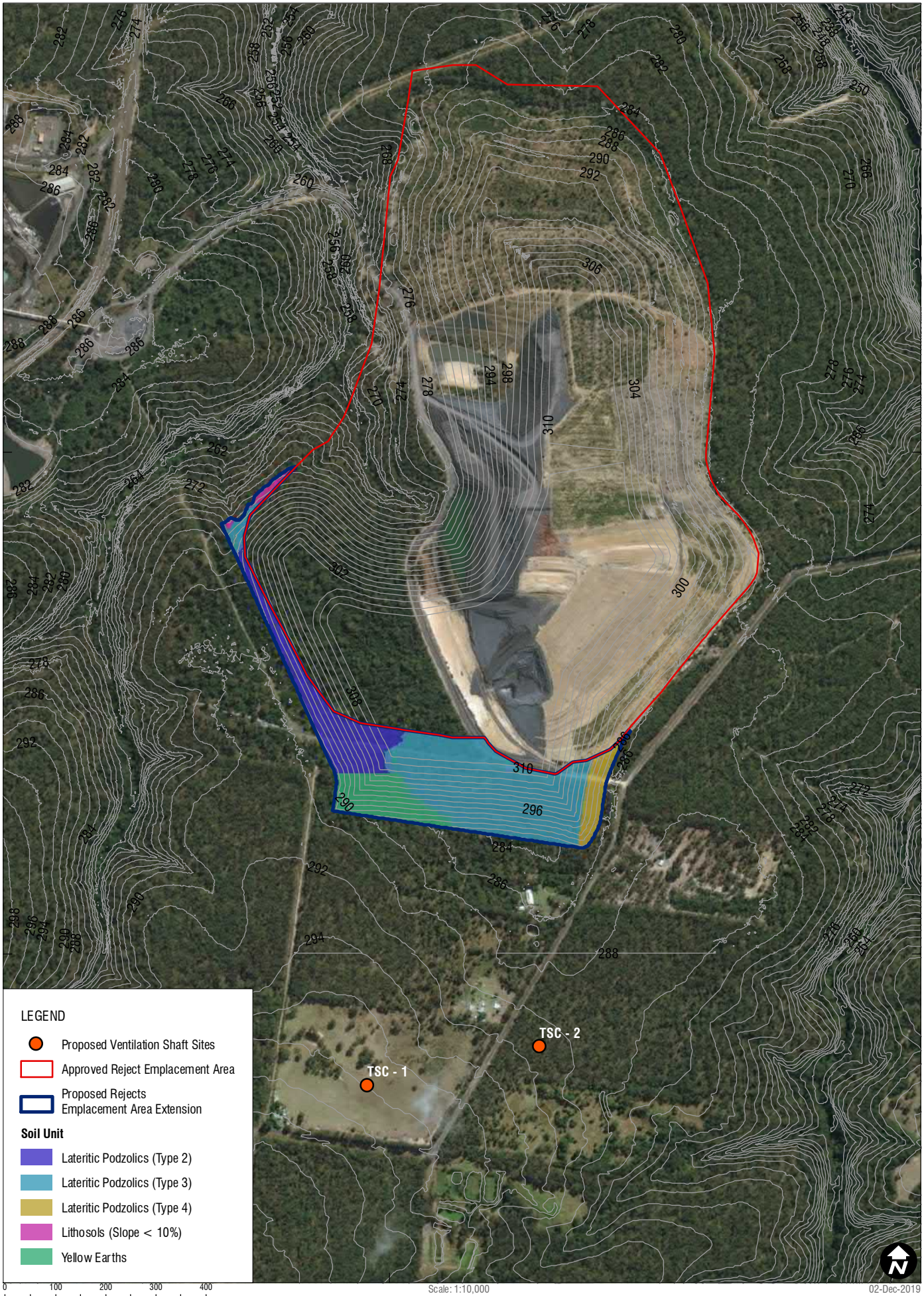
Great Soil Group	Associated Soil Landscape Unit	Soil Stripping Limitations
Yellow Earths	Lucas Heights	Acidity and sodicity.
Lateritic Podzolic Soils	Lucas Heights	Acidity, sodicity and sandstone fragments and stones.
Lithosols	Gymea	Acidity and sandstone fragments and stones, and rock outcrop.

The topsoil structure of Yellow Earths and Lithosols are generally marginally suitable for reuse due to coarse topsoil texture and poor soil structure. Material may be stripped and reused in rehabilitation provided appropriate erosion and sediment controls are in place. They will need organic ameliorants to improve their structure. The topsoil of Lateritic Podzolic soils will also require organic amelioration to improve soil structure. Subsoil is not recommended for stripping due to chemical limitations associated with strong acidity and sodicity.

The recommended topsoil stripping depths for each soil is shown in **Table 9** and **Figure 8**. With a total maximum disturbance area of 11.06 hectares, this provides a maximum topsoil balance of 29,695.4 cubic metres. Based on these calculations, this volume will just about satisfy the required topsoil depth across the REA extension area. Any small deficit will be made up from imported soil.

Table 9 Soil Stripping Recommendations

Great Soil Group	Ave. Topsoil Depth (m)	Ave. Subsoil Depth (m)	Stripping Depth (m)	Area (ha)	Volume (m^3)
Yellow Earths	0 – 0.35	0.35 – 0.9	0.35	1.57	5,507.4
Lateritic Podzolic Soil – Type 2	0 – 0.25	0.25 – 0.95	0.25	2.43	6,087.4
Lateritic Podzolic Soil – Type 3	0 – 0.25	0.25 – 0.75	0.25	6.09	15,232.0
Lateritic Podzolic Soil – Type 4	0 – 0.30	0.3 – 0.60	0.30	0.78	2,324.9
Lithosols (Slope greater than 10%)	0 – 0.30	N/A	0.30	0.18	543.6
			Total	**11.06**	**29,695.4**



Soil Units

FIGURE 7

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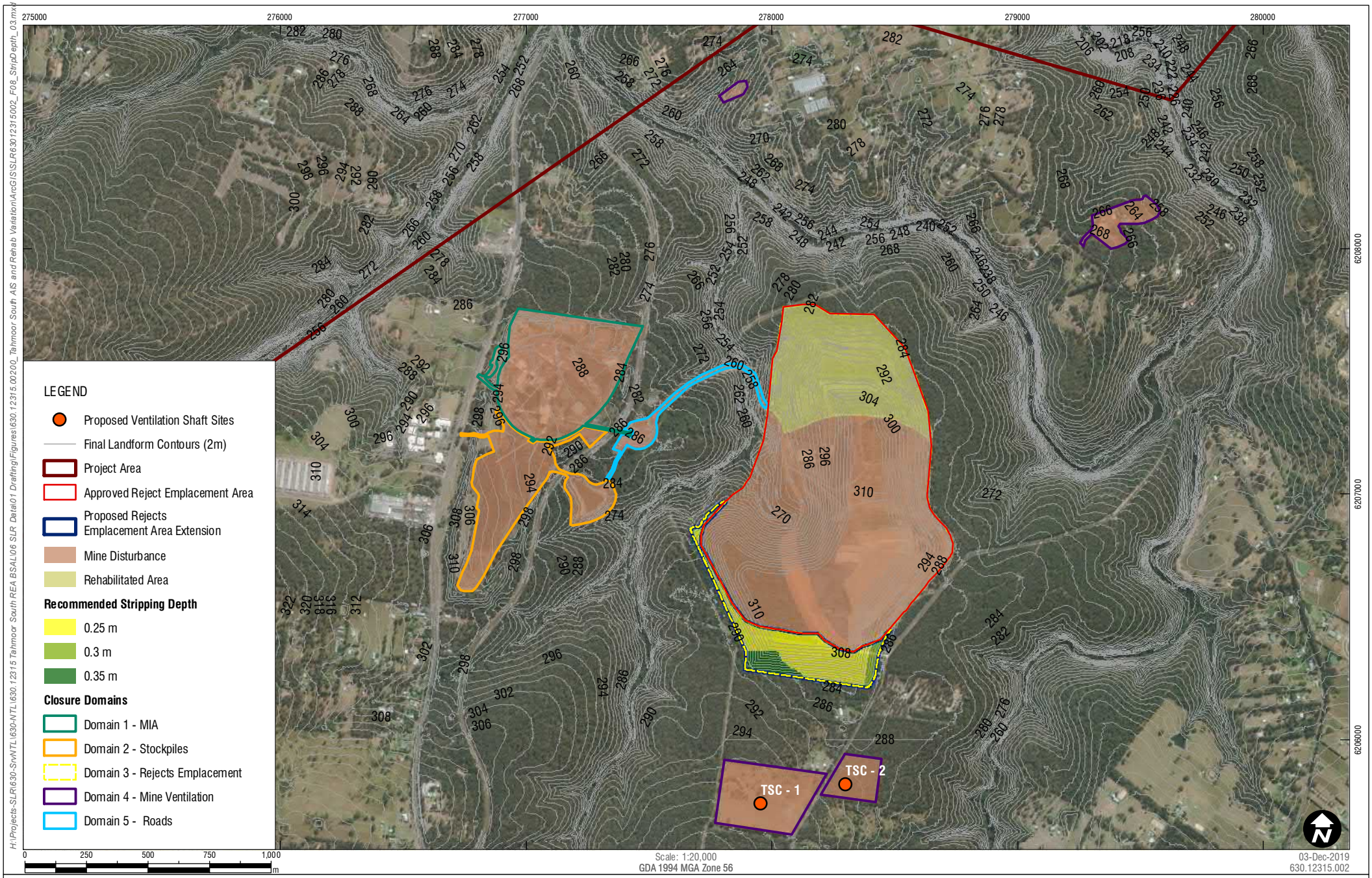

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Recommended Stripping Depth

FIGURE 8

11.5.5 Summary

A literature review of baseline soil information was conducted for the area of the proposed REA Extension Area to provide a soil stripping assessment and mapping. The major points of the assessment are summarised below:

- The Study Area was located within two soil landscape units, Lucas Heights and Gymea;
- Three major soil types were mapped within the Study Area: Yellow Earths, Lateritic Podzolics and Lithosols;
- A topsoil balance of 29,695 cubic metres was calculated for the maximum disturbance area of 11.06 hectares; and
- Amelioration with lime or gypsum is recommended for all stripped topsoil, due to the highly acidic nature of the soil within the Study Area.

11.5.6 Topsoil Stripping and Handling

The topsoil management plan (TMP) will include detailed protocols for soil stripping and handling. The following proposed techniques will be adopted to prevent excessive soil deterioration as a result of soil stripping and stockpiling:

- Topsoil will be maintained in a slightly moist condition during stripping. Where possible, material will not be stripped in either an excessively dry or wet condition.
- Stripped topsoil will be placed directly onto regraded disturbed areas and spread immediately (if mining sequences, equipment schedules and weather conditions permit) to avoid the requirement for stockpiling.
- Where stockpiling is required soil will be graded or pushed into windrows with excavators, graders or dozers for loading into rear dump trucks by front-end loaders. This is the preferred method as it minimises compression effects of the heavy equipment that is often necessary for economical transport of soil material.
- Soil stockpiles surfaces will be left in a coarsely-textured condition (rough, not smoothed) to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming.
- Where possible, a maximum stockpile height that prevents biological and structural degradation will be maintained. Clayey soils will be stored in lower stockpiles for shorter periods of time compared to soils that have a coarser texture.
- Free-draining stockpiles will be created to minimise the formation of anaerobic zones. Stockpiles will be formed in a “chevron” profile with batters roughly graded to achieve slopes approaching 18°, where practicable, but not smoothed.
- If long-term stockpiling is planned (i.e. greater than 12 months), stockpiles will be seeded and fertilised. An annual cover crop species that produces sterile florets or seeds will be sown. A rapid growing and healthy annual pasture sward provides sufficient competition to minimise the emergence of undesirable weed species. Annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance desirable micro-organism activity in the soil.

- Prior to re-spreading stockpiled topsoil onto regraded disturbed areas (particularly onto designated tree seeding areas), an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and/or "scalping" of weed species prior to topsoil spreading.
- Topsoil will be spread to a nominal depth range of 0.1 metres (steep slopes) up to 0.2 metres (flatter areas). Soil respreading on steep slopes at depths exceeding 0.1 m can be deleterious because of the "sponge" effect, which can cause slippage of the topsoil from the slope. Total soil spreading will be to a nominal depth of 300 mm, including subsoil.

11.5.7 Topsoil Respreading and Seedbed Preparation

Where possible, suitable topsoil will be re-spread directly onto reshaped disturbance areas and, where topsoil resources allow, topsoil will be spread to a nominal minimum depth range of 0.1 to 0.2 metres up to a total of 0.3 m, including subsoil on all rehabilitation areas. Specific topsoil respreading depths for different post mining landform elements will be specified in the project's TMP and Soil and Water Management Plan (SWMP).

The spreading of topsoil, addition of soil ameliorants and application of seed will be carried out in consecutive operations to reduce the potential for topsoil loss to wind and water erosion.

Thorough seedbed preparation will be undertaken to ensure optimum establishment and growth of vegetation. All topsoiled areas will be lightly contour ripped (after topsoil spreading) to create a "key" between the soil and the subsoil/capping materials. This process will be undertaken on the contour and the tynes lifted for approximately 2 metres every 200 metres to reduce the potential for channelized erosion. Where possible, it will be undertaken when the soil is moist and immediately prior to sowing for best results. The respread topsoil surface will be scarified prior to, or during, seeding to reduce run-off and increase infiltration.

Some of the soils in the Project Area may exhibit sodic properties. Sodic soils are not optimal for rehabilitation works as the clay particles tend to disperse and swell producing poor physical soil conditions. These conditions include water-logging and hard-setting crusts, which in turn negatively affect infiltration rates, plant-available water capacity, seedling emergence and root development. Where practicable, topsoil resources for rehabilitation works will be selected to minimise potential soil sodicity effects. For some soils, application of soil ameliorants that decrease soil dispersibility and increase soil aggregate stability will be an important soil rehabilitation management tool.

Soil organic matter increases soil aggregate stability and adding carbon as a soil ameliorant will improve soil structure. Carbon ameliorants, such as mulch, will be beneficial for rehabilitated landforms within the Project Area. Organic amendments will supplement elevated organic carbon levels in the Project Area's soils to improve structural stability. Fertiliser additions will be undertaken, if required.

11.6 Acid Sulfate Soils

The site is not considered at risk of acid sulfate soil or acid generation as a result of disturbance due to the distance and elevation from the low lying coastal soils, as well as the soil types identified on site. In the event acid generation is observed, soil acidity measurements and remedial action will be taken in accordance with NSW OEH *Acid Sulfate Soil Manual* (1998).

11.7 Erosion and Sediment Control

The Tahmoor Colliery stormwater management plan (SWMP) will be revised prior to the Tahmoor South Project commencing to include all aspects of the project life cycle (construction, operations and closure). The principle objectives of the SWMP are to:

- Minimise erosion and sedimentation from all active and rehabilitated areas, thereby minimising sediment ingress into surrounding surface waters;
- Ensure the segregation of contact water (surface runoff from disturbed catchments (eg active areas of disturbance, stockpiles and rehabilitated areas (until stabilised)) from non-contact water (surface runoff from catchments that are undisturbed or relatively undisturbed by project-related activities and rehabilitated catchments), and maximise the retention time of contact water such that any discharge from the Project Area complies with the appropriate discharge criteria;
- Minimise the volume of water discharged from the Project Area but, should the discharge of water prove necessary, ensure sufficient settlement time is provided prior to discharge such that suspended sediment within the water meets the objectives identified in the point above;
- Manage surface flows upstream of the Project Area so that rehabilitation and coal recovery activities are not affected by flooding. Non-contact water diversion channels will be constructed prior to commencement of clearing in the REA;
- Prevent erosion of the ephemeral watercourses that traverse the site;
- Manage erosion of the remedial works required as a result of subsidence impacts on the surface;
- Develop sustainable long-term surface water features following rehabilitation of the Project Area, including implementation of an effective revegetation and maintenance program; and
- Monitor the effectiveness of surface water and sediment controls and to ensure all relevant surface water quality criteria are met.

Effective erosion and sediment control for the Project Area will require appropriate activities to be carried out over the life of the project, including:

- Construction;
- Operations; and
- Rehabilitation and closure.

The effectiveness of erosion and sediment controls during the operational and closure stages will be optimised through effective mine planning and design. Suitable strategies will include:

- Designing and operating drainage systems for the life of the mine so that they do not cause erosion. This will involve scour protection of open drains and energy dissipaters located at drain outlets.
- Designing the REA geometry to create a landform that allows free drainage of surface runoff while minimising erosion.

Where possible, contact and non-contact water will be segregated to minimise the requirement for on-site storage. This would allow water suitable for direct discharge (eg undisturbed catchments) to be diverted and on-site containment of water requiring treatment (eg settling suspended sediment).

Contact water from disturbed areas will be captured in sediment dams to allow suspended solids to settle and, if necessary, allow a flocculent to be added to remove fine or dispersive sediment to meet allowable turbidity discharge limits. Opportunities for use of contact water within the mining operations will be maximised to reduce overall water requirements for the site.

11.8 Subsidence

Where surface cracks as a result of subsidence are small, it is not anticipated that intervention will be required, as these cracks tend to self-seal after a few rainfall events as fine sediments wash into and seal up the cracks. Where cracks are large, or are not self-sealing, further remediation works will then be undertaken, where required, behind the advancing face of the longwall as soon as practical post-subsidence. Inspections will be conducted over subsided areas to identify these locations. Remedial works will include the ripping and seeding of subsidence areas. If cracks are too wide, clay will be imported to fill the cracks and the area will be spread with topsoil and seeded.

MSEC (2020) note that fracturing and surface flow diversions have previously occurred in the sandstone bedrock along streams, in particular in streams located directly above longwalls. In some instances, the fracturing impacted the holding capacity of standing pools; however, it was considered unlikely that there was any net loss of water from the catchment.

In streams with significant sediment accumulation, it is anticipated that the fractures will naturally fill over time (MSEC, 2020). However, in streams with lower sediment accumulation it may be necessary to seal the fractures and voids with grout. Tahmoor Colliery currently has a subsidence management plan (SMP) that considers potential impacts on steams due to mining activities, including monitoring and trigger response plans. An extraction plan will be prepared and implemented for the Tahmoor South Project.

Subsidence impacts have previously been observed relating to the Tahmoor Colliery, including impacts to surface features, roads, houses and infrastructure. The extraction plan prepared for mining operations will also consider the potential impacts to roads, houses, infrastructure, etc. In addition, potential impacts and trigger response actions relating to archaeological sites will also be included in the extraction plan.

Tahmoor Colliery also has a risk management plan to manage potential impacts to residential structures. This includes prior identification of buildings in poor pre-mining condition that could potentially become hazardous. Where impacts are identified, claims and repairs will be addressed via the process managed by Subsidence Advisory NSW.

To ensure subsided land is suitable for grazing, initial repair works will be undertaken, where required, behind the advancing face of the longwall. Repair works will focus on any surface disturbances, such as existing highly eroded access tracks and erosion gullies, that will concentrate the flow of water and increase erosion associated with subsidence cracking.

Rehabilitation of subsidence cracks will be undertaken as soon as practical post-subsidence. This will include, as appropriate:

- Carrying out inspections over subsided areas and locating surface cracking.
- Undertaking minimal clearing, if required, of areas around cracks to allow for ripping and seeding.

- Ripping and seeding of areas, where required. Following initial ripping and seeding, if trees are to be planted, they will not be planted until sufficient rain has fallen. This will enable the soil to consolidate, and finer particles to fill underground air pockets. Otherwise, if not done, air pockets can cause roots to dry out, which will result in poor growth rates or seedling deaths.
- Seeding and/or planting appropriate species of vegetation to achieve a post-subsidence land use the same as that pre-subsidence (i.e. low intensity cattle grazing).
- Subsided areas to be regraded and some may be backfilled with mine spoil to control surface water flow and minimise erosion and sedimentation. Drainage works, such as graded banks and diversion drains, may be used to partially drain the larger subsidence voids and direct water into stable areas or sediment control dams.

For areas where ripping is not feasible due to the width of cracks:

- Topsoil will be stripped and stockpiled;
- Clay material will be imported to fill and seal cracks;
- Topsoil will be respread once cracks have sealed; and
- The area will be seeded with appropriate plant species.

Where required, stock will be excluded from subsided and rehabilitated areas, including riparian areas, to prevent injury to animals and to increase grass cover and seed store. This will be achieved through the erection of fences in consultation with the relevant landholder(s). Where required, people will also be excluded and appropriate signage, warning of the potential hazards due to subsidence, will be erected.

The rehabilitation undertaken on subsided areas will be monitored annually. Where the regeneration of dominant species disturbed by remediation works does not occur within one year, additional vegetation will be seeded or planted, as required.

11.8.1 Subsidence of Watercourse and Drainage Lines

The rehabilitation methodology for drainage lines affected by subsidence in existing mining areas at Tahmoor is detailed in Corrective Management Action Plans (CMAP), which form part of the approved 2019/2020 Mining Operations Plan (MOP) (SIMEC 2019b), recently developed for Redbank and Myrtle Creeks.

The Extraction Plan for each longwall, along with the CMAPs, provide detail regarding potential impacts to streams resulting from the mining of longwalls, and remedial measures. A similar methodology as adopted in the CMAP for Myrtle and Redbank Creek will be adopted for Tahmoor South, and revised accordingly in consideration of learnings from the rehabilitation works undertaken in these creeks.

Monitoring

Monitoring is and will continue to be conducted prior to, during and post mining for the following environmental features at specified locations:

- Daily rainfall;
- Pool water level and streamflow;
- Stream water quality;
- Aquatic habitat/ecology;

- Channel bank stability; and
- First and second order tributaries.

Monitoring data is/will be benchmarked against historical data to determine whether changes have occurred (triggers).

Response

The trigger action response plan (TARP) (from the CMAPs and EMPs listed above) is and will continue to be used to determine the scale of response required in relation to any change that has been identified. Results of comparing monitoring data against historical data determines the scale of impact that has occurred. The scale of impact is based on whether the impact is:

- Within normal limits (no impact);
- Within predicted (within the range of outside-normal) limits (change that may or may not be as a result of mining and may be within natural variability); or
- Exceeds predicted (unlikely to be within the range of natural variability).

Based on the above triggers, specified actions/responses are to be followed.

Generally, the specified actions/responses for each trigger are as follows, with some variations depending on the feature and potential impact:

- Normal – continue monitoring, six-monthly assessment;
- Within predicted – continue monitoring, in some cases review and confirm existing monitoring data, cross check against other related environmental data (where relevant), then monthly assessment until trigger returns to "normal"; and
- Exceeds predicted:
    - Convene Tahmoor Coal Environmental Response Group to review response;
    - Immediately undertake the same analysis for the exceeded feature parameter to confirm exceedance or;
    - Notify DPIE – Biodiversity and Conservation Division, DP&IE and/or relevant stakeholders, as appropriate, within 7 days of current findings and proposed approach for investigation upon identification of the potential trigger;
    - Undertake investigation and take all necessary steps to ensure that the exceedance ceases and does not re-occur;
    - Implement remediation measures to the satisfaction of the relevant parties;
    - If it is concluded that there has been a mining-related impact then implement a corrective management action plan (CMAP);
    - Review mining design/predictions against mine design criteria; and
    - Prepare written report to relevant regulatory agency as per consent and relevant approvals, as appropriate.

Remediation/Management Measures

Where flows and water levels are not generally consistent with pre-mining flows and water levels (exceed predicted), remedial works will be undertaken to either increase or decrease flows or water levels, depending on the change that has been created.

In relation to flows, this could include enhancement of erosion and sediment controls or installation of additional instream obstructions to slow flows while rehabilitation is establishing, or progressive removal of erosion and sediment controls or instream obstructions to increase flows as rehabilitation establishes.

In relation to water levels, this could include using grout injection to effect a grouted curtain wall to provide a barrier for subsurface stream flow or hand grouting and mortaring to increase holding capacity of pools to increase surface water levels or other techniques outlined in the existing extraction plan technical report for Longwalls W1-W2 (HEC, 2020a), environmental management plan (EMP) for Longwall 32 (SIMEC, 2019a), corrective management action plans (CMAPs) for Tahmoor Underground (Myrtle Creek CMAP) (Glencore, 2017) and Redbank Creek (SIMEC, 2019c), and mine operations plan (MOP) (SIMEC, 2019b), which includes the Myrtle Creek and Redbank Creek CMAPs

Potential contingency measures in the event of unforeseen impacts or impacts in excess of those predicted would include:

- Conducting additional monitoring (eg increase in monitoring frequency or additional sampling) to inform the proposed contingency measures;
- Implementing stream remediation measures to reduce the extent and effect of subsidence fracturing;
- Implementing revegetation measures to remediate impacts of vegetation loss due to subsidence, eg:
    - Provide a cover of topsoil in a weathered rock matrix to create a stable substrate for revegetation of channel banks. Weathered rock provides temporary erosion protection by covering erodible soils and minimising topsoil loss;
    - Replace sand across the channel bed, including higher sand deposits suitable for re-creation of in-channel benches;
    - Install timber groynes/pile field retards at the base of the channel banks (extending into the channel) to mitigate erosion undercutting the channel banks and to facilitate creation of in-channel benches;
    - In areas where less active bank erosion develops, large woody debris could be placed in-stream to encourage the deposition of sediment and revegetation over time;
    - Design local drainage works to prevent the uncontrolled flow of runoff over channel banks. Small diversion bunds directing runoff to properly engineered rock chute structures could be installed to minimise bank erosion;
    - Topsoiling and revegetation on banks. Stock could be excluded to a width of at least 30 metres from the top of bank and subsided areas to minimise further impacts on vegetation cover and land condition; and
    - A targeted revegetation could be undertaken in areas where surface water patterns have been affected;
- Providing suitable offset(s) to compensate for the reduction in the quantity of water resources/flow;
- Making-good provisions, to be negotiated with the landholder, in the event that water supply from a surface water system (as designated by a Water Supply Works and Water Use Approval) is impacted; and/or
- Implementation of adaptive management measures, eg reducing the thickness of the coal seam extracted, narrowing of the longwall panels and/or increasing the setback of the longwalls from the affected area.

Any additional mechanisms, as identified by the annual subsidence monitoring, will also be considered.

11.9 Revegetation

11.9.1 Revegetation Program Implementation

A revegetation strategy is proposed for the Project Area that seeks to compliment desirable post-mining land-use objectives whilst maintaining effective erosion and weed controls.

Revegetation activities will be scheduled to occur after the completion of reshaping, re-topsoiling and drainage works. Where possible, the timing of these works will enable a preferred seasonal sowing of pasture and tree seed in autumn or spring.

On prepared surfaces, selected tree, shrub and pasture species will be sown using seed stock and/or planted depending on the species, slope gradients and area to be revegetated. Tree and shrub species will be established at a density and richness consistent with the nominated post-mine ecosystem.

11.9.2 Species Selection

Plant selection for areas to be rehabilitated to pre-existing conditions will focus on those species that will successfully establish on the available growth medium, bind the soil and will result in a variety of structure and food/habitat resources. Native species will be established through direct seeding or planting of tube stock/nursery-raised stock from local propagules. Seed will be collected locally, where possible, to ensure it is adapted to environmental conditions in the area.

Prior to application, some of the tree seed will be pre-treated (ie inoculated and scarified) to break dormancy restrictions and promote earlier germination, develop more robust seedlings, encourage wider and more uniform germination, and increase germination rates.

Revegetation will be undertaken based on the proposed final land use objectives for the disturbed areas, using species identified during the terrestrial ecology assessment undertaken by Niche (2020b). The proposed species to be used include a range of trees, shrubs, grasses and groundcovers, which are outlined in **Table 10**.

Table 10 Indicative Species for Revegetation

Scientific Name	Common Name
Trees	
Eucalyptus crebra	Narrow-leaved Ironbark
Eucalyptus eugenioides	Thin-leaved Stringybark
Eucalyptus fibrosa	Red Ironbark
Eucalyptus punctata	Grey Gum
Allocasuarina littoralis	Black She-Oak
Corymbia gummifera	Red Bloodwood
Eucalyptus racemosa	Narrow-leaved Scribbly Gum, Snappy Gum
Shrubs	
Acacia decurrens	Black Wattle, Green Wattle, Sydney Green Wattle
Bursaria spinosa	Blackthorn, Boxthorn, Sweet Bursaria, Kurwan
Exocarpos cupressiformis	Cherry Ballart, Native Cherry
Indigofera australis	Australian Indigo, Duwabili

Scientific Name	Common Name
Kunzea ambigua	Tick Bush
Melaleuca thymifolia	Thyme Honey-Myrtle
Pultenaea villosa	Hairy Bush-pea
Olearia microphylla	Small-leaved Daisy Bush
Ozothamnus diosmifolius	Rice Flower, Dog Wood, Pill Flower, Sago Bush
Acacia ulicifolia	Prickly Moses
Acacia terminalis	Sunshine Wattle
Acacia linifolia	White Wattle
Banksia spinulosa var. *spinulosa*	Hill Banksia, Golden Candlestick
Hakea sericea	Needle Bush
Persoonia levis	Broad-leaved Geebung
Persoonia linearis	Narrow-leaved Geebung
Leptospermum trinervium	Flaky-barked Tea-tree, Slender Tea-tree
Grasses	
Anisopogon avenaceus	Oat Speargrass
Aristida ramosa	Purple Wiregrass
Aristida vagans	Threeawn Speargrass
Cyathochaeta diandra	Sheath Rush, Spear Grass
Entolasia stricta	Wiry Panic
Eragrostis brownii	Brown's Lovegrass
Microlaena stipoides	Weeping Grass
Themeda australis	Kangaroo Grass, Durawi
Ground Covers	
Billardiera scandens	Hairy Apple Berry
Cassytha glabella	Slender Devil's Twine
Cheilanthes sieberi	Poison Rock Fern, Mulga Fern
Einadia hastata	Berry Saltbush
Lomandra filiformis	Wattle Mat-rush
Lomandra obliqua	Fish Bones
Lepidosperma laterale	Variable Saw Edge
Phyllanthus hirtellus	Thyme Spurge
Pratia purpurascens	Whiteroot
Solanum prinophyllum	Forest Nightshade
Goodenia hederacea	Forest Goodenia, Ivy Goodenia
Pimelea linifolia subsp. *linifolia*	N/A
Xanthosia tridentata	Rock Xanthosia

The revegetation seed mix may include a cereal cover crop and/or improved pasture species to maximise the potential for rapid re-colonisation of the disturbed areas and minimise erosion and soil loss. These complimentary species will be selected with consideration for the proposed final land use and the appropriate completion criteria that will facilitate lease relinquishment and/or on-sale of the land.

Legumes may also be selected to assist in the supply of bio-available nitrogen to the soil. If the use of introduced grasses and/or legumes is deemed necessary for erosion control in the bushland areas, pasture seed and fertiliser will be applied at a lower rate than for pasture outcomes to reduce competition with tree seed and/or seedlings.

Where appropriate, native pasture species (warm season perennial, cool season perennial, year-long green perennial and annual) will be sown. If steep slopes are present and it is not practicable to re-shape the area and/or there is a high risk of erosion, introduced, stoloniferous grass species (eg Rhodes Grass) will be sown, as their growth provides more extensive coverage in a shorter time . If native species are unsuccessful in areas identified as grazing pasture for final land use, Atlas Phalaris, Uplands Cocksfoot or Tall Fescue (or other introduced pasture species) may be used on the condition that there is a sufficient buffer zone.

The use of buffer zones will be site specific and should be considered prior to any revegetation activities. However, buffer zones should be established around any areas of remnant vegetation that are relatively undisturbed and where exotic species are not present.

Buffer zones may be established by initially seeding with a non-invasive cover crop (eg millet, oats or barley) to achieve rapid ground cover and to minimise soil erosion. Native grass seed will be included in the cover crop seed mix. Inclusion of native grass seed will allow native species to germinate through the protective cover crop. This will provide rapid surface coverage and erosion protection for the surface soil and provide a buffer from exotic pasture species.

Appropriate buffer zones should be evaluated when considering the use of introduced species and introduced species will only be used on the condition that:

- The area does not border an area allocated for rehabilitation of bushland; or
- Border any area of uncleared vegetation.

Aerial sowing and ground broadcasting will be conducted for both tree and pasture seed as the preferred sowing methods and grazing will be restricted whilst the vegetation is establishing.

All revegetated areas will be monitored to ensure long-term groundcover establishment and success. Revegetation techniques will be continually developed and refined over the life of the mine through an ongoing process of monitoring at the site and recognition of other industry experiences.

11.9.3 Special Treatment Areas

Additional erosion control measures, such as the application of ‘Hydromulch’, will be considered, particularly in drainage lines and steeper batter areas (eg infrastructure “cut and fill” batters). For example, sugar cane mulch as slurry provides cover for the soil to improve pasture growth, modifying the soil surface to control erosion, or a combination of both. Securely pressed against the surface of the soil, mulch provides a high degree of erosion control and improves moisture availability to establishing pasture. Mulch also has the effect of improving the micro-environment for seed germination and establishment by reducing evaporation losses, and assisting in the control of surface erosion caused by raindrop impact and overland water flow.

Opportunities for use of potential soil ameliorants (biosolids) to accelerate the rehabilitation process will also be investigated, as appropriate.

11.10 Rehabilitation Monitoring

Tahmoor Coal has developed and implements an annual rehabilitation monitoring program, as documented in the MOP (SIMEC, 2019b).

The annual rehabilitation program consists of two main parts:

- Annual rehabilitation inspection (assessment of rehabilitated areas in general to confirm trajectory towards completion criteria); and
- Long-term rehabilitation monitoring sites (detailed evaluation of permanent monitoring transects located throughout rehabilitated areas to monitor progress over time towards achieving completion criteria).

The intent of Tahmoor's rehabilitation monitoring program is to measure the success of rehabilitation, using consistent methods year to year, so results are comparable and improvement actions can be tracked over time. Rehabilitation monitoring is conducted over all phases of rehabilitation, with the greatest emphasis on the ecosystem development stage of the MOP rehabilitation phase.

Outcomes of the annual rehabilitation monitoring inspections are recorded and compiled into a report, with improvement actions that are identified as part of the inspection entered into the site action database for tracking and implementation. Improvement actions include care and maintenance activities, such as additional seeding or fertiliser, weed management, and erosion repair to improve the quality of rehabilitation areas where deficiencies are identified during the annual monitoring. Improvement actions may also trigger changes to rehabilitation procedures, so rehabilitation methods and standards can be continually improved.

The annual rehabilitation inspection includes an assessment of the following broad indicators:

- Evidence of soil profile development;
- Visual assessment of surface materials;
- Evidence of erosion;
- Stability and function of erosion and sediment control structures;
- Growth rates;
- Evidence of plant mortality or dieback;
- Species diversity, including both native and weed species;
- Presence of overstorey, mid-storey and under-storey species;
- Evidence of reproductive potential;
- Evidence of biological nutrient cycling;
- Occurrence of potholing or slumping;
- Evidence of spontaneous combustion; and
- Evidence of contamination or other limitations to vegetative establishment.

The long-term rehabilitation monitoring includes an assessment of the following indicators at permanently established monitoring transects each year:

- General site description of vegetation;
- Assessment of reproductive potential of the existing vegetation and soils (soil sampling and laboratory analysis);
- Number of plants of all species (excluding grasses);
- Measure live vegetation cover for under-storey and grasses (separately) using a line intercept method;
- Record details of ground cover (leaf litter, logs and rocks);
- Tag and measure diameter at breast height (DBH) of trees >1.6 m tall, to a maximum of 10 for any one species;
- Record canopy cover over 20 m centreline (when trees are tall enough);
- Subjectively describe tree health, by species if relevant, noting signs of drought stress, nutrient deficiencies, disease and severe insect attack as percentage;
- Record any new plant species not present in the smaller plots, including any problem and declared noxious weeds;
- Record the location, number and dimension of all gullies, rill and slope wash features; and
- Photographic monitoring of all sites and repair to permanent transect markers (star pickets), as required.

11.10.1 Weed Management

The presence of weed species has the potential to have a major impact on revegetation and regeneration activities. In addition, the presence of weed species within the surrounding land has the potential to significantly decrease the value of the native vegetation. Weed management will be a critical component of mine rehabilitation and landscape reconstruction. Weeds will be managed across the site through a series of control measures, including:

- Hosing down “at risk” equipment in an approved wash down area before entry to site;
- Scalping weeds off topsoil stockpiles prior to re-spreading topsoil;
- Regular inspections of rehabilitation to identify potential weed infestations;
- Identifying and spraying existing weed populations on-site together with ongoing weed spraying over the life of the mine; and
- Regular inspection of areas to be stripped and on topsoil stockpiles and use of agricultural herbicides to prevent weed establishment and infestations occurring.

Weed control, if required, will be undertaken in a manner that minimises soil disturbance. Any use of herbicides will be carried out in accordance with appropriate State and/or Federal regulatory requirements to minimise potential environmental impacts. Records will be maintained of weed infestations and control programs will be implemented according to best management practices for the weed species concerned.

11.11 Rehabilitation Maintenance

Maintenance of rehabilitated areas is also documented in the MOP (SIMEC, 2019b) and includes fertilising, sediment and erosion control, weed control, and re-planting or re-seeding, as required. The intensity of these activities will be highest over a likely period of two (2) years following ecosystem establishment, however, depending on the success of rehabilitation, care and maintenance may be required beyond this period to achieve the identified completion criteria for ecosystem development for each closure domain.

The MOP (SIMEC, 2019b) also incorporates a trigger, action, response plan (TARP) to manage unexpected variations in rehabilitation outcomes.

Post-mining surveys of the rehabilitation will be progressively undertaken across the Project Area to determine whether the site is progressing towards meeting the success criteria and whether the results are being maintained over time. Once maintenance and rehabilitation are no longer required, the area will be relinquished to the relevant stakeholders.

12 REHABILITATION SUCCESS CRITERIA

Rehabilitation success criteria have been developed to provide long-term performance goals for rehabilitation activities.

Final rehabilitation success criteria will be developed for the Project during the detailed closure planning, which is typically undertaken when the Project is no later than five years from permanent closure. This will include development of specific, measurable, achievable, realistic, and outcome-based criteria. The criteria will be based on the results of research and ongoing monitoring of the progressive rehabilitation areas.

Rehabilitation success criteria are provided in **Table 11**. Each criterion is designed as a performance objective or standard against which rehabilitation success can be demonstrated. Meeting the success criteria (as indicated by monitoring results) demonstrates that the rehabilitated landscape is in a sustainable condition, ready to be relinquished, and handed back to the appropriate stakeholders.

The success criteria comprise indicators for vegetation, fauna, soil, stability, land use and safety on a landform-type basis that reflects the nominated post-mine land use of native bushland.

Table 11 Preliminary Rehabilitation Success Criteria

Rehabilitation Element	Domain	Indicator	Criteria
Phase 1 – Decommissioning			
Infrastructure	Domains 1, 2, 3 and 4	Native Bushland	All buildings, water storage, roads and other infrastructure (except those used by the public or heritage protected, unless otherwise agreed) have been removed and disposed of appropriately, for example to an appropriate waste management facility, unless agreed with stakeholders for their retention.
	Domain 5 and 6	Land use	Roads (except those used by the public) and other infrastructure have been removed unless stakeholders have entered into formal written agreements for their retention. Minor dozer reshaping work will be undertaken to ensure surface level consistency with the surrounding areas. Any creek crossings (ie culverts, etc) will be removed and the pre-existing drainage line re-instated, where applicable. If required, the area will be deep ripped to loosen compacted material. A light vehicle access road is to be maintained to enable inspections of the site following closure of the mine. Fertiliser and pasture/tree seed will be applied to assist establish the applicable post-mine land use.
	Domain 6	Boreholes	All boreholes (except those retained for monitoring purposes) have been shut down, bore casings near the surface are removed and holes plugged or capped to the regulatory standards.
	All Domains	No contamination	All sites have been assessed by a suitably qualified person as not containing contaminants above the relevant criteria for the proposed final land use.

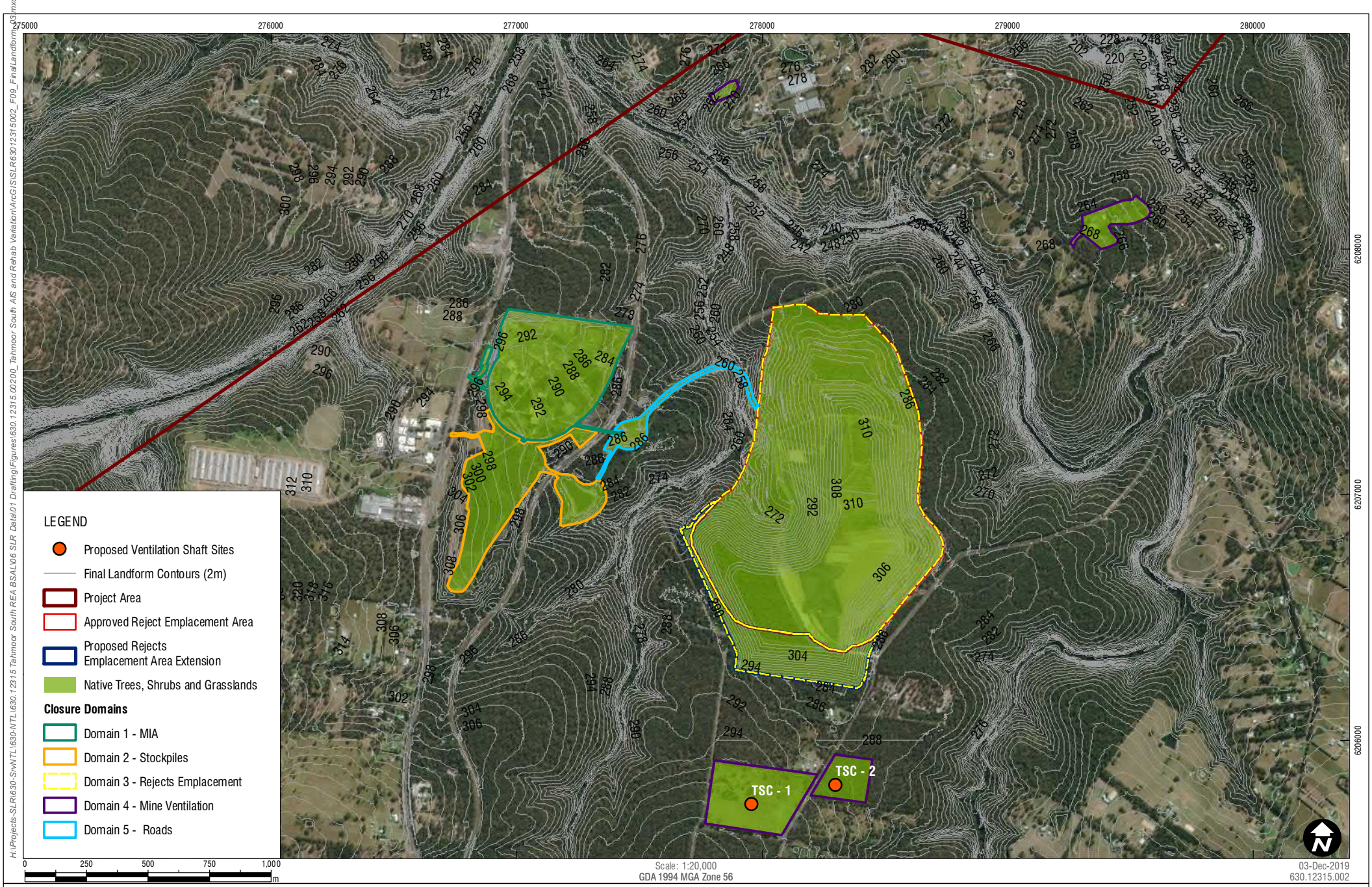
Rehabilitation Element	Domain	Indicator	Criteria
Safety	All Domains	Physical	Excavations to be rendered safe. All holes/pits and other openings are to be securely capped, filled or otherwise made safe. Access to members of the public and livestock is restricted, as appropriate, to site conditions. No rubbish should remain at the surface, or at risk of being exposed through erosion. Risk assessment has been undertaken in accordance with relevant guidelines and Australian Standards and risks reduced to levels agreed with the stakeholders. Closure documentation includes the contaminated sites register, which identifies contaminated sites and the treatment applied.
Phase 2 – Landform Establishment			
Landform Stability	Domains 1 and 2	Slope Gradient	The average gradient is 18% with a minimum of 1% and maximum of 50%
	Domain 3	Slope Gradient	The average gradient is 20% with a minimum of 1% and a maximum of 50%.
	Domain 4	Slope Gradient	The average gradient is 20% with a minimum of 1% and maximum of 50%
	Domains 5 and 6	Slope Gradient	The average gradient is 19% with a minimum of 1% and maximum of 50%
	Domain 3	Capping	Capping material will be applied to the REA final landform at a depth that is in accordance with the MOP (currently 300 mm) No water is observed leaching from the facility.
	Domains 1, 2, 3, 4 and 5	Surface water drainage	The landform is stable and contour banks and diversion drains are installed to direct water into stable areas or sediment control basins.
	Domains 1, 2, 3, 4 and 5	Erosion control	Erosion control structures are installed at intervals commensurate with the slope of the landform.
	Domain 6	Erosion control	Erosion mitigation measures have been applied.

Rehabilitation Element	Domain	Indicator	Criteria
	Domain 6	Subsidence impacts	Perform regular inspections over subsidence areas to identify any surface cracks and/or sinkholes. Undertake minimal clearing, if required, of areas around cracks and/or sinkholes to allow for ripping and seeding. Ripping and seeding of areas, where required. Following initial ripping and seeding, if trees are to be planted, they will not be planted until enough rain has fallen. Seed and/or plant appropriate species of vegetation to achieve a post-subsidence land use the same as that pre-subsidence (eg low intensity cattle grazing). Regrade subsidence areas and, where necessary, backfill with mine spoil to control surface water flow and minimise erosion and sedimentation. If ripping is not feasible due to the width of the cracks, topsoil will be stripped and stockpiled, clay material will be imported to fill and seal cracks, and the topsoil will be respread once the cracks have sealed. The area will then be reseeded with appropraite plant species.
	Domain 6	Surface water drainage	Design local drainage works to prevent the uncontrolled flow of runoff from the subsided floodplain area over the channel banks. Small diversion bunds directing floodplain runoff to properly engineered rock chute structures will be installed to minimise bank erosion.
Water Storage	Domains 3, 4 and 5	Stable landform	Water storages to be rehabilitated to a stable non-polluting condition.

Rehabilitation Element	Domain	Indicator	Criteria
Water Storage and Waterways	Domain 6	Surface water management	Provide a cover of topsoil in a weathered rock matrix to create a stable substrate for revegetation of channel banks. Weathered rock provides temporary erosion protection by covering erodible soils and minimising topsoil loss. Replace sand across the channel bed, including higher sand deposits, suitable for re-creation of in-channel benches. Install timber groynes/pile field retards at the base of the channel banks (extending into the channel) to mitigate erosion undercutting the channel banks and to facilitate creation of in-channel benches. The structures will be built between each of the subsided panels affecting the river before subsidence occurs. In areas where less active bank erosion develops, large woody debris will be placed in-stream to encourage the deposition of sediment and revegetation over time. Local drainage works will be designed to prevent the uncontrolled flow of runoff from the subsided floodplain area over the channel banks. Small diversion bunds directing floodplain runoff to properly engineered rock chute structures will be installed to minimise bank erosion. Topsoil will be placed on banks and banks will be revegetated. Stock will be excluded to a width of at least 30 metres from the top of bank and subsided floodplain areas to minimise further impacts on vegetation cover and land condition. A targeted revegetation will be undertaken in areas where surface water patterns have been affected.
Watercourses and Drainage Channels	Domains 1, 2, 3, 4, 5 and 6	Maintaining and/or reinstating flows and water levels	Flows and water levels in watercourses and drainage channels will be monitored so they are maintained or reinstated generally in accordance with pre-mining flows and water levels.
Phase 3 – Growth Media Development			
Top soil	Domains 1, 2, 3, 4, 5 and 6	Physical and chemical parameters	Soil salinity content is less than 0.6 dS/m. Soil pH is between 5.5 and 8.5. Soil Exchange Sodium Percentage (ESP) is greater than 15%. Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other micro symbionts. Adequate macro and micro-nutrients are present. Where practical, previously stockpiled topsoil will be used to sustain the proposed post-mining land use. Where it is assessed as not being suitable, an alternative topsoil substitute will be considered (eg bio-solids, organics, etc)

Rehabilitation Element	Domain	Indicator	Criteria
Phase 4 – Ecosystem Establishment			
Vegetation	Domains 1, 2, 3, 4, 5 and 6	Species composition	Where relevant, eg areas where the post-mining land use is native bush, vegetation present is commensurate with the pre-mining environment and/or nearby undisturbed reference sites.
Phase 5 – Ecosystem Development			
Vegetation	Domains 1, 2, 3, 4, 5 and 6	Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces greater than 20 square metres in area or greater than 10 metres in length down slope.
	Domains 1, 2, 3, 4, 5 and 6	Community structure	That the community structure is commensurate with pre-mining conditions and/or nearby undisturbed reference sites.
	Domains 1, 2, 3, 4, 5 and 6	Resilience to disturbance	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species.
	Domains 1, 2, 3, 4, 5 and 6	Sustainability	Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of tree/shrub species.
Fauna	Domains 1, 2, 3, 4, 5 and 6	Vertebrate Species	The number of vertebrate species does not decrease by more than 25% in the successive seasons prior to mine lease relinquishment or by more than 40% over the two successive seasons prior to mine lease relinquishment.
	Domains 1, 2, 3, 4, 5 and 6	Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.
	Domains 1, 2, 3, 4, 5 and 6	Habitat structure	Typical food and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including a variety of food plants and signs of natural generation of shelter sources, including leaf litter.
Land Use	Domains 1, 2, 3, 4 and 5	Land use	The site can be managed for its designated land use without any greater management inputs than other land in the area being used for a similar purpose.

A conceptual final landform is shown as **Figure 9**.



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Scale: 1:20,000
GDA 1994 MGA Zone 56

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Final Landform

FIGURE 9

13 INDICATIVE CLOSURE TIMELINE

An indicative closure timeline is shown in **Table 12** below, including the key rehabilitation and closure activities throughout the life of the project. In particular, the key activities include:

- Closure planning;
- Decommissioning and rehabilitation;
- Maintenance and monitoring;
- Relinquishment; and
- Post-relinquishment activities.

A revised closure timeline/schedule will be developed during closure planning and will include activities such as:

- Salvage of plant and equipment from the underground workings and the CHPP;
- Removal of remnant coal from the site for processing through the CHPP where practicable;
- Phase 1 and 2 contamination assessments to identify contamination and the extent;
- Removal of plant, equipment and materials from the surface storage areas;
- Sealing of underground workings following shut down of the ventilation system and removal of electrical supply;
- Demolition of all buildings and surface infrastructure;
- Excavation of any contaminated soil for remediation on-site or off-site disposal;
- Removal or capping of carbonaceous material;
- Capping and reshaping works to achieve the post-mining land use landform design, including construction of a stable drainage network; and
- Revegetation activities.

Table 12 Indicative Closure Timeline

Years from Closure	Closure Planning					Decommissioning & Rehabilitation				Monitoring & Maintenance				Relinquishment	
	-5	-4	-3	-2	-1	1	2	3	4	5	6	7	8	9	10
Closure Planning															
Stakeholder consultation regarding closure															
Agreed final detailed closure strategy															
Develop an infrastructure demolition plan															
Closure Activities															
Reject emplacement capping															
Demolition of infrastructure															
Landform establishment															
Growth media establishment															
Ecosystem establishment															
Ecosystem development															
Post Closure Activities															
Maintenance of rehabilitated areas															
Monitoring and inspections															

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