Adani Mining Pty Ltd

Carmichael coal mine (off-site infrastructure) | Closure and rehabilitation strategy

Prepared for Adani Mining Pty Ltd | 26 July 2013

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Table of Contents

Table of Contents *(Cont'd)*

Appendices

Tables

Figures

1 Introduction

1.1 Project overview

Adani Mining Pty Ltd (Adani) is proposing to develop a 60 million tonne per annum (Mtpa) thermal coal mine in the north Galilee Basin approximately 160 kilometres (km) north-west of the town of Clermont, Central Queensland (Figure 1.1). Coal from the Project will be transported by rail to the existing Goonyella and Newlands rail systems, operated by Aurizon Operations Limited (Aurizon). The coal will be exported via the Port of Hay Point and the Port of Abbot Point over the 60 year (90 years in the EIS) mine life.

Project components are as follows:

- The Project (Mine) - a greenfield coal mine over EPC 1690 and the eastern portion of EPC 1080, which includes both open-cut and underground mining, on mine infrastructure and associated mine processing facilities (the Mine) and the Mine (off-site) infrastructure including a workers accommodation village and associated facilities, a permanent airport site, an industrial area and water supply infrastructure.

- The Project (Rail) - a greenfield rail line connecting the mine to the existing Goonyella and Newlands rail systems to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point, respectively including:

    - Rail (west) - a 120 kilometre (km) dual gauge portion running west from the Mine site east to Diamond Creek.

    - Rail (east) - a 69 km narrow gauge portion running east from Diamond Creek connecting to the Goonyella rail system south of Moranbah.

- Quarries - The use of five local quarries to extract quarry materials for construction and operational purposes.

1.2 Purpose and scope

For the purpose of preparing the closure and rehabilitation management strategy, Carmichael Coal Mine and Rail Project has been divided into four discrete components. These components include the:

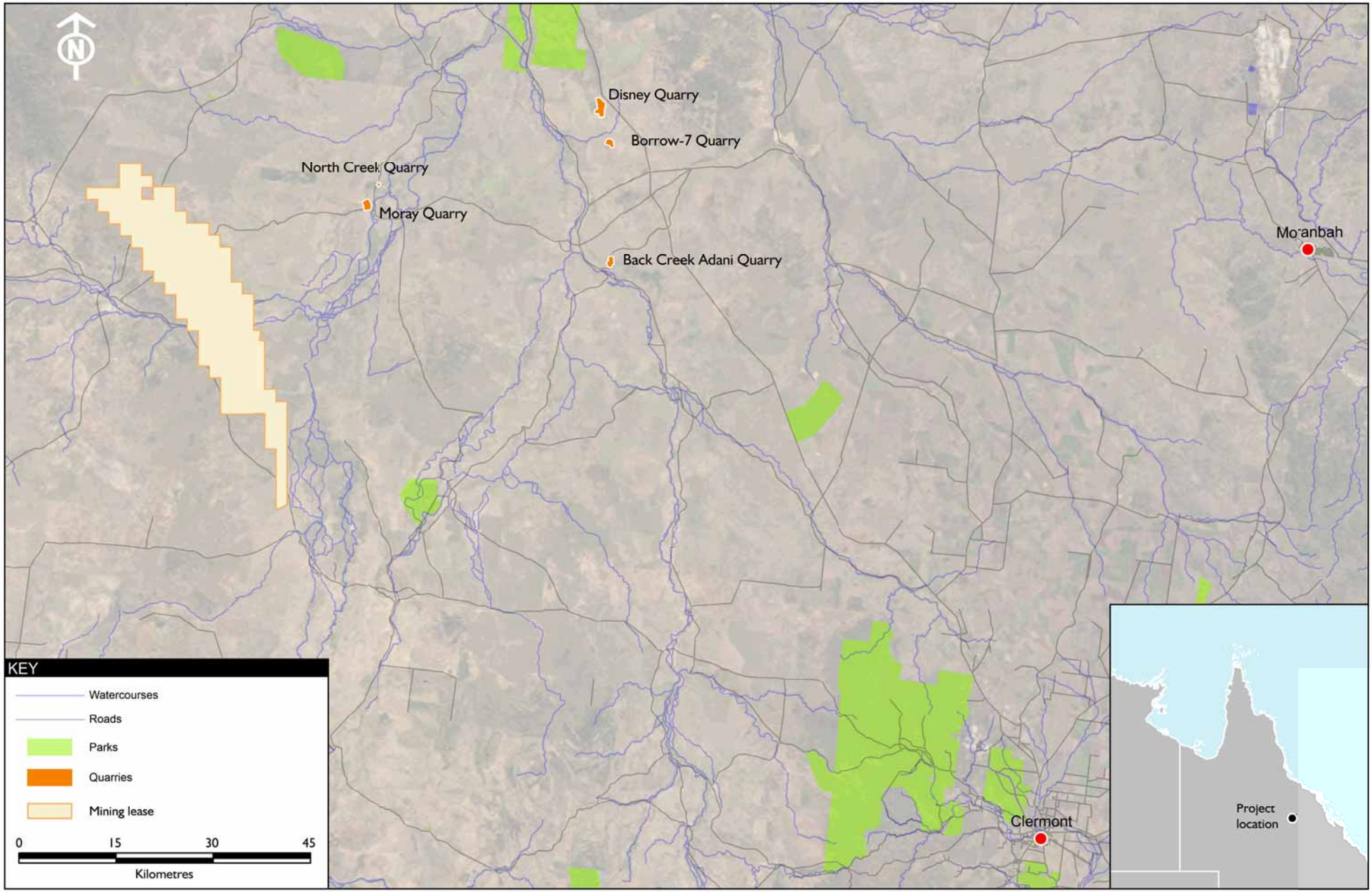
- mine site (including all activities carried out within the mining leases);

- off-site infrastructure area (including workers accommodation village, dedicated airport, off-site industrial area, water supply, storage and transfer infrastructure and access roads;

- railway activities and associated infrastructure; and

- quarries.

EMGA Mitchell McLennan (EMM) was commissioned by Adani to complete a separate closure and rehabilitation management strategy for each component. The closure and rehabilitation management strategies implement the management controls and methods outlined in the *Carmichael Coal Mine and Rail Project Environmental Management Strategy* (EMP).



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Project location

Rehabilitation management plan (off-site)

Figure 1.1

The objectives of the closure and rehabilitation management strategies are to:

- ensure compliance with the requirements of relevant environmental legislation, best practice guideline, conditions of any applicable licence, approval or permit;
- provide conceptual rehabilitation management and mitigation procedures for site personnel;
- describe indicators and rehabilitation completion criteria where they can be identified, where they cannot be identified, document this so that future iterations of the strategy can include a schedule for continuous improvement;
- provide methods and process to allow the site to be rehabilitated to a safe and stable condition;
- describe progressive and interim rehabilitation procedures;
- establish a monitoring program for rehabilitation assessment; and
- describe the procedure to be used to revegetate the post-activity landscape to achieve the relevant performance outcomes and completion criteria.

This closure and rehabilitation management strategy covers rehabilitation of all operational activities and associated infrastructure being undertaken as part of the Project off-site. Construction activities requiring rehabilitation of off-site areas will be managed via the *Construction Off-site Operations Plan* with guidance from this closure and rehabilitation management strategy.

This closure and rehabilitation management strategy covers rehabilitation of all off-site infrastructure elements being undertaken as part of the Project (Off-site). This includes:

- workers accommodation village;
- dedicated airport;
- off-site industrial area (includes rail sidings);
- water supply, storage and transfer infrastructure; and
- access roads.

Construction activities requiring rehabilitation at off-site infrastructure sites site will be managed with guidance from this closure and rehabilitation management strategy. The closure and rehabilitation management strategy will evolve over time as activities progress and additional technical studies and investigations are completed. It is envisaged that with each review a continuous improvement schedule will be developed to include new items resulting from the review process.

1.3 Strategy structure

This closure and rehabilitation management strategy incorporates rehabilitation objectives, an overall management strategy and general rehabilitation methods for off-site infrastructure sites structured around five domains (Figure 1.2). The closure and rehabilitation management strategy is structured as follows:

- Chapter 2 describes responsibilities, delegations and review.

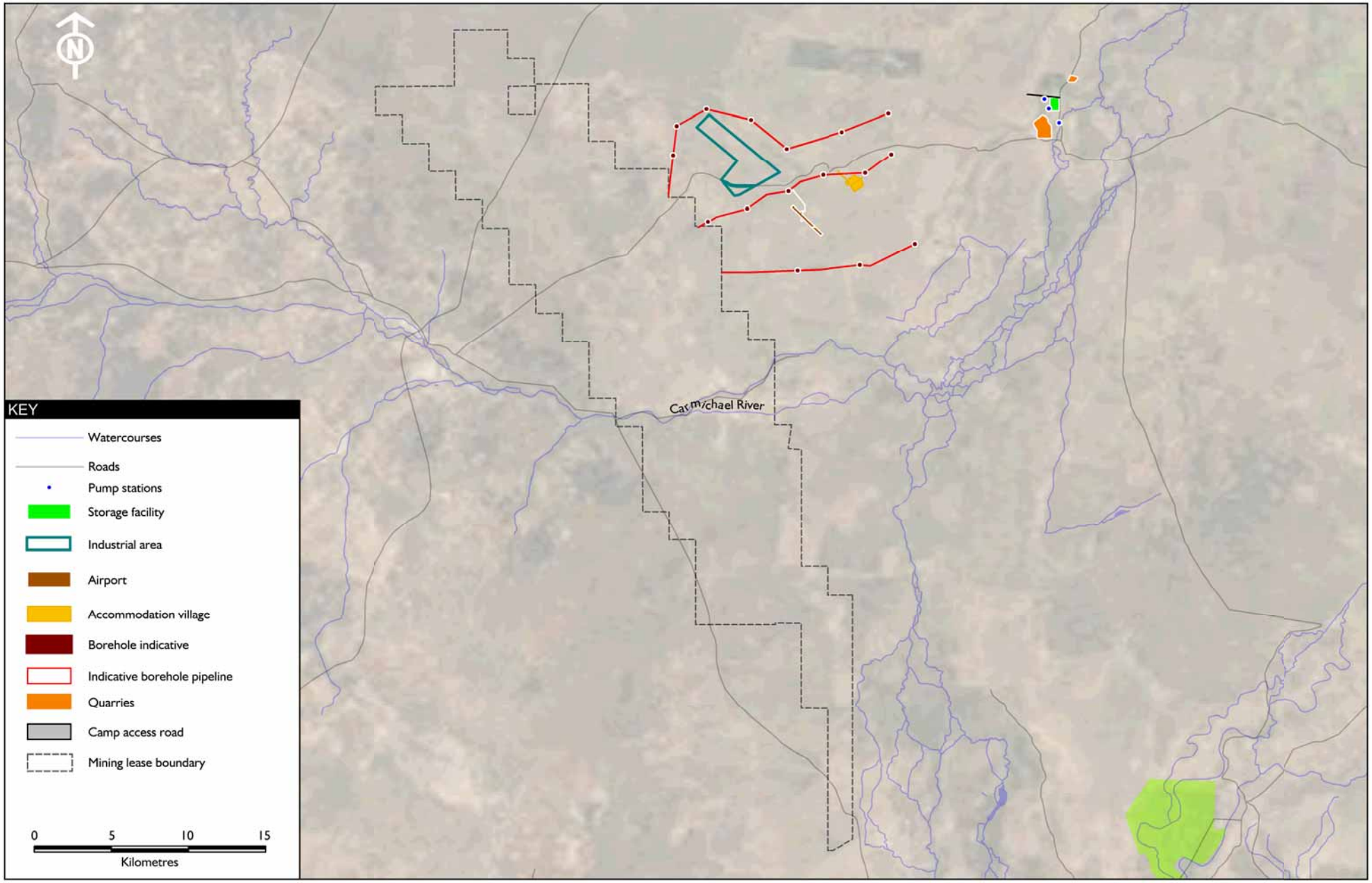
- Chapter 3 describes the rehabilitation objectives. The objectives are staged as a continuum between short and long-term reflecting the changing nature of off-site infrastructure sites as they evolve through rehabilitation.

- Chapter 4 describes the preferred rehabilitation strategy for each of the five domains. The chapter also describes how the preferred closure strategy differs from the pre-mining land capability/suitability assessment.

- Chapter 5 describes general rehabilitation activates that are common to all domains.

- Chapter 6 describes the final land use objectives and describes final landforms for each domain. The completion criteria presented in this chapter are intended to be used to measure and describe whether the final landforms are meeting the objectives described in Chapter 3.

- Chapter 7 describes the monitoring and maintenance program.



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Off-site mining infrastructure domains

Rehabilitation management plan (off-site)

Figure 1.2

2 Delegation and review

2.1 Roles and responsibilities

Table 2.1 Role and responsibilities

Role	Responsibility
Mine Manager or representative	Ensure that adequate resources are available within Adani and ensure that contractors meet all compliance requirements
	Implement the closure and rehabilitation management strategy.
	Facilitate rehabilitation planning review.
Environment Manager or representative	Implement the closure and rehabilitation management strategy.
	Review, update and further develop the closure and rehabilitation management strategy annually as a minimum throughout the life of the quarries.
	Train staff in environmental awareness, site issues and requirements of the monitoring program.
	Facilitate the monitoring and implementation of measures outlined in this closure and rehabilitation management strategy.
	Report non-conformances to Mine Manager or representative and ensure corrective actions are closed out.
	Advise Mine Manager or representative and other management on environmental permit requirements and provide advice to assist with achieving compliance.
	Investigate environmental incidents and liaise with EHP where necessary/as requested by the Mine Manager or representative.
Employees	Be familiar with the contents of this closure and rehabilitation management strategy.
	Ensure works are completed in accordance with the closure and rehabilitation management strategy.
	Report all incidents or non-compliance with the closure and rehabilitation management strategy to the Mine Manager or representative.
Contractors	Be familiar with this closure and rehabilitation management strategy
	Ensure works are completed in accordance with the closure and rehabilitation management strategy
	Report all incidents or non-compliance with the closure and rehabilitation management strategy to the Mine Manager or representative.

2.2 Review

The preliminary closure and rehabilitation management strategy will be reviewed annually throughout the life of off-site infrastructure sites. As the operational plan changes or rehabilitation activities are completed, the strategy will be updated to reflect these changes. Five years prior to the confirmed closure date, the final closure and rehabilitation management strategy will be developed to properly address the post-activity landscape for off-site infrastructure areas.

3 Rehabilitation overview

3.1 Rehabilitation hierarchy

Adani intends to use the rehabilitation hierarchy from the department of Environment and Heritage Protection (DEHP) *Rehabilitation requirements for mining projects* to guide rehabilitation choices where possible. The rehabilitation hierarchy, in order of decreasing capacity to prevent or minimise environmental harm, is:

- avoid disturbance that will require rehabilitation to prevent of minimise future environmental harm;
- reinstate the original natural ecosystem;
- develop an alternative outcome with a higher economic value than the previous land use;
- reinstate previous land use (eg grazing); and
- develop lower value land use (if this is acceptable to the relevant stakeholders).

3.2 Rehabilitation objectives

Adani intends to return the off-site infrastructure sites to a stable landform capable of supporting similar land uses to pre-disturbance in a manner which is consistent with the rehabilitation hierarchy in *Rehabilitation requirements for mining projects*.

The nominated post-activity land-use includes grazing on pasture and/or a mosaic of native pasture. For areas disturbed by off-site infrastructure the following overarching objectives will apply:

- The site will be safe to humans and fauna.
- Rehabilitation will aim to create a landform that is stable and with similar land use capabilities and/or suitability that existed prior to the disturbance, unless other end uses are determined.
- Disturbed land will be rehabilitated so that they are non-polluting and self-sustaining or to a condition where the maintenance requirements are limited.
- Surface and ground waters leaving off-site infrastructure sites will not be degraded compared to their condition prior to the commencement of disturbance. Current and future water quality will be maintained at levels that are acceptable for users downstream of the site and meet environmental needs.
- Vegetation cover will be established to reduce rates of erosion and sediment loss to that in surrounding, comparable undisturbed landscapes.
- Soil suitability for use in rehabilitation will be assessed and soils will be ameliorated as required.

It is important that the closure and rehabilitation management strategy recognises the limit of how the above described overarching objectives can be applied during rehabilitation. The following continuum describes how these objectives will be met during and after rehabilitation.

3.2.1 Short-term

Rehabilitation objectives in the short-term are to:

- progressively reshape and stabilise disturbed areas;
- provide short-term erosion control measures;
- mange soil to ensure suitability and beneficial reuse during rehabilitation;
- ameliorate wastes and soils as necessary to address physical and chemical constraints to revegetation and erosion stability; and
- refine rehabilitation methods through continuing review and update of this closure and rehabilitation management strategy.

3.2.2 Medium-term

Rehabilitation objectives in the medium-term are to:

- establish functionally important and structurally dominant species from the surrounding native vegetation communities;
- demonstrate rehabilitation succession in comparison with analogue sites; and
- reduce reliance on structural drainage and erosion control methods through landform design and construction that lends itself to the surrounding fluvial and landscape processes.

3.2.3 Long-term

The long-term rehabilitation objectives are to:

- monitor rehabilitation areas to ensure succession of planted native vegetation with functionality trending toward analogue native vegetation communities;
- apply adaptive management measures if natural succession is not occurring; and
- demonstrate rehabilitation performance.

3.3 Closure and rehabilitation schedule

A conceptual off-site infrastructure rehabilitation schedule based on current approved dates of closure is provided in Table 3.1. Many of the decommissioning closure tasks will be undertaken concurrently and the duration shown is indicative of each specific task only. Any infrastructure including dams, roads and buildings, which has beneficial future use by post-activity landowners, will be left in place.

Table 3.1 Summary of rehabilitation schedule

Offsite	Disturbance area (ha)	Year disturbance starts	Year progressive rehabilitation starts	Year progressive rehabilitation ends	Total area rehabilitated (ha)
Workers accommodation village and Dedicated airport.[1]	126.8	TBA	TBA	TBA	126.8
Off-site industrial area.	964.8	TBA	TBA	TBA	964.8
Water supply, storage and transfer infrastructure.	116.4	TBA	TBA	TBA	116.4
Access roads.	115.6	TBA	TBA	TBA	115.6

Notes: [1] The domains workers accommodation and village and dedicated airport are combined to form a single line entry in this table

3.3.1 Unplanned closure

Site closure may be initiated in a number of different scenarios including: planned closure, unplanned or imminent closure and temporary closure.

In the event of unplanned closure some of the objectives, processes and implementation timeframes may vary. However, the practice of progressive rehabilitation and closure planning including adequate financial provisioning will be in place. This forms a strong foundation, in the event of unplanned closure, to provide the highest chance of a successful closure to the satisfaction of the relevant agencies and stakeholders.

4 Preferred rehabilitation strategy

4.1 Domains

For the purpose of rehabilitation management and planning, this closure and rehabilitation management strategy applies to the following five domains for off-site infrastructure areas:

- workers accommodation village;
- dedicated airport;
- off-site industrial area;
- water supply, storage and transfer infrastructure; and
- access roads.

The preferred rehabilitation strategies for each domain are discussed below. The preferred rehabilitation strategies for the mine site and the rail corridor are addressed in the *Closure and rehabilitation management strategy (Mine site)* and the *Closure and rehabilitation management strategy (Rail corridor)*. Additional detail will be provided in the supplementary EIS.

4.1.1 Workers accommodation village

The workers accommodation village will include:

- accommodation units;
- office and administration units;
- dining facilities;
- medical facilities;
- recreational areas such as outdoor barbecues and shelters, gymnasium and sport fields;
- covered walkways;
- parking areas;
- water and sewage treatment facilities;
- power generation facilities; and
- waste transfer facilities.

All components suitable for reuse at other mining or industrial operations will be reused. Otherwise, recyclable materials will be recovered and non-recyclable components will be disposed of at authorised facilities.

A risk assessment of all below ground infrastructure and components will be completed to determine what can be removed (for reuse and/or disposal) and what can be left in place. Surface disturbance and impacts associated with the removal of below ground infrastructure and components will be considered in addition to the potential for contamination. Below ground infrastructure that is left in place will be made safe (eg depressurising, draining and sealing of pipelines) and the location will be recorded.

Contaminated soil assessments will be conducted as required (Section 4.2). Contaminated soils or other potential sources of contamination will be preferentially treated on-site. If contamination cannot be treated then it may be disposed of at an authorised facility. Incident registers will be used to identify locations where spills have occurred. Treatment versus off-site disposal will depend on whether domains are listed on the Contaminated Land Register (CLR) and Environmental Management Register (EMR) and whether it is deemed appropriate to have them removed as part of the rehabilitation process.

Compacted surfaces will be ripped/de-compacted and topsoil will be placed in accordance with the topsoil management plan and topsoil register. Soil will be seeded or planted and watered. Weeds will be managed until >70% cover is achieved.

De-compacted areas may be graded and re-profiled such that surface drainage is restored and ponding and scouring risk is reduced to as low as reasonable possible.

4.1.2 Airstrip

The permanent airport will occupy approximately 365 ha and consist of:

- an airstrip with a maximum length of 3,000 m and a width of 300 m; and
- a landside terminal of approximately 3,000 m^2.

In the event of demolition, recyclable materials will be recovered and non-recyclable components will be disposed of at authorised facilities.

Contaminated soil assessments will be conducted as required (Section 4.2). Contaminated soils or other potential sources of contamination will be preferentially treated on-site. If contamination cannot be treated then it may be disposed of at an authorised facility. Incident registers will be used to identify locations where spills have occurred. Treatment versus off-site disposal will depend on whether domains are listed on the CLR/EMR and whether it is deemed appropriate to have them removed as part of the rehabilitation process.

A risk assessment of all below ground infrastructure and components will be completed to determine what can be removed (for reuse and/or disposal) and what can be left in place. Surface disturbance and impacts associated with the removal of below ground infrastructure and components will be considered in addition to the potential for contamination. Below ground infrastructure that is left in place will be made safe (eg depressurising, draining and sealing of pipelines) and the location will be recorded.

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De-compacted areas may be graded and re-profiled such that surface drainage is restored and ponding and scouring risk is reduced to as low as reasonable possible.

4.1.3 Off-site industrial area (workshops, rail siding, fuel storage, buildings, car parks)

An industrial area will be established as part of the off-site infrastructure to provide servicing and maintenance of vehicles and equipment. Facilities within the industrial area will include:

- vehicle and equipment fabrication and maintenance workshops;
- rail siding;
- bulk fuel storage;
- vehicle wash areas;
- warehouse and storage;
- office and administration buildings;
- concrete batching plant; and
- water treatment facilities.

All components suitable for reuse at other mining or industrial operations will be reused. Otherwise, recyclable materials will be recovered and non-recyclable components will be disposed of at authorised facilities.

A risk assessment of all below ground infrastructure and components will be completed to determine what can be removed (for reuse and/or disposal) and what can be left in place. Surface disturbance and impacts associated with the removal of below ground infrastructure and components will be considered in addition to the potential for contamination. Below ground infrastructure that is left in place will be made safe (eg depressurising, draining and sealing of pipelines) and the location will be recorded.

Contaminated soil assessments will be conducted as required (Section 4.2). Any waste, contaminated soils or other potential sources of contamination will be preferentially treated on-site. If contamination cannot be treated then it may be disposed of at an authorised facility. Incident registers will be used to identify locations where spills have occurred. Treatment versus off-site disposal will depend on whether domains are listed on the CLR/EMR and whether it is deemed appropriate to have them removed as part of the rehabilitation process.

Compacted surfaces will be ripped/de-compacted and topsoil will be placed in accordance with the topsoil management plan and topsoil register. Vegetation will be seeded or planted and watered. Weeds will be managed until >70% cover is achieved.

De-compacted areas may be graded and re-profiled such that surface drainage is restored and ponding and scouring is reduced to as low as reasonable possible.

4.1.4 Water supply, storage and transfer infrastructure

Water supply associated with the off-site infrastructure will include:

- pipeline and associated facilities;
- river offtake pumping stations;

- flood harvesting dam; and
- potable and recycled water processing and storage facilities.

All components suitable for reuse at other mining or industrial operations will be reused. Otherwise, recyclable materials will be recovered and non-recyclable components will be disposed of at authorised facilities.

A risk assessment of all below ground infrastructure and components will be done to determine what can be removed (for reuse and/or disposal) and what can be left in place. Surface disturbance and impacts associated with the removal of below ground infrastructure and components will be considered in addition to the potential for contamination. Below ground infrastructure that is to be left in place will be made safe (eg depressurising, draining and sealing of pipelines) and the location of all infrastructure and other components will be recorded.

Contaminated soil assessments will be conducted as required (Section 4.2). Contaminated soils or other potential sources of contamination will be preferentially treated on-site. If contamination cannot be treated then it may be disposed of at an authorised facility. Incident registers will be used to identify locations where spills have occurred. Treatment versus off-site disposal will depend on whether domains are listed on the CLR/EMR and whether it is deemed appropriate to have them removed as part of the rehabilitation process.

Compacted surfaces will be ripped/de-compacted and topsoil will be placed in accordance with the topsoil management plan and topsoil register. Soil will be seeded or planted and watered. Weeds will be managed until >70% cover is achieved.

De-compacted areas may be graded and re-profiled such that surface drainage is restored and ponding and scouring risk is reduced to as low as reasonable possible.

The rehabilitation approach for all water storages will consist of:

- testing of water quality in all dams and storages; and
- determining, in consultation with the landholder, whether any water storages may be of beneficial use for ongoing grazing. Only water storages where water quality and sediment quality meets stock watering criteria will be left in place.

For those storages that are to be removed:

- water will be treated as required to meet water quality requirements prior to discharge or use;
- walls will be breached so that the storage can no longer contain water;
- the area will be graded and re-profiled to ensure that surface drainage is restored and ponding and scouring potential is reduced to as low as reasonably possible;
- compacted surfaces will be ripped or otherwise de-compacted;
- topsoil will be placed as per the topsoil management plan and topsoil register;
- topsoil will be seeded or planted
- weeds will be managed until 70% revegetation cover is achieved.

4.1.5 Access roads

Access roads provide vehicular access to:

- workers accommodation village;
- airport;
- industrial area;
- all water pumping station, storage locations and supply infrastructure; and
- all electrical infrastructure.

Parking and loading areas, suitably sized for appropriate vehicles, will also be constructed to allow for maintenance and removal of mechanical and electrical equipment.

At closure compacted surfaces will be ripped/de-compacted and topsoil will be placed in accordance with the topsoil management plan and topsoil register. Soil will be seeded or planted and watered. Weeds will be managed until >70% cover is achieved.

4.2 Management of contaminated land

Areas of off-site infrastructure and associated facilities are likely to be deemed contaminated under the *Environmental Protection* (EP) *Act 1994*. The CLR and Environmental EMR are administered by the Department of Environment, Heritage and Planning (EHP) under Chapter 7, Part 8 of the EP Act.

The process for assessing and removing land from the CLR will need to be confirmed with EHP at the time of closure.

Under the current EHP system the following general phases will need to be completed by a suitable qualified person:

1. Have a suitable qualified person complete a stage 1 or stage 2 contaminated land assessments.
2. If there is no contamination then the suitable qualified person will produce a report for submission to EHP requesting that the site be removed from the CLR.
3. If the contaminated site still contains contaminated soil, but it is being appropriately managed then the suitable qualified person can reflect this in their report. This may still allow the land to be removed from the CLR.

The process for assessing and removing land from the EMR will need to be confirmed with EHP at the time of closure. The system is currently under review by EHP. It is however likely that in addition to a report from a suitable qualified person an additional review and report will be required from a third-party-reviewer to verify the suitable qualified person report.

4.3 Post-activity land use strategy

Off-site infrastructure sites are a mix of short and long-term use of land. This section of the closure and rehabilitation management strategy outlines Adani commitments to a sustainable post-activity land use of the proposed areas of disturbance from off-site infrastructure. Where possible the proposed post-activity

land use strategy seeks to return the final landform as closely as possible to its original condition; ie having a similar suitability and range of land use options as existed prior to the activity. The basic strategy for how this will be achieved is described in Section (Section 4.1).

There will be areas of off-site infrastructure where land has existed in a degraded condition or was subject to poor land management. In such cases, other beneficial post-activity land use options have been identified.

All areas significantly disturbed by off-site infrastructure will be rehabilitated in accordance with Table 4.1. Figure 4.1 illustrates the post-activity good quality agricultural land (GQAL) ranking, presented in Table 4.2.

Detailed design for each domain is described in Chapter 6 and includes where available:

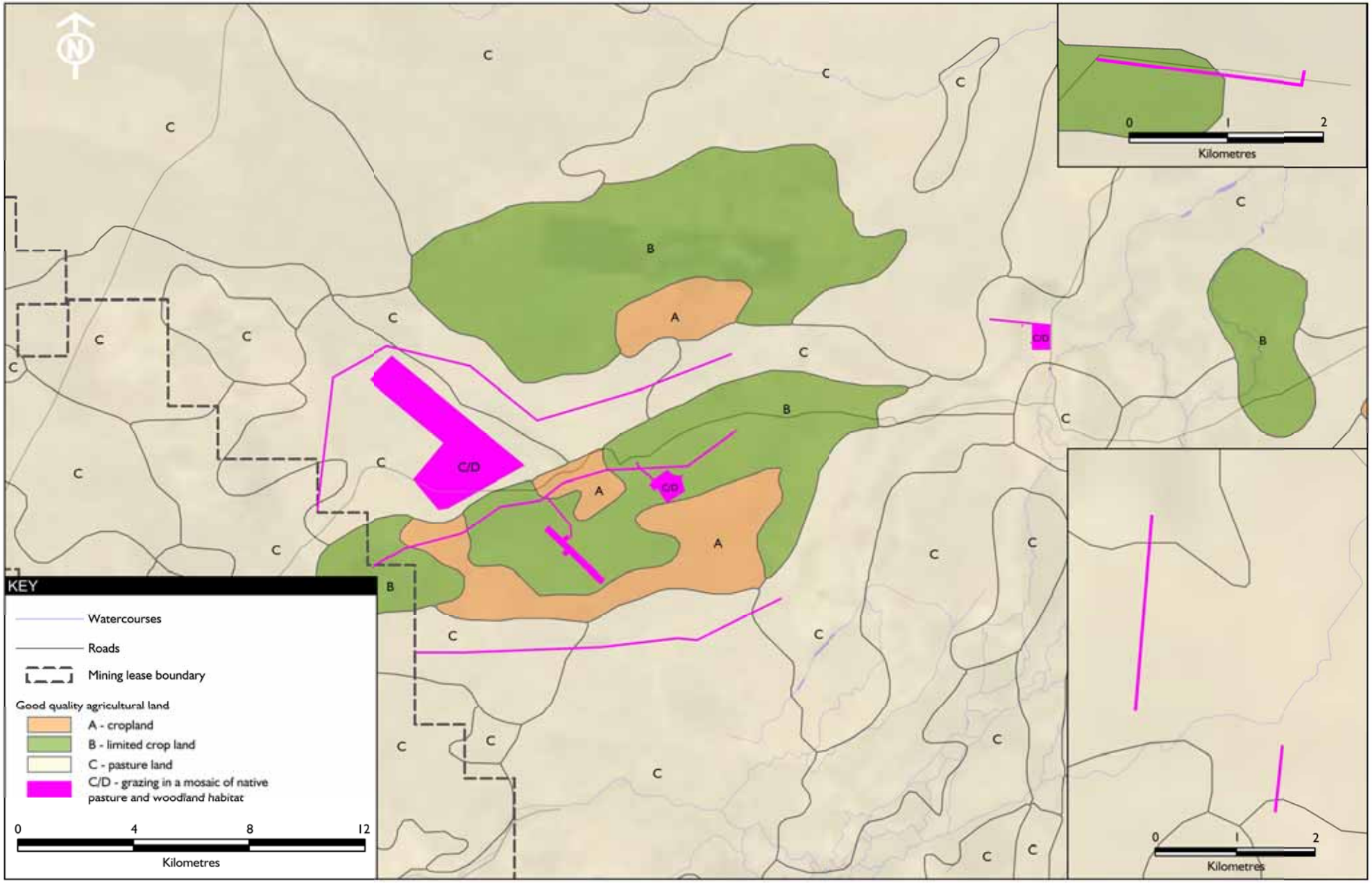
- schematic representation of final land form inclusive of slope and cover design;
- drainage design; and
- erosion controls proposed on reformed land.

Table 4.1 Summary of final land use and rehabilitation

	Domain				
	Workers accommodation village	**Dedicated airport**	**Off-site industrial area**	**Water supply, storage and transfer infrastructure**	**Access roads**
Approximate surface area (ha).	70.91	56.34	968.00	167.9	15.14
Pre-mining land use.	Combination of grazing on pasture; a mosaic of native pasture and woodland habitat.				
Post mining land use.	Grazing on pasture; a mosaic of native pasture and woodland habitat.			Farm water supply OR Combination of grazing on pasture; a mosaic of native pasture and woodland habitat.	Farm access roads OR Combination of grazing on pasture; a mosaic of native pasture and woodland habitat.
Project covers range.	>70% cover of grasses				
Target slope range (%).	Consistent with surrounding landscape typography OR constructed slopes not to exceed 6°.			Walls left in place will be graded where necessary such that slopes do not exceed 10°.	Consistent with surrounding landscape typography OR constructed slopes not to exceed 6°.

Table 4.2 Conceptual post-activity land use summary

Domain	Pre-mining GQAL	Post-activity GQAL	Description/reason for loss/gain of GQAL
Workers accommodation village.		C/D -	No net gain of class A or class B GQAL. Aim is to return land to low ranking class C or class D land.
Dedicated airport.		C/D -	No net gain of class A or class B GQAL. Aim is to return land to low ranking class C or class D land.
Off-site industrial area.		C/D -	No net gain of class A or class B GQAL. Aim is to return land to low ranking class C or class D land.
Water supply, storage and transfer infrastructure.		C/D -	No net gain of class A or class B GQAL. Aim is to return land to low ranking class C or class D land.
Access roads.		C/D -	No net gain of class A or class B GQAL. Aim is to return land to low ranking class C or class D land.



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Post-mining good quality agricultural land (GQAL)

Rehabilitation management plan (off-site)

Figure 4.1

5 General rehabilitation activities

The operational life of the Carmichael Coal Rail Project sites is over 60 years; therefore a general overview of closure and rehabilitation is provided based on current legislative and other potential requirements, noting that such requirements may be different at the time of closure and rehabilitation. Relevant legislative and other obligations and their potential impact on closure and rehabilitation is summarised in Appendix A.

The general rehabilitation methods and principles detailed in this chapter are common across all domains. Specific rehabilitation methods for landforms for each domain are presented in Chapter 6.

5.1 Decommissioning

The overall philosophy is to reinstate the infrastructure sites to natural vegetation or an agreed alternate land use. The following decommissioning strategy will be used:

- Adani will appoint a deconstructing contractor at closure.
- It is assumed that there will be a phased shutdown of large sections of the site. The size and complexity of the operations make it unlikely that the whole site will close simultaneously.
- Prior to commencing full scale removal of plant and equipment and structural deconstruction; the following will be carried out by personnel who are familiar with the process and equipment:
    - all operations completed and equipment isolated and left in a safe condition;
    - main plant area electrically isolated, and checked;
    - all chemical and materials storages emptied and purged;
    - all services isolated, purged and tested; and
    - handover to demolition contractor.
- Issues that may impact on the deconstruction method will be further considered in the decommissioning management plan including:
    - how to deal with live services that cross the demolition site that are required for operations;
    - lay down and storage areas for scrap; and
    - the requirements of legislation of the day.

5.1.1 Scrap and salvage items

It is likely that across the site there will be a significant number of items that may have some residual salvage value that could be realised at a sale or auction. Other items that may have significant scrap or salvage value include:

- aluminium cladding;

- copper from electrical services and some service pipework;
- overhead cranes;
- structural steel;
- mobile equipment; and
- pump parts.

5.2 Environmental management

5.2.1 Topsoil stockpiling and application

Appropriate topsoil management during construction and rehabilitation is critical to the successful rehabilitation of disturbed areas. Topsoil management during construction and operation will include activities such as vegetation clearing; topsoil stripping, subsoil removal, stockpiling, re-profiling, ripping and de-compacting and soil amelioration.

A topsoil management plan (TMP) will be developed to maximise the recovery and reuse of topsoil. The TMP will include:

- all relevant aspects for topsoil retrieval such as stripping, stockpiling, erosion prevention and re-spreading procedures, stockpile locations and inventory;
- topsoil stripping quantities formulated from pre-mining soil survey information; and
- stripping and stockpile management.

5.2.2 Erosion and sediment control

During construction activities, erosion and sediment control plans (ESCPs) will be developed for each work area. General principles for erosion and sediment control will be drawn from the International Erosion Control Association (Australasia) (IECA) *Best Practice Erosion and Sediment Control*.

5.2.3 Native revegetation

Revegetation will be completed preferentially using seeds collected from local plant stocks and will likely include a mixture of pasture seed with a selection of native trees and shrubs. The specific species mix for each rehabilitation area will be based on:

- the end land use;
- slope and drainage characteristics; and
- availability of topsoil for placement in rehabilitation areas.

Revegetation will take place soon after the placement of topsoil. Revegetation may be by seeding or planting of tube stock.

Revegetated areas will be watered regularly until established. Weed inspections and control will be undertaken regularly until vegetation cover criteria are met (70% coverage).

5.2.4 Weed control

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

- all vehicles and equipment will be cleaned at an approved weed wash down station and certified before being allowed on-site;
- all off-site soil and materials of plant origin will be certified as weed free by the supplier using the Queensland Government weed hygiene declaration form or similar;
- regular inspections of disturbed areas for weed proliferation (including within subsided areas where ponding occurs and at key water resource locations) will be done;
- a weed and pest control program will be developed and implemented if required.

6 Final landform strategy

6.1 Workers accommodation village

6.1.1 Final land use objectives

The final proposed land use is grazing on pasture. Rehabilitation will be consistent with the rehabilitation objectives in Section 3.2.

A conceptual post-activity land use strategy, which includes this domain, is described in Section 4.3.

6.1.2 Landform design

Landform design will achieve a safe and stable landform with drainage restored such that ponding, obstruction of overland flow and scouring is avoided. Detailed landform designs will be developed prior to closure and detailed plans prepared.

All infrastructures, not identified for future use, will be removed from the site.

i Drainage

Compaction of soils and development/removal of infrastructure may affect drainage patterns and water quality. Where possible interrupted overland flows will be restored such that ponding, obstruction of overland flow and scouring (concentration of flow) is avoided.

ii Slope

Landform design will ensure slopes are representative of the surrounding landscape. Slopes will not exceed 6°.

iii Cover

The workers accommodation village will have:

- ripping to remove compaction;
- 0.2 m of topsoil respread on the surface;
- grass and tree species seeding consistent with the final land use; and
- management of weeds and revegetation until 70% cover is achieved.

6.1.3 Completion criteria and monitoring

The proposed monitoring schedule for the workers accommodation village is described in Table 6.1.

Table 6.1 Proposed monitoring of the workers accommodation village

Monitoring[1]	Frequency[2]	Period of monitoring after rehabilitation is completed
Erosion	half-yearly	5 years
Surface water	quarterly and event based	5 years
Geotechnical (stability)	half-yearly	5 years
Rehabilitation (Ecology)	annually	5 years
Dust-monitoring	during closure earthworks	-

Notes: [1] monitoring is described in detail in Chapter 7.

[2] the frequency of monitoring will be subject to the environmental authority (EA) conditions for the Carmichael Coal Mine and Rail project. This closure and rehbilitation management strategy will be updated to reflect the ea conditions if they are different to what is indicated in this closure and rehbilitation management strategy.

i Interpretation of completion criteria and monitoring table (Table 6.2)

All reporting is to be completed as an annual rehabilitation monitoring report unless otherwise specified in Table 6.2. Further detail on reporting will be documented in the rehabilitation monitoring management plan.

Quantified indicators will be developed at the first annual review of the closure and rehbilitation management strategy incorporating criteria from the environmental authority.

Monitoring and reporting to be completed for five years post-rehabilitation as per Table 6.1.

Table 6.2 makes reference to Landform Function Analysis. The procedure for how to complete this analysis will be documented in the rehabilitation monitoring management plan.

It should be noted that Table 6.2 makes reference to comparison to an analogue site. An analogue site is defined as a site of similar environment features eg slope, soil, vegetation that can be compared to a representative rehabilitated area to compare whether the rehabilitated area is performing similarly to the undisturbed analogue site.

Completion criteria for the workers accommodation village are presented in Table 6.2. The completion criteria have been presented aligning to the phase of closure relevant to the domain. That is:

- decommissioning – cleaning the site up;
- landform establishment – earthworks for landform and surface water management;
- vegetation establishment – seeding and planting; and
- sustainable final landform – a functioning landscape with minimal intervention and sustained agro-economic value.

Table 6.2 Summary of completion criteria for the workers accommodation village

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
Decommissioning	All infrastructures, not identified for future use, will be removed.	Buildings and foundations removed.	Buildings and foundations removed.
	Unwanted bituminous sealed areas will be removed.	Bituminous seals will be tested for contaminants. Contaminated bitumen will be removed from site. Uncontaminated bitumen can be used as fill.	Bituminous seals removed.
	Clean-up of potential/actual contamination.	Hydrocarbons less than assessment criteria. Heavy metals less than assessment criteria.	Hazardous material audit and contamination at acceptable level. Site is assessed by a suitable qualified person and removed from CLR, EMR or both.
	Dust generation below acceptable limits.	Dust below than assessment criteria.	Evidence in reporting that dust monitoring results at sensitive receptors has complied.
Landform establishment	Slopes are stable.	Re-profiled areas are stable with slopes not exceeding 6°.	As built design reports. No evidence of slumping of slopes.
	Topsoil replacement consistent with pre-activity conditions.	Soil based criteria typical with analogue sites or fall within desirable ranges provided by the agricultural industry (to be determined based on sampling results). Depth - = 0.2 m.	Monitoring and comparison to analogue site.
	Dust levels below thresholds.	Dust based criteria typical with analogue sites.	Monitoring and comparison to analogue site.
	Appropriate management of surface water.	All permanent sediment traps and drains meet approved design criteria. All regulated structures meet design criteria. All non-permanent structures are decommissioned in accordance with regulating authority requirements.	Certification by an appropriately qualified person.
	Non-polluting.	Not contributing excess sediment load to downstream watercourses when compared to a suitable analogue sites.	Surface water monitoring and reporting.
Vegetation establishment	Establishment of the functionally important and structurally dominant species from the relevant native vegetation communities – where	The diversity of shrubs and juvenile trees with a stem less than 5 cm is comparable to that of the analogue sites.	Monitoring and comparison to analogue site.

Table 6.2 Summary of completion criteria for the workers accommodation village

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
	existing pre-landform disturbance exists		
		Number of weeds species and surface area cover ≤ analogue site.	Monitoring and comparison to analogue site.
		Equal or greater proportion of over storey species occurring as regeneration.	Monitoring and comparison to analogue site.
	Demonstrating rehabilitation succession.	The number of tree species, shrub species, herbs and forbs and grasses species regardless of age comprising the vegetation community is comparable to that of the analogue sites.	Monitoring and comparison to analogue site.
	Vegetation covers to minimise erosion.	Evidence that the vegetation type and density are of species suited to the fill composition, slope, aspect, climate and other factors.	Vegetation type and density.
		Vegetation types and density are comparable with the relevant reference site.	Vegetation type and density.
		Minimum of 70% vegetation cover is present.	Foliage cover.
		Foliage cover is comparable with the relevant reference site.	Foliage cover.
		Nutrient cycling is occurring and the presence of leaf litter is assisting in limiting erosion of the soil /fill surface.	Leaf litter, humus, depth of growing medium.
		Leaf litter, humus, depth of growing medium comparable with the relevant reference site.	Leaf litter, humus, depth of growing medium.
Sustainable landscape	Landform generally blends in with surrounding landscape and is stable ie no sodic saline soil or spoil at the surface of the landform and minimal erosion.	Soils surface cover ≥70%.	Monitoring and reporting.
		Exchangeable Sodium Percentage (ESP) ≤6% for surface soil and fill.	Monitoring and reporting.
		Absence of gullies >300mm wide or deep and gullies stable.	Post-closure monitoring report.

Table 6.2 Summary of completion criteria for the workers accommodation village

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
		Land function stability analysis based on key characteristics including: Soil cover; Litter cover; Cryptogam cover; Crust broken-ness; Erosion type and severity; Deposited materials; Surface resistance to disturbance; Slake test; Compaction; and Surface roughness.	Landform function analysis and reporting.
		Nutrient recycling based on key characteristics including: Soil fertility; Soil organic matter; Litter cover; and Perennial grass basal and tree and shrub foliage cover.	Landform function analysis and reporting.
	Weed infestation less then pre-activity conditions.	Equal or lesser proportion of weed species occurring in regeneration by comparison to analogue site.	Rehabilitation monitoring and reporting.
	Agricultural cattle Grazing.	Determination of safe carrying capacity for future land use and future management strategies/agreements in place.	Cattle stocking trials indicate areas nominated for cattle grazing as a post mining land use are sustaining an equal to or better stocking rate that that calculated for relevant reference site.
		Land maintenance requirements are comparable to reference sites.	Landform stability when grazed. Safety of landform for stock and for undertaking management activities associated with stock.

6.2 Airstrip

6.2.1 Final land use objectives

The final land use proposed for the airstrip and associated infrastructure is for grazing and/or a mosaic of native pasture and woodland habitat. Rehabilitation will be consistent with the rehabilitation objectives in Section 3.2.

A conceptual post-activity land use strategy, which includes this domain, is described in Section 4.3.

6.2.2 Landform design

Landform design will achieve a safe and stable landform with drainage restored such that ponding, obstruction of overland flow and scouring is avoided. Detailed land form designs will be developed prior to closure and detailed plans prepared.

All infrastructures, not identified for future use, will be removed from the site.

i Drainage

Compaction of soils and development/removal of infrastructure may affect drainage patterns and water quality. Where possible interrupted overland flows will be restored such that ponding, obstruction of overland flow and scouring (concentration of flow) is avoided.

ii Slope

Landform design will ensure slopes are representative of the surrounding landscape. Slopes will not exceed 6°.

iii Cover

The airstrip will have:

- ripping to remove compaction;
- 0.2 m of topsoil respread on the surface;
- grass and tree species seeding consistent with the final land use; and
- management of weeds and revegetation until 70% cover is achieved.

6.2.3 Completion criteria and monitoring

The proposed monitoring schedule for the airstrip is described in Table 6.3.

Table 6.3 Proposed monitoring of airstrip

Monitoring[1]	Frequency[2]	Period of monitoring after rehabilitation is completed
Erosion	half-yearly	5 years
Surface water	quarterly	5 years

Table 6.3 Proposed monitoring of airstrip

Monitoring[1]	Frequency[2]	Period of monitoring after rehabilitation is completed
Geotechnical (stability)	half-yearly	5 years
Rehabilitation (Ecology)	annually	5 years
Dust-monitoring	during closure earthworks	-

Notes: [1] monitoring is described in detail in Chapter 7.

[2] the frequency of monitoring will be subject to the environmental authority (EA) conditions for the Carmichael Coal Mine and Rail project. This closure and rehbilitation management strategy will be updated to reflect the ea conditions if they are different to what is indicated in this closure and rehbilitation management strategy.

i Interpretation of completion criteria and monitoring table (Table 6.4)

All reporting is to be completed as an annual rehabilitation monitoring report unless otherwise specified in Table 6.4 . Further detail on reporting will be documented in the rehabilitation monitoring management plan.

Quantified indicators will be developed at the first annual review of the closure and rehbilitation management strategy incorporating criteria from the environmental authority.

Monitoring and reporting to be completed for five years post-rehabilitation as per Table 6.3 .

Table 6.4 makes reference to Landform Function Analysis. The procedure for how to complete this analysis will be documented in the rehabilitation monitoring management plan.

It should be noted that Table 6.4 makes reference to comparison to an analogue site. An analogue site is defined as a site of similar environment features eg slope, soil, vegetation that can be compared to a representative rehabilitated area to compare whether the rehabilitated area is performing similarly to the undisturbed analogue site.

Completion criteria for the airstrip are presented in Table 6.4. The completion criteria have been presented aligning to the phase of closure relevant to the domain. That is:

- decommissioning – cleaning the site up;
- landform establishment – earthworks for landform and surface water management;
- vegetation establishment – seeding and planting; and
- sustainable final landform – a functioning landscape with minimal intervention and agro-economic value.

Table 6.4 Summary of completion criteria for the airstrip

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
Decommissioning	All infrastructures, not identified for future use, will be removed.	Buildings and foundations removed.	Buildings and foundations removed.
	Unwanted bituminous sealed areas will be removed.	Bituminous seals will be tested for contaminants. Contaminated bitumen will be removed from site. Uncontaminated bitumen can be used as fill.	Bituminous seals removed.
	Clean-up of potential/actual contamination.	Hydrocarbons less than assessment criteria. Heavy metals less than assessment criteria.	Hazardous material audit and contamination at acceptable level. Site is assessed by a suitable qualified person and removed from CLR, EMR or both.
	Dust generation below acceptable limits.	Dust below than assessment criteria.	Evidence in reporting that dust monitoring results at sensitive receptors has complied.
Landform establishment	Slopes are stable.	Re-profiled areas are stable with slopes not exceeding 6°.	As built design reports. No evidence of slumping of slopes.
	Topsoil replacement consistent with pre-activity conditions.	Soil based criteria typical with analogue sites or fall within desirable ranges provided by the agricultural industry (to be determined based on sampling results). Depth - = 0.2 m.	Monitoring and comparison to analogue site.
	Dust levels below thresholds.	Dust based criteria typical with analogue sites.	Monitoring and comparison to analogue site.
	Appropriate management of surface water.	All permanent sediment traps and drains meet approved design criteria. All regulated structures meet design criteria. All non-permanent structures are decommissioned in accordance with regulating authority requirements.	Certification by an appropriately qualified person.
	Non-polluting.	Not contributing excess sediment load to downstream watercourses when compared to a suitable analogue sites.	Surface water monitoring and reporting.
Vegetation establishment	Establishment of the functionally important and structurally dominant species from the relevant native vegetation communities – where	The diversity of shrubs and juvenile trees with a stem less than 5 cm is comparable to that of the analogue sites.	Monitoring and comparison to analogue site.

Table 6.4 Summary of completion criteria for the airstrip

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
	existing landform disturbance exists.		
		Number of weeds species and surface area cover ≤ analogue site.	Monitoring and comparison to analogue site.
		Equal or greater proportion of over storey species occurring as regeneration.	Monitoring and comparison to analogue site.
	Demonstrating rehabilitation succession.	The number of tree species, shrub species, herbs and forbs and grasses species regardless of age comprising the vegetation community is comparable to that of the analogue sites.	Monitoring and comparison to analogue site.
	Vegetation covers to minimise erosion.	Evidence that the vegetation type and density are of species suited to the fill composition, slope, aspect, climate and other factors.	Vegetation type and density.
		Vegetation types and density are comparable with the relevant reference site.	Vegetation type and density.
		Minimum of 70% vegetation cover is present.	Foliage cover.
		Foliage cover is comparable with the relevant reference site.	Foliage cover.
		Nutrient cycling is occurring and the presence of leaf litter is assisting in limiting erosion of the soil /fill surface.	Leaf litter, humus, depth of growing medium.
		Leaf litter, humus, depth of growing medium comparable with the relevant reference site.	Leaf litter, humus, depth of growing medium.
Sustainable landscape	Landform generally blends in with surrounding landscape and is stable ie no sodic saline soil or spoil at the surface of the landform and minimal erosion.	Soils surface cover ≥70%.	Monitoring and reporting.
		Exchangeable Sodium Percentage (ESP) ≤6% for surface soil and fill.	Monitoring and reporting
		Absence of gullies >300mm wide or deep and gullies stable.	Post-closure reporting.
		Land function stability analysis based on key	Landform function analysis and reporting.

Table 6.4 Summary of completion criteria for the airstrip

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
		characteristics including: Soil cover; Litter cover; Cryptogam cover; Crust broken-ness; Erosion type and severity; Deposited materials; Surface resistance to disturbance; Slake test; Compaction; and Surface roughness.	
		Nutrient recycling based on key characteristics including: Soil fertility; Soil organic matter; Litter cover; and Perennial grass basal and tree and shrub foliage cover.	Landform function analysis and reporting.
	Weed infestation less then pre-activity conditions.	Equal or lesser proportion of weed species occurring in regeneration by comparison to analogue site.	Rehabilitation monitoring and reporting.
	Agricultural cattle Grazing.	Determination of safe carrying capacity for future land use and future management strategies/agreements in place.	Cattle stocking trials indicate areas nominated for cattle grazing as a post mining land use are sustaining an equal to or better stocking rate that that calculated for relevant reference site.
		Land maintenance requirements are comparable to reference sites.	Landform stability when grazed. Safety of landform for stock and for undertaking management activities associated with stock.

6.3 Off-site industrial area (workshops, fuel storage, buildings, car parks)

6.3.1 Final land use objectives

The final land use proposed for the off-site industrial area (workshops, fuel storage, buildings and car parks) is for grazing on pasture and/or a mosaic of native pasture. Rehabilitation will be consistent with the rehabilitation objectives in Section 3.2.

A conceptual post-activity land use strategy, which includes this domain, is described in Section 4.3.

6.3.2 Landform design

Landform design will achieve a safe and stable landform with drainage restored such that ponding, obstruction of overland flow and scouring risk is avoided. Detailed land form designs will be developed prior to closure and detailed plans prepared.

All infrastructures, not identified for future use, will be removed from the site.

i Drainage

Compaction of soils and development/removal of infrastructure may affect drainage patterns and water quality. Where possible, interrupted overland flows will be restored such that ponding, obstruction of overland flow and scouring (concentration of flow) is avoided.

ii Slope

Landform design will ensure slopes are representative of the surrounding landscape. Slopes will not exceed 6°.

iii Cover

The off-site industrial area will have:

- ripping to remove compaction;
- 0.2 m of topsoil respread on the surface;
- grass and tree species seeding consistent with the final land use; and
- managing weeds and revegetation until 70% cover is achieved.

6.3.3 Completion criteria and monitoring

The proposed monitoring schedule for the off-site industrial area is described in Table 6.5.

Table 6.5 Proposed monitoring of off-site industrial area

Monitoring[1]	Frequency[2]	Period of monitoring after rehabilitation is completed
Erosion	half-yearly	5 years
Surface water	quarterly	5 years

Table 6.5 Proposed monitoring of off-site industrial area

Monitoring[1]	Frequency[2]	Period of monitoring after rehabilitation is completed
Geotechnical (stability)	half-yearly	5 years
Rehabilitation (Ecology)	annually	5 years
Dust-monitoring	during closure earthworks	-

Notes: [1] monitoring is described in detail in Chapter 7.

[2] the frequency of monitoring will be subject to the environmental authority (EA) conditions for the Carmichael Coal Mine and Rail project. This closure and rehbilitation management strategy will be updated to reflect the ea conditions if they are different to what is indicated in this closure and rehbilitation management strategy.

i Interpretation of completion criteria and monitoring table (Table 6.6)

All reporting is to be completed as an annual rehabilitation monitoring report unless otherwise specified in Table 6.6. Further detail on reporting will be documented in the rehabilitation monitoring management plan.

Quantified indicators will be developed at the first annual review of the closure and rehbilitation management strategy incorporating criteria from the environmental authority.

Monitoring and reporting to be completed for five years post-rehabilitation as per Table 6.5.

Table 6.6 makes reference to Landform Function Analysis. The procedure for how to complete this analysis will be documented in the rehabilitation monitoring management plan.

It should be noted that Table 6.6 makes reference to comparison to an analogue site. An analogue site is defined as a site of similar environment features eg slope, soil, vegetation that can be compared to a representative rehabilitated area to compare whether the rehabilitated area is performing similarly to the undisturbed analogue site.

Completion criteria for the off-site industrial area are presented in Table 6.6. The completion criteria have been presented aligning to the phase of closure relevant to the domain. That is:

- decommissioning – cleaning the site up;
- landform establishment – earthworks for landform and surface water management;
- vegetation establishment – seeding and planting; and
- sustainable final landform – a functioning landscape with minimal intervention and agro-economic value.

Table 6.6 Summary of completion criteria for the off-site industrial area

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
Decommissioning	All infrastructures, not identified for future use, will be removed.	Buildings and foundations removed.	Buildings and foundations removed.
	Unwanted bituminous sealed areas will be removed.	Bituminous seals will be tested for contaminants. Contaminated bitumen will be removed from site. Uncontaminated bitumen can be used as fill.	Bituminous seals removed.
	Clean-up of potential/actual contamination.	Hydrocarbons less than assessment criteria. Heavy metals less than assessment criteria.	Hazardous material audit and contamination at acceptable level. Site is assessed by a suitable qualified person and removed from CLR, EMR or both.
	Dust generation below acceptable limits.	Dust below than assessment criteria.	Evidence in reporting that dust monitoring results at sensitive receptors has complied.
Landform establishment	Slopes are stable.	Re-profiled areas are stable with slopes not exceeding 6°.	As built design reports. No evidence of slumping of slopes.
	Topsoil replacement consistent with pre-activity conditions.	Soil based criteria typical with analogue sites or fall within desirable ranges provided by the agricultural industry (to be determined based on sampling results). Depth - = 0.2 m.	Monitoring and comparison to analogue site.
	Dust levels below thresholds.	Dust based criteria typical with analogue sites.	Monitoring and comparison to analogue site.
	Appropriate management of surface water.	All permanent sediment traps and drains meet approved design criteria. All regulated structures meet design criteria. All non-permanent structures are decommissioned in accordance with regulating authority requirements.	Certification by an appropriately qualified person.
	Non-polluting.	Not contributing excess sediment load to downstream watercourses when compared to a suitable analogue sites.	Surface water monitoring and reporting.
Vegetation establishment	Establishment of the functionally important and structurally dominant species from the relevant native vegetation communities – where	The diversity of shrubs and juvenile trees with a stem less than 5 cm is comparable to that of the analogue sites.	Monitoring and comparison to analogue site.

Table 6.6 Summary of completion criteria for the off-site industrial area

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
	existing landform disturbance exists.		
		Number of weeds species and surface area cover ≤ analogue site.	Monitoring and comparison to analogue site.
		Equal or greater proportion of over storey species occurring as regeneration.	Monitoring and comparison to analogue site.
	Demonstrating rehabilitation succession.	The number of tree species, shrub species, herbs and forbs and grasses species regardless of age comprising the vegetation community is comparable to that of the analogue sites.	Monitoring and comparison to analogue site.
	Vegetation covers to minimise erosion.	Evidence that the vegetation type and density are of species suited to the fill composition, slope, aspect, climate and other factors.	Vegetation type and density.
		Vegetation types and density are comparable with the relevant reference site.	Vegetation type and density.
		Minimum of 70% vegetation cover is present.	Foliage cover.
		Foliage cover is comparable with the relevant reference site.	Foliage cover.
		Nutrient cycling is occurring and the presence of leaf litter is assisting in limiting erosion of the soil /fill surface.	Leaf litter, humus, depth of growing medium.
		Leaf litter, humus, depth of growing medium comparable with the relevant reference site.	Leaf litter, humus, depth of growing medium.
Sustainable landscape	Landform generally blends in with surrounding landscape and is stable ie no sodic saline soil or spoil at the surface of the landform and minimal erosion.	Soils surface cover ≥70%.	Monitoring and reporting.
		Exchangeable Sodium Percentage (ESP) ≤6% for surface soil and fill.	Monitoring and reporting
		Absence of gullies >300mm wide or deep and gullies stable.	Post-closure monitoring report.
		Land function stability analysis based on key	Landform function analysis and reporting.

Table 6.6 Summary of completion criteria for the off-site industrial area

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
		characteristics including: Soil cover; Litter cover; Cryptogam cover; Crust broken-ness; Erosion type and severity; Deposited materials; Surface resistance to disturbance; Slake test; Compaction; and Surface roughness.	
		Nutrient recycling based on key characteristics including: Soil fertility; Soil organic matter; Litter cover; and Perennial grass basal and tree and shrub foliage cover.	Landform function analysis and reporting.
	Weed infestation less then pre-activity conditions.	Equal or lesser proportion of weed species occurring in regeneration by comparison to analogue site.	Rehabilitation monitoring and reporting.
	Agricultural cattle Grazing.	Determination of safe carrying capacity for future land use and future management strategies/agreements in place.	Cattle stocking trials indicate areas nominated for cattle grazing as a post mining land use are sustaining an equal to or better stocking rate that that calculated for relevant reference site.
		Land maintenance requirements are comparable to reference sites.	Landform stability when grazed. Safety of landform for stock and for undertaking management activities associated with stock.

6.4 Water supply, storage and transfer infrastructure

6.4.1 Final land use objectives

Water supply, storage and transfer infrastructure will either be retained at the request of the landholder and used for farm water supply or otherwise removed and rehabilitated to allow grazing on pasture and/or a mosaic of native pasture. Rehabilitation will be consistent with the rehabilitation objectives in Section 3.2.

A conceptual post-activity land use strategy, which includes this domain, is described in Section 4.3.

6.4.2 Landform design

Landform design will achieve a safe and stable landform that is non-polluting and is suitable for grazing.

Any water storages that are retained (at the request of the landholder) will be inspected and certified against the relevant guidelines in place at the time. Furthermore, there must be no risk of dam failure. The landholder will be made aware of any ongoing inspection and maintenance requirements in relation to ongoing use of the storages.

i Drainage

Unwanted water storage walls will be breached such that water can no longer be retained and that ponding does not occur. Drainage channels will be established to mimic natural systems and avoid erosion and scouring so that the impact on agricultural potential is minimised.

Compaction of soils and development/removal of infrastructure may affect drainage patterns and water quality.

ii Slope

Landform design will ensure slopes are representative of the surrounding landscape. Slopes will not exceed 10°.

iii Cover

The water supply, storage and transfer infrastructure will have:

- ripping to remove compaction;
- 0.2 m of topsoil respread on the surface;
- grass and tree species seeding consistent with the final land use; and
- management of weeds and revegetation until 70% cover is achieved.

6.4.3 Completion criteria and monitoring

The proposed monitoring schedule for the water supply, storage and transfer infrastructure is described in Table 6.7.

Table 6.7 Proposed monitoring of water supply, storage and transfer infrastructure

Monitoring[1]	Frequency[2]	Period of monitoring after rehabilitation is completed
Erosion	half-yearly	5 years
Surface water	quarterly	5 years
Geotechnical (stability)	half-yearly	5 years
Rehabilitation (Ecology)	annually	5 years
Dust-monitoring	during closure earthworks	-

Notes: [1] monitoring is described in detail in Chapter 7.

[2] the frequency of monitoring will be subject to the environmental authority (EA) conditions for the Carmichael Coal Mine and Rail project. This closure and rehbilitation management strategy will be updated to reflect the ea conditions if they are different to what is indicated in this closure and rehbilitation management strategy.

i Interpretation of completion criteria and monitoring table (Table 6.8)

All reporting is to be completed as an annual rehabilitation monitoring report unless otherwise specified in Table 6.8. Further detail on reporting will be documented in the rehabilitation monitoring management plan.

Quantified indicators will be developed at the first annual review of the closure and rehbilitation management strategy incorporating criteria from the environmental authority.

Monitoring and reporting to be completed for five years post-rehabilitation as per Table 6.7.

Table 6.8 makes reference to Landform Function Analysis. The procedure for how to complete this analysis will be documented in the rehabilitation monitoring management plan.

It should be noted that Table 6.8 makes reference to comparison to an analogue site. An analogue site is defined as a site of similar environment features eg slope, soil, vegetation that can be compared to a representative rehabilitated area to compare whether the rehabilitated area is performing similarly to the undisturbed analogue site.

Completion criteria for the water supply, storage and transfer infrastructure are presented in Table 6.8. The completion criteria have been presented aligning to the phase of closure relevant to the domain. That is:

- decommissioning – cleaning the site up;
- landform establishment – earthworks for landform and surface water management;
- vegetation establishment – seeding and planting; and
- sustainable final landform – a functioning landscape with minimal intervention and sustained agro-economic value.

Table 6.8 Summary of completion criteria for the water supply, storage and transfer infrastructure

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
Decommissioning	No retention of water in decommissioned dams and ponds.	Decommission dams and pond wall breached and no ponding of water.	Decommissioning report and no ponding.
	All infrastructures, not identified for future use, will be removed.	Buildings and foundations removed.	Buildings and foundations removed.
	Clean-up of potential/actual contamination.	Hydrocarbons less than assessment criteria. Heavy metals less than assessment criteria.	Hazardous material audit and contamination at acceptable level. Site is assessed by a suitable qualified person and removed from CLR, EMR or both.
	Dust generation below acceptable limits.	Dust below than assessment criteria.	Evidence in reporting that dust monitoring results at sensitive receptors has complied.
Landform establishment	Slopes are stable. Long-term safety.	Remaining wall slopes are stable and angled at a maximum slope of 10°.	As built design reports. No evidence of slumping of slopes. Certification of slopes and void by an appropriately qualified person. Geotechnical stability has been achieved and geotechnical investigations demonstrate that this has been achieved and reported.
	Appropriate management of surface water.	All permanent diversion channels/drains meet approved design criteria. All regulated structures meet design criteria. All non-permanent structures are decommissioned in accordance with regulating authority requirements.	Certification by an appropriately qualified person.
	Non-polluting.	Not contributing excess sediment load to downstream watercourses when compared to a suitable analogue sites.	Surface water monitoring and reporting.
	Topsoil replacement consistent with pre-activity conditions.	Soil based criteria typical with analogue sites or fall within desirable ranges provided by the agricultural industry (to be determined based on sampling results). Depth - = 0.2 m.	Monitoring and comparison to analogue site.
	Dust levels below thresholds.	Dust based criteria typical with analogue sites.	Monitoring and comparison to analogue site.
Vegetation establishment	Establishment of the functionally important and structurally dominant	The diversity of shrubs and juvenile trees with a stem less than 5 cm is comparable to that of the	Monitoring and comparison to analogue site.

Table 6.8 Summary of completion criteria for the water supply, storage and transfer infrastructure

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
	species from the relevant native vegetation communities – where existing landform disturbance exists.	analogue sites.	
		Number of weeds species and surface area cover ≤ analogue site.	Monitoring and comparison to analogue site.
		Equal or greater proportion of over storey species occurring as regeneration.	Monitoring and comparison to analogue site.
	Demonstrating rehabilitation succession.	The number of tree species, shrub species, herbs and forbs and grasses species regardless of age comprising the vegetation community is comparable to that of the analogue sites.	Monitoring and comparison to analogue site.
	Vegetation covers to minimise erosion.	Evidence that the vegetation type and density are of species suited to the fill composition, slope, aspect, climate and other factors.	Vegetation type and density.
		Vegetation types and density are comparable with the relevant reference site.	Vegetation type and density.
		Minimum of 70% vegetation cover is present.	Foliage cover.
		Foliage cover is comparable with the relevant reference site.	Foliage cover.
		Nutrient cycling is occurring and the presence of leaf litter is assisting in limiting erosion of the soil /fill surface.	Leaf litter, humus, depth of growing medium.
		Leaf litter, humus, depth of growing medium comparable with the relevant reference site.	Leaf litter, humus, depth of growing medium.
Sustainable landscape	Landform generally blends in with surrounding landscape and is stable ie no sodic saline soil or spoil at the surface of the landform and minimal erosion.	Soils surface cover ≥70%.	Monitoring and reporting.
		Exchangeable Sodium Percentage (ESP) ≤6% for surface soil and fill.	Monitoring and reporting
		Absence of gullies >300mm wide or deep and	Post-closure monitoring report.

Table 6.8 Summary of completion criteria for the water supply, storage and transfer infrastructure

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
		gullies stable.	
		Land function stability analysis based on key characteristics including: Soil cover; Litter cover; Cryptogam cover; Crust broken-ness; Erosion type and severity; Deposited materials; Surface resistance to disturbance; Slake test; Compaction; and Surface roughness.	Landform function analysis and reporting.
		Nutrient recycling based on key characteristics including: Soil fertility; Soil organic matter; Litter cover; and Perennial grass basal and tree and shrub foliage cover.	Landform function analysis and reporting.
	Weed infestation less then pre-activity conditions.	Equal or lesser proportion of weed species occurring in regeneration by comparison to analogue site.	Rehabilitation monitoring and reporting.
	Agricultural cattle Grazing.	Determination of safe carrying capacity for future land use and future management strategies/agreements in place.	Cattle stocking trials indicate areas nominated for cattle grazing as a post mining land use are sustaining an equal to or better stocking rate that that calculated for relevant reference site.
		Land maintenance requirements are comparable to reference sites.	Landform stability when grazed. Safety of landform for stock and for undertaking management activities associated with stock.

6.5 Access roads

6.5.1 Final land use objectives

The final land use proposed for access roads is for grazing on pasture and/or a mosaic of native pasture. Rehabilitation will be consistent with the rehabilitation objectives in Section 3.2.

A conceptual post-activity land use strategy, which includes this domain, is described in Section 4.3.

6.5.2 Landform design

Landform design will achieve a safe and stable landform with drainage restored such that ponding, obstruction of overland flow and scouring is avoided. Detailed land form designs will be developed prior to closure and detailed plans prepared.

All infrastructures, not identified for future use, will be removed from the site.

i Drainage

Compaction of soils and development/removal of infrastructure may affect drainage patterns and water quality. Where possible, interrupted overland flows will be restored such that ponding, obstruction of overland flow and scouring (concentration of flow) is avoided.

ii Slope

Landform design will ensure slopes are representative of the surrounding landscape. Slopes will not exceed 6°.

iii Cover

The access roads will have:

- ripping to remove compaction;
- 0.2 m of topsoil respread on the surface;
- grass and tree species seeding consistent with the final land use; and
- managing weeds and revegetation until 70% cover is achieved.

6.5.3 Completion criteria and monitoring

The proposed monitoring schedule for the access roads is described in Table 6.9.

Table 6.9 Proposed monitoring of access roads

Monitoring[1]	Frequency[2]	Period of monitoring after rehabilitation is completed
Erosion	half-yearly	5 years
Surface water	quarterly	5 years
Geotechnical (stability)	half-yearly	5 years

Table 6.9 Proposed monitoring of access roads

Monitoring[1]	Frequency[2]	Period of monitoring after rehabilitation is completed
Rehabilitation (Ecology)	annually	5 years
Dust-monitoring	during closure earthworks	-

Notes: [1] monitoring is described in detail in Chapter 7.

[2] the frequency of monitoring will be subject to the environmental authority (EA) conditions for the Carmichael Coal Mine and Rail project. This closure and rehbilitation management strategy will be updated to reflect the ea conditions if they are different to what is indicated in this closure and rehbilitation management strategy.

i Interpretation of completion criteria and monitoring table (Table 6.10)

All reporting is to be completed as an annual rehabilitation monitoring report unless otherwise specified in Table 6.10. Further detail on reporting will be documented in the rehabilitation monitoring management plan.

Quantified indicators will be developed at the first annual review of the closure and rehbilitation management strategy incorporating criteria from the environmental authority.

Monitoring and reporting to be completed for five years post-rehabilitation as per Table 6.9.

Table 6.10 makes reference to Landform Function Analysis. The procedure for how to complete this analysis will be documented in the rehabilitation monitoring management plan.

It should be noted that Table 6.10 makes reference to comparison to an analogue site. An analogue site is defined as a site of similar environment features eg slope, soil, vegetation that can be compared to a representative rehabilitated area to compare whether the rehabilitated area is performing similarly to the undisturbed analogue site.

Completion criteria for the access roads are presented in Table 6.10. The completion criteria have been presented aligning to the phase of closure relevant to the domain. That is:

- decommissioning – cleaning the site up;
- landform establishment – earthworks for landform and surface water management;
- vegetation establishment – seeding and planting; and
- sustainable final landform – a functioning landscape with minimal intervention and agro-economic value.

Table 6.10 Summary of completion criteria for the access roads

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
Decommissioning	All infrastructures, not identified for future use, will be removed.	Bridges and foundations removed.	Bridges and foundations removed.
	Unwanted bituminous sealed areas will be removed.	Bituminous seals will be tested for contaminants. Contaminated bitumen will be removed from site. Uncontaminated bitumen can be used as fill.	Bituminous seals removed.
	Clean-up of potential/actual contamination.	Hydrocarbons less than assessment criteria. Heavy metals less than assessment criteria.	Hazardous material audit and contamination at acceptable level. Site is assessed by a suitable qualified person and removed from CLR, EMR or both.
	Dust generation below acceptable limits.	Dust below than assessment criteria.	Evidence in reporting that dust monitoring results at sensitive receptors has complied.
Landform establishment	Slopes are stable.	Re-profiled areas are stable with slopes not exceeding 6°.	As built design reports. No evidence of slumping of slopes.
	Topsoil replacement consistent with pre-activity conditions.	Soil based criteria typical with analogue sites or fall within desirable ranges provided by the agricultural industry (to be determined based on sampling results). Depth - ≥ 0.2 m.	Monitoring and comparison to analogue site.
	Dust levels below thresholds.	Dust based criteria typical with analogue sites.	Monitoring and comparison to analogue site.
	Appropriate management of surface water.	All permanent sediment traps and drains meet approved design criteria. All regulated structures meet design criteria. All non-permanent structures are decommissioned in accordance with regulating authority requirements.	Certification by an appropriately qualified person.
	Non-polluting.	Not contributing excess sediment load to downstream watercourses when compared to a suitable analogue sites.	Surface water monitoring and reporting.
Vegetation establishment	Establishment of the functionally important and structurally dominant species from the relevant native vegetation communities – where	The diversity of shrubs and juvenile trees with a stem less than 5 cm is comparable to that of the analogue sites.	Monitoring and comparison to analogue site.

Table 6.10 Summary of completion criteria for the access roads

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
	existing landform disturbance exists.		
		Number of weeds species and surface area cover ≤ analogue site.	Monitoring and comparison to analogue site.
		Equal or greater proportion of over storey species occurring as regeneration.	Monitoring and comparison to analogue site.
	Demonstrating rehabilitation succession.	The number of tree species, shrub species, herbs and forbs and grasses species regardless of age comprising the vegetation community is comparable to that of the analogue sites.	Monitoring and comparison to analogue site.
	Vegetation covers to minimise erosion.	Evidence that the vegetation type and density are of species suited to the fill composition, slope, aspect, climate and other factors.	Vegetation type and density.
		Vegetation types and density are comparable with the relevant reference site.	Vegetation type and density.
		Minimum of 70% vegetation cover is present.	Foliage cover.
		Foliage cover is comparable with the relevant reference site.	Foliage cover.
		Nutrient cycling is occurring and the presence of leaf litter is assisting in limiting erosion of the soil /fill surface.	Leaf litter, humus, depth of growing medium.
		Leaf litter, humus, depth of growing medium comparable with the relevant reference site.	Leaf litter, humus, depth of growing medium.
Sustainable landscape	Landform generally blends in with surrounding landscape and is stable ie no sodic saline soil or spoil at the surface of the landform and minimal erosion.	Soils surface cover ≥70%.	Monitoring and reporting.
		Exchangeable Sodium Percentage (ESP) ≤6% for surface soil and fill.	Monitoring and reporting
		Absence of gullies >300mm wide or deep and gullies stable.	Post-closure monitoring report.
		Land function stability analysis based on key	Landform function analysis and reporting.

Table 6.10 Summary of completion criteria for the access roads

Phase	Objective	Completion criteria	Indicator that completion criteria is being met
		characteristics including: Soil cover; Litter cover; Cryptogam cover; Crust broken-ness; Erosion type and severity; Deposited materials; Surface resistance to disturbance; Slake test; Compaction; and Surface roughness.	
		Nutrient recycling based on key characteristics including: Soil fertility; Soil organic matter; Litter cover; and Perennial grass basal and tree and shrub foliage cover.	Landform function analysis and reporting.
	Weed infestation less then pre-activity conditions.	Equal or lesser proportion of weed species occurring in regeneration by comparison to analogue site.	Rehabilitation monitoring and reporting.
	Agricultural cattle Grazing.	Determination of safe carrying capacity for future land use and future management strategies/agreements in place.	Cattle stocking trials indicate areas nominated for cattle grazing as a post mining land use are sustaining an equal to or better stocking rate that that calculated for relevant reference site.
		Land maintenance requirements are comparable to reference sites.	Landform stability when grazed. Safety of landform for stock and for undertaking management activities associated with stock.

7 Monitoring and maintenance

This section of the strategy describes conceptual monitoring and maintenance activities that will be undertaken post-rehabilitation.

The post-rehabilitation phase commences upon completion of the strategy. During post-rehabilitation, monitoring will be conducted to assess whether the closure objectives and criteria are being met, while maintenance will be undertaken to address those areas where closure objectives and criteria are not being successfully met. At this stage, the identified monitoring and maintenance activities are conceptual and will need to be refined as the strategy develops in the future.

Upon completion of rehabilitation activities, maintenance and monitoring will be conducted at various intervals.

Post-rehabilitation monitoring plans will need to be confirmed with relevant government authorities.

7.1 Surface water

Detailed information on surface water monitoring requirements will be outlined in the receiving environment management plan (REMP).

7.2 Geotechnical monitoring and soil testing

Geotechnical monitoring and soil testing will be undertaken by a qualified geotechnical engineer who will assess the stability and quality of post-closure features. Monitoring frequency is presented in Chapter 6.

7.3 Dust monitoring and analyses

Dust monitoring and analyses will be conducted to assess the quality of post-rehabilitation corrective action to control dust generation. This will be conducted as part of a dust control program to identify and quantify airborne dust concentrations. Monitoring frequency is presented in Chapter 6.

7.4 Rehabilitation monitoring

A rehabilitation monitoring schedule is presented in Chapter 6.

A procedure is yet to be developed describing the specific monitoring methodologies to determine statistical adequacy of the sample population. These methodologies will entail but not be limited to: transect location determination, floral and faunal sampling and identification, and biodiversity assessments.

7.5 Weed and feral animal control and inspection

Weed and feral animal control will be conducted annually during the first five years after rehabilitation.

Weed and feral animal inspections will be conducted in all areas of off-site infrastructure sites, and control will be performed as required.

7.6 Maintenance

Maintenance will encompass post-rehabilitation monitoring to identify areas requiring maintenance, and identify and address deviations from the expected outcomes.

Maintenance activities will include the maintenance of new vegetation (eg addition of fertiliser, re-planting of significant areas of failed vegetation) prior to its establishment within the ecosystem; upkeep of water management structures; regular checking, replacement and probable repairs, where necessary, to newly fenced areas and signage in the event they become compromised after rehabilitation.

Appendix A

Legal and other requirements

A critical factor in defining the scope and context of closure and rehabilitation is to identify and evaluate the legal and other obligations that affect closure and rehabilitation. Legal requirements for closure and rehabilitation are general found in legislation or in the Development Approval conditions which are established in the early stages of project development. Other obligations include internal standards, external commitments and industry codes and guidelines. In most cases, the other obligations that influences decisions are often far more onerous and comprehensive than regulatory requirements.

A.1 Legal Requirements

A summary of potential issues and related legislation and best practice guidelines that may apply at closure or rehabilitation and the potential obligation that may arise is summarised in Table A.1.

It should be noted that Table A.1 is not an exhaustive list; rather it is tailored based on what is perceived as rehabilitation issues identified during the preparation of this closure and rehbilitation management strategy.

Table A.1 Summary of Legalisation and best practice and potential Project obligation

Issue	legislation	Objective	Obligation
Flora and Fauna	Environmental Protection and Biodiversity Conservation Act 1999	To provide a federal environmental protection framework as well as determining nationally endangered species and communities.	Not to undertake action that may have a significant impact on a "matter of national environmental significance" or on the environment within Commonwealth land without approval under the Act.
Due Diligence	Environmental Protection Act 1994	To protect the environment while allowing development that improves the total quality of life and ecologically sustainable development.	General environmental 'duty of care' to be observed to ensure that any potential environmental impact from the Project is minimised.
Contamination	Environmental Protection Regulation 1998	Lists Environmentally Relevant Activities, which are activities that may potentially cause environmental harm and require approval. Also gives effect to National Environmental Protection Measure (NEPMs).	The NEPM contamination allows the development site specific clean-up criteria to determine the required level of remediation. These criteria are known as Health Investigation Levels (HIL's).
Waste	Environmental Protection (Waste) Regulation 2000	Provides waste management strategies to limit impact of waste on the environment.	Management of regulated wastes will be subject to this legislation.
Water	Environmental Protection (Waters)Policy 2009	Provides a framework to develop water quality guidelines to protect Queensland waters and prevent pollution.	Water quality measurement parameters may be sort from relevant guidelines.
Air	Environmental Protection (Air) Policy 2008	Specifies air quality indicators and goals to protect the environmental values and provides a framework for making consistent and fair decisions about managing the air environment and involving the community.	Air quality measurement parameters may be sort from relevant guidelines.

Table A.1 Summary of Legalisation and best practice and potential Project obligation

Issue	legislation	Objective	Obligation
Safety	Work Health and Safety Act 2011	To prevent a person's death, injury or illness being caused by a workplace, by a relevant workplace area, by work activities, or by plant or substances for use at a workplace.	Compliance with safety requirements throughout the closure period to be incorporated into the closure plan.
Industrial Relations	Workplace Relations Act 1996	The principal object of this Act is to provide a framework for cooperative workplace relations which promotes the economic prosperity and welfare of the people of Australia.	Closure plan to consider impact on employees of the operation.
Water	ANZECC Guidelines	Provide guidelines for the monitoring and management of water ways	Guidelines to provide details of water monitoring requirements.
Land Use	Land Act 1994	Relates to the administration and management of nonfreehold land and deeds of grant in trust and the creation of freehold land, and for related purpose	Regulates the opening and closing of road reserves and land dealings relating to changes in land tenure.
Flora and Fauna	Nature Conservation Act 1992	To provide framework for the protection of state listed threatened species and communities.	Rehabilitation strategies may need to include any state listed threatened species or communities that occur in the area.
Due Diligence	State Development and Public Works Organisation Act 1971	To provide state planning and organisational legislation that aids in the delivery of ecologically sustainable development.	Commitments during the EIS phase may impact on the rehabilitation of the site.
Flora and Fauna	Vegetation Management Act 1999	Regulates clearing of vegetation to ensure appropriate management and conservation.	Development to comply with state and regional vegetation management plans and policies and also comply with vegetation management practices on leased and freehold land.
Due Diligence	Minerals Council of Australia (MCA) (2000) Code for Environmental Management	Now superseded by Enduring Value – the Australian Minerals Industry Framework for Sustainable Development.	Highlights a range of closure Scenarios that should be considered during planning. Scenarios include: Planned Closure: This occurs when mining and processing ceases due to economic or operational requirements, or if the resource is exhausted. In this situation a decommissioning and closure plan will be prepared and submitted to the regulatory authorities for approval prior to closure. Unplanned Closure: This occurs

Table A.1 Summary of Legalisation and best practice and potential Project obligation

Issue	legislation	Objective	Obligation
			when processing ceases due to financial constraints or non-conformances with regulatory requirements. In this situation a decommissioning plan will be prepared immediately. Care and Maintenance: This can occur if the economics of the project area are unfavourable or if there is some impediment to extracting the resource. In this situation a 'caretaker' manages the site until conditions become favourable again. A decommissioning plan would be prepared which takes into account the recommencement. The plan will be implemented when a decision has been made to close the operation.
Land Use	Strategic framework for Mine Closure – Australian and New Zealand Minerals Council of Australia	States mine life criteria and rehabilitation guidelines	May be relevant to rehabilitation requirements.