CHAPTER 7 – REHABILITATION AND DECOMMISSIONING

GULF ALUMINA LTD – SKARDON RIVER BAUXITE PROJECT
# TABLE OF CONTENTS

7.1 Introduction .................................................................................................................. 7-1
7.2 Legislative, Policy and Plans Context ........................................................................ 7-1
  7.2.1 Environmental Protection Act 1999 ..................................................................... 7-1
  7.2.2 Kaolin Mine Rehabilitation and Decommissioning ............................................. 7-2
  7.2.3 Rehabilitation Hierarchy and Goals ..................................................................... 7-2
  7.2.4 Mineral Resources Act 1989 ................................................................................ 7-3
  7.2.5 Technical Guidelines for the Environmental Management of Exploration and
      Mining in Queensland ............................................................................................. 7-3
7.2.6 National Strategy for Ecologically Sustainable Development .................................. 7-3
7.2.7 The Australian and New Zealand Minerals and Energy Council ............................. 7-4
7.3 Rehabilitation Goals and Objectives ............................................................................ 7-4
  7.3.1 Rehabilitation Goals ............................................................................................ 7-4
  7.3.2 Site Specific Objectives ....................................................................................... 7-5
  7.3.3 Mined Areas ......................................................................................................... 7-5
  7.3.4 Port infrastructure Area ....................................................................................... 7-6
  7.3.5 Camp, Airstrip and Haul Roads .......................................................................... 7-7
  7.3.6 Traditional Owner Retention Agreement ............................................................. 7-8
  7.3.7 Current Land Use ................................................................................................ 7-8
  7.3.8 Post Mine Landform and Land Use .................................................................... 7-9
7.4 Description of Proposed Rehabilitation Activities ........................................................ 7-11
  7.4.1 Native Vegetation on Bauxite Mining Areas .......................................................... 7-11
  7.4.2 Vegetation Responses to Disturbance in Open Eucalyptus Woodland ................ 7-11
  7.4.2.1 Persistence ...................................................................................................... 7-11
  7.4.2.2 Opportunism .................................................................................................. 7-12
  7.4.3 Revegetation Type Prediction Post Bauxite Mining .............................................. 7-13
  7.4.4 Soil Preparation & Revegetation Process ............................................................. 7-16
  7.4.5 Seeding ................................................................................................................ 7-20
  7.4.5.1 Seed Collection & Storage ............................................................................. 7-20
  7.4.5.2 Seedbed Preparation ....................................................................................... 7-20
  7.4.5.3 Seed Sowing ................................................................................................... 7-21
  7.4.6 Fire Management ................................................................................................ 7-21
  7.4.7 Vegetation Monitoring ......................................................................................... 7-21
  7.4.8 End Point Criteria in Mine Site Rehabilitation ..................................................... 7-22
7.5 Impacts, Emissions and Releases .................................................................................. 7-22
7.6 Management Measures and Plans .............................................................................. 7-23
  7.6.1 Progressive Rehabilitation .................................................................................... 7-23
  7.6.2 Completion Criteria and Indicators ...................................................................... 7-24
  7.6.3 Final Land Use and Rehabilitation Schedule ....................................................... 7-26
  7.6.4 Mine Closure Planning ......................................................................................... 7-26
  7.6.4.1 Closure Planning ............................................................................................ 7-39
  7.6.4.2 Implementation ............................................................................................... 7-39
  7.6.4.3 Relinquishment ............................................................................................... 7-39
  7.6.5 Monitoring Program ............................................................................................. 7-39
7.7 Conclusion ..................................................................................................................... 7-40
Tables

Table 7-1  Land Units on Laterite/Bauxite Plateau and Slopes and Low Lying Clay Soil Areas (Source: Gunness et al. 1987) ............................................................... 7-15
Table 7-2  Plants Species Suitable for Rehabilitation on Skardon River Mine ................................ 7-17
Table 7-3  Examples of Operational Soil Analysis to be Conducted on Mining Areas ............ 7-18
Table 7-4  Final Rehabilitation Requirements – Mined Areas ...................................................... 7-27
Table 7-5  Final Rehabilitation Requirements – Port Infrastructure Area, Roads, Airstrip and Camp .............................................................................................................. 7-32

Figures

Figure 7-1  Reduction in Elevation in Post Mining Landform...................................................... 7-10
Figure 7-2  Schematic Representation of Pre and Post Bauxite Mining Land Units.............. 7-14
7. REHABILITATION AND DECOMMISSIONING

7.1 Introduction

Progressive rehabilitation and closure of a mine provides opportunities for land disturbed by mining to be rehabilitated to one or more sustainable post-mining land uses. This chapter describes the legislative and policy framework for rehabilitation, rehabilitation objectives and strategies for each mine domain, the current and proposed post-mining land uses, progressive rehabilitation, decommissioning and mine closure planning.

Decommissioning and rehabilitation of the former kaolin mine operations does not form part of this EIS as these activities are already approved under the existing, approved environmental authority and plan of operations (PoO). However, this EIS make provision for containment and further stabilisation of kaolin overburden piles as part of construction of a Namaleta Creek crossing.

7.2 Legislative, Policy and Plans Context

7.2.1 Environmental Protection Act 1999

In Queensland, rehabilitation is required under the Environmental Protection Act 1994 (EP Act), which has as its objective the attainment of ecologically sustainable development (ESD). Financial Assurance (FA) will be required under Section 292 of the EP Act to ensure that the government holds sufficient money to cover any costs that it may incur to rehabilitate the site and achieve compliance with an Environmental Authority (EA) for mining activities if the holder is unable to meet the conditions or fails to rehabilitate or restore the site. Progressive rehabilitation has the potential to significantly decrease these costs and to minimise the amount of FA held by the administering authority.

Section 318ZD and Section 262 of the EP Act requires a Progressive Rehabilitation Report (PRR) or Final Rehabilitation Report (FRR) respectively to be submitted to the administering authority for assessment before certification of progressive rehabilitation or acceptance of EA surrender. The administering authority will consider the requirements for these reports outlined in Section 318ZF and Section 264 when making their decision to accept the EA surrender.

Throughout the life of a mining project, the EA holder is required to notify the administering authority if a notifiable activity (listed in Schedule 3 of the EP Act) is being carried out on land within the mining tenement. The land is subsequently recorded on the Environment Management Register (EMR). Prior to approving the application for surrender of the EA, or certifying progressive rehabilitation, the administering authority must be satisfied that any land within the area subject to the PRR or FRR, that is listed on the EMR because of the mining activity, has been satisfactorily rehabilitated and does not pose an unacceptable risk to human health or the environment.

7.2.1.1 Plan of Operations

Under the EP Act, a Plan of Operations is required to be approved prior to carrying out any activities under the relevant mining lease. The Plan of Operations cannot be created for a term of more than five years and is required to:

- describe all resource activities that will take place
- propose a program of actions to comply with the EA conditions
- describe the rehabilitation program for land disturbed by any resource activities
 propose an amount of financial assurance
 include a compliance statement detailing the level to which the EA conditions have been complied with.

The rehabilitation requirements detailed in the Model Mining Conditions (EHP, 2014a) state that rehabilitation must commence progressively as soon as areas become available and in accordance with the Plan of Operations.

7.2.2 Kaolin Mine Rehabilitation and Decommissioning

Gulf Alumina manages the decommissioned kaolin mine (in care and maintenance) under a Plan of Operations and Rehabilitation Plan, with the current plan covering the period from February 2015 to February 2016. Financial assurance has been provided to the State, based on the expected rehabilitation of the kaolin mine. Much of the infrastructure (e.g. wet plant) has been decommissioned and removed from the site. In addition, the existing EA for the mining leases conditions environmental management of the kaolin mine whilst in care and maintenance.

The environmental management plan (EM Plan) presented in Appendix 13 provides a summary of the rehabilitation and decommissioning described in the Plan of Operations and Rehabilitation Plan. This chapter describes rehabilitation and decommissioning of the bauxite mine, which is also included in the EM Plan in Appendix 13.

7.2.3 Rehabilitation Hierarchy and Goals

The EHP Guideline – Rehabilitation requirements for mining projects (EHP, 2014b) describes the preferred rehabilitation hierarchy which, in order of decreasing capacity to prevent or minimise environmental harm, is:

 Avoid disturbance that will require rehabilitation.
 Reinstate a ‘natural’ ecosystem as similar as possible to the original ecosystem.
 Develop an alternative outcome with a higher economic value than the previous land use.
 Reinstate the previous land use (e.g. grazing or cropping).
 Develop lower value land use.
 Leave the site in an unusable condition or with a potential to generate future pollution of adversely affect environmental values.

The guideline outlines that the strategies listed higher in the hierarchy should be adopted in preference to those listed lower. Developing a lower value land use may however be appropriate if that use is acceptable to stakeholders and if all higher strategies are impractical. Leaving the site in an unstable condition or with potential to cause environmental harm will rarely be acceptable.

Rehabilitation goals as described in the EHP guideline and listed as a performance objective for the activities relating to land in Schedule 5 of the Environmental Protection Regulation 2008 (EP Regulation) require that areas disturbed will be rehabilitated or restored to achieve sites that are--

 safe to humans and wildlife; and
 non-polluting; and
 stable; and
 able to sustain an appropriate land use after rehabilitation or restoration.
7.2.4 Mineral Resources Act 1989

The Mineral Resources Act 1989 (MR Act) requires environmental impacts be addressed and managed during all prospecting, exploration, mining and rehabilitation activities. The principle objectives of the MR Act include to:

- minimise land use conflict
- encourage environmental responsibility
- encourage responsible land care management.

7.2.5 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland

To assist the mining industry in meeting environmental responsibilities, the former Department of Minerals and Energy (DME), in consultation with the Queensland Mining Council (QMC), developed an ‘Environmental Management Policy for Mining in Queensland’ (DME, 1991). The purpose of environmental management, as stated in the policy, is to achieve:

- acceptable post mining land use capability/suitability
- stable post mining landform(s)
- preservation of downstream water quality.


One of these technical guidelines, titled ‘Determination of Post-Mining Land Use’ (DME, 1995), describes the identification and selection of suitable post mining land use options.

The guideline details the following principles for determining the preferred post mining land use:

1. Where land is not proposed to be disturbed by mining operations, a continuation of existing pre-mining land use is recommended. Care needs to be taken to ensure that such use does not cause degradation of land within the residual lease area.
2. Where land is proposed to be disturbed, it is recommended that rehabilitation should aim to return the area to its pre-mining land suitability (where Group 1 uses are involved, i.e. Agricultural and Forestry Uses). Alternative nature conservation/enhancement (i.e. Group 2 uses) or other forms of beneficial use (i.e. Group 3 uses) should generally only be considered if a return to original land use potential is not practically and economically feasible.
3. Alternative beneficial uses (i.e. Group 3 uses) should only be selected where any such use:
   a. Is compatible with existing or committed future surrounding land uses.
   b. Offers demonstrable community and/or environmental benefits.
   c. Is sustainable and maintenance free or alternatively has an ongoing maintenance or management regime established and capable of implementation.

7.2.6 National Strategy for Ecologically Sustainable Development

The National Strategy for Ecologically Sustainable Development (NESD), (COA, 1992) promotes economic growth that safeguards the welfare of future generations, provides equity within and between generations, protects biological diversity and maintains essential ecological processes and life support systems. The ESD framework includes the “polluter pays” principle, i.e. those who generate pollution and waste should bear the cost of containment, avoidance or abatement. To ensure sound environmental practices throughout the industry, NESD also sets several objectives for mining including development of rehabilitation policies based on:
repairing the land so its ongoing maintenance needs are consistent with those of equivalent unmined land under equivalent land use
- rehabilitation requirements that are open to public scrutiny
- treating rehabilitation and mine closure as integral components of the planning and operation of mines.

7.2.7 The Australian and New Zealand Minerals and Energy Council

The Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Minerals Council of Australia (MCA) jointly published the Strategic Framework for Mine Closure (ANZMEC, 2000). The framework recognised that the mining industry is responsible for rehabilitation of mine disturbance in an environmentally and socially acceptable way. It considered mine planning, stakeholder involvement, financial provisioning for rehabilitation, implementation, standards and relinquishment; and developed the following key principles:

- legislation should provide a broad regulatory framework for the mine closure process
- standards of rehabilitation should be acceptable and achievable
- completion criteria are specific to each mine and should reflect its unique set of environmental, social and economic circumstances
- an agreed set of indicators should be developed to demonstrate that successful rehabilitation has been achieved
- targeted research will assist both government and industry in making better decisions about rehabilitation.

7.3 Rehabilitation Goals and Objectives

The rehabilitation goals and objectives below are based on Schedule 5, Table 2 of the Environmental Protection Regulations 2008 (EP Regulation) and the EHP Guideline - Rehabilitation requirements for mining projects. The mitigation and management measures presented in this chapter are designed to achieve these rehabilitation goals and objectives. The environmental management plan (EM Plan) presented in Appendix 13 provides a consolidated description of rehabilitation plans. Kaolin mine rehabilitation objectives and plans are provided in the EM Plan.

7.3.1 Rehabilitation Goals

Rehabilitation goals include returning the site to a stable and self-sustaining landform with a productivity level that conforms to a defined final land use through effective mine closure planning, establishment of key performance indicators, stabilisation of landforms and revegetation with suitable species.

Gulf will progressively rehabilitate the mine floor (i.e. after backfilling with subsoil and topsoil) and other disturbance areas not required for the duration of operations. Once operations are completed, all infrastructure will be decommissioned and disturbance areas rehabilitated, unless ongoing use is agreed with the landholder and regulators. The objective will be to return the area to a similar condition to that which existed prior to mining.

Gulf will develop a Rehabilitation Management Plan (RMP) for the Project, informed by the rehabilitation goals, objectives and plans described in this chapter. In accordance with the EHP Guideline - Rehabilitation requirements for mining projects, the following rehabilitation goals have been derived for decommissioning and rehabilitation of areas disturbed by the Project:

- The mine site will be safe for humans and wildlife.
The mine floor and land used for infrastructure will be rehabilitated so that they are non-polluting and self-sustaining.

Some infrastructure areas will be retained as requested by Traditional Owners in accordance with the Retention Agreement.

Surface waters that leave the Project area will be within defined water quality criteria.

Hazardous materials will be identified and adequately managed to ensure the site is non-polluting.

Stable landform with land use capabilities and/or suitabilities as determined in the Rehabilitation Management Plan (RMP).

Allow for ongoing land use following final rehabilitation and decommissioning.

Vegetation cover will be established to reduce rates of erosion and sediment loss.

Activities that disturb the landscape will be managed in a way that prevents or minimises adverse effects on landscape character, including progressive rehabilitation and decommissioning.

Final rehabilitation will be designed as permanent stable, self-sustaining landforms, not requiring ongoing maintenance or management.

7.3.2 Site Specific Objectives

Specific rehabilitation objectives and performance outcomes are described for each mine domain as follows:

- mined areas
- Port infrastructure area, roads, airstrip and camp.

7.3.3 Mined Areas

The rehabilitation objectives for the mined areas are:

- Ripping of the mine floor to improve water infiltration
- Topsoil and subsoil will be placed back on the mine floor to maintain a healthy soil substrate and support regeneration of native vegetation.
- Slopes are battered to less than 3:1 slopes.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Vegetation (including grass) cover is established to minimise erosions rates.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Landform does not present a risk to people and stock.
- All areas disturbed by mining activities will be rehabilitated to stable landform design criteria compatible with adjacent undisturbed areas.
- Achievement of self-sustaining native ecosystems with species composition and distribution similar to undisturbed local provenances.
- Ongoing management requirements are similar to non-mined land.

Topsoil and subsoil that have been stripped prior to mining will be placed on the mine floor in the correct sequence and revegetated in accordance with the RMP. The quality of topsoil and subsoil will be preserved by strip-to-floor mining, avoiding stock piling as far as possible by transferring stripped topsoil and subsoil to another mined area. The final landform of mined area is expected to be one to three metres below the natural surface elevation resulting in shallow depressions in the landscape.
Chapter 10 describes the nature of the soils in the proposed mine area and conservation management measures required, which are intended to improve rehabilitation success. The rehabilitation plan for the mine floor is to:

- strip-to-floor mining with minimum stockpiling of topsoil and subsoil
- apply stripped subsoils (30-50 cm) and topsoil material (minimum of 100 mm)
- deep rip the ironstone mine floor with a single tine
- scarify the surface (immediately before seeding)
- seed with a broad range seed mix collected from local provenances
- avoid introduction of weed species by not introducing soil material from external sources and minimising stockpiling.

Ongoing monitoring of the success of rehabilitation will be undertaken in accordance with the RMP.

Baseflow (seepage to groundwater) from the mine area, including rehabilitated areas, will be monitored for sediment loads and turbidity. Surface water sites beyond the mine will also be monitored.

7.3.4 Port infrastructure Area

The Port infrastructure area includes:

- bauxite stockpile
- infrastructure to convey and load bauxite onto barges, including conveyors and wharf
- Port facilities for unloading material and equipment
- any roads within the Port infrastructure area
- workshops and laydown yards
- administration area and offices
- landfill and waste transfer areas
- fuel storage area
- sediment control dam(s)

Some of this infrastructure already exists as it was constructed for the former kaolin mine.

As described in Chapter 6, water from mining areas will be managed within the pits. One or more sediment ponds will be located at the Port infrastructure area to manage runoff from this area. In addition a network of pipes will transfer water from the existing kaolin mine water storage pits and shallow aquifers to holding tanks at the Port infrastructure area. Note that rehabilitation of the former kaolin mine water storage infrastructure is subject to the existing environmental authority approval conditions and Plan of Operations for the mining lease, and hence is not considered in the rehabilitation requirements for the Project.

Rehabilitation objectives for the Port infrastructure area are:

- Establishment of post-mine land use in accordance with the RMP.
- Final landform is geotechnically stable.
- Hazardous or contaminated material or areas are identified and managed.
- Infrastructure is dismantled and removed, unless included in the retention agreement with Traditional Owners.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Vegetation cover is established to minimise erosion rates, other than in areas where infrastructure will be retained.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Landform does not present a risk to people and stock.
- Ongoing management requirements are similar to non-mined land.

The mining infrastructure will be decommissioned, dismantled and removed upon completion of the mining operations. Concrete bases and footings not required by Traditional Owners will be removed and the area ripped, reshaped and topsoil applied before revegetation. Drainage control through ripping, profiling or the provision of erosion control structures will also be undertaken.

Port infrastructure will be decommissioned, dismantled and removed upon completion of the mining operations, unless it is retained for beneficial use of Traditional Owners or the Port operator.

There is potential for beneficial use of Port sediment ponds by landholders after mining and will be retained where agreed to by the post-mining landowner. Any plan to retain water storage facilities post mining will consider the water quality and quantity requirements. These requirements will vary depending on whether the site is to be used for stock, wildlife, or human consumption, or recreational uses. Such a land use option may need separate hydrological and/or hydrogeological assessments. Criteria of achievement will show that all environmental and water quality requirements consistent with the use have been met and that the intended users of the water have a need for the facility. Responsibility for ongoing operation and management of dams, that will benefit the landholder, will be transferred to the landholder following mine closure.

Sediment ponds will either be retained as water storages for the post-mining land use or rehabilitated. Rehabilitation will vary depending on the storage history and sediment ponds will be returned to natural vegetation of the region, as occurred pre-mining. There are no regulated structures (dams or levees) proposed as part of the Project and hence rehabilitation and decommissioning objectives for regulated structures have not been proposed.

A contaminated land assessment of the product stockpile areas, fuel storage area, chemical storage areas, waste storage / transfer areas, sediment ponds and any other potentially contaminated sites will be undertaken. Any contaminated material found will be treated on the bio-remediation pad.

Any metals or materials that may contaminate the site (e.g. batteries, waste oils and other regulated wastes) will be removed from site (likely by ship) and disposed of at an appropriately licensed waste disposal facility. Other wastes will be buried on site in the landfill. The majority of wastes will have low potential to cause contamination through seepage. The landfill will be capped and covered with suitable soils to allow revegetation of the area. Further information is provided in Chapter 7.

Drainage control through ripping, profiling or the provision of erosion control structures will also be undertaken. Once decommissioned, the rehabilitation plan for the Port infrastructure area will be to:
- rip compacted areas to between 0.5-1 m
- apply stripped subsoils and topsoil material (average between 100-150 mm)
- scarify the surface (immediately before seeding)
- seed with appropriate seed mix
- control weed species.

7.3.5 Camp, Airstrip and Haul Roads

The rehabilitation objectives for camp, airstrip and roads are:
- The camp, airstrip and main haul road will be retained by Traditional Owners as per the retention agreement.
- Hazardous or contaminated material or areas are identified and managed.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Ongoing management requirements are similar to non-mined land.

Responsibility for ongoing operation and management of the airstrip, roads and other infrastructure retained by the Traditional Owners will be transferred to a management body of their choice following mine closure.

Some roads will be temporarily retained following rehabilitation as access roads for rehabilitation monitoring purposes. This will be determined in consultation with Traditional Owners.

A contaminated land assessment of the effluent treatment plant area, treated effluent irrigation area and any other potentially contaminated sites will be undertaken. Management of any contaminated areas will be by in-situ remediation, or removal to the remediation pad.

Decommissioned roads in the Project area will be rehabilitated by profiling, deep ripping, application of topsoil and seeding. Drainage construction will be applied where necessary. Roads which are selected to remain at the Project site post-mine closure may require ongoing management of sediment containment measures to minimise potential erosion and sediment entering into waterways.

It is likely that the airstrip will be retained by the Traditional Owners and hence will not be subject to rehabilitation and decommissioning (refer to Section 7.3.6).

### 7.3.6 Traditional Owner Retention Agreement

Gulf signed a native title agreement with the registered Native Title Claimants on 4 December 2013 covering the proposed bauxite mining activities. Included in this agreement is retention of the following existing and future infrastructure upon conclusion of the proposed bauxite mining operation and closure of the mine:

1. airstrip
2. road from Skardon River Port landing to Namaleta Creek and the airstrip
3. two kaolin water storage pits (Claystone Pit and Raw Water pit) as water pits with a pipeline to Skardon River Port
4. complete or partial retention of the third kaolin water storage pit (Fluvial Pit)
5. dry plant shed at Skardon River Port, unless removed by the new owner
6. accommodation camp, unless removed by the new owner
7. other infrastructure erected as part of the proposed bauxite mining operation.

### 7.3.7 Current Land Use

Current land use in areas where rehabilitation and decommissioning may be required are described in the following chapters:

- Chapter 10 - Geology, Topography and Soils
- Chapter 11 - Land Use Assessment
- Chapter 12 - Water Values and Quality
- Chapter 13 - Hydrology and Hydrogeology
The primary land uses within the Project footprint are the former kaolin mine operations, Port of Skardon River. Limited use of the land occurs within the majority of the Project footprint area containing native vegetation.

There are no mapped areas of regional interest within the Project area.¹

The land within the Project footprint, additional to the existing kaolin mine footprint, (approximately 1,376 ha) has limited potential for pastoral activities such as the grazing of cattle.

### 7.3.8 Post Mine Landform and Land Use

The post mining landform will be reduced in elevation by the approximate thickness of bauxite, which varies between 0.5 m and 4.5 m. Figure 7-1 shows the reduction in elevation across the mining areas in the post mining landform.

Mine closure planning will consider the choice of post-mining land use. This final land use may not necessarily be the original use. The final land use will largely be dependent on pre-mining land suitability, landholder preferences for land use, the potential uses of likely rehabilitated landforms, and the existing use or environmental values of surrounding land. Determination of post-mining land use will be made in consideration of the rehabilitation hierarchy (refer Section 7.2.3).

The majority of the Project disturbance areas will be returned to their previous land use (i.e. native vegetation), unless retained for future beneficial use. These areas will be developed to a similar value land use, and will be left in a stable condition that minimises the potential to generate future pollution or adversely affect environmental values.

Consideration and final determination of post-mine land use for the Project site will be documented in the RMP, which will be developed by the proponent. The RMP will describe the post mine land uses and will be developed within one year of the effective date of the environmental authority for the Project, based on the following considerations:

- an inventory of existing land uses that further analyses specific areas to establish criteria for rehabilitation success
- a description of the location and extent of land proposed to be disturbed by mining activities
- an assessment of post-mining land suitability and options, and their community benefits
- an assessment of the feasibility to achieve the rehabilitation objectives including any ongoing maintenance or management needs.

---

¹ As described in the Regional Planning Interests Act 2014 (RPI Act).
Reduction in Elevation of Post Mining Landform

Date: 9/10/2015

Legend

- Mining Lease Boundaries
- Port of Skardon River

Reduction in Elevation (m)

<table>
<thead>
<tr>
<th>0 - 0.5</th>
<th>0.6 - 1</th>
<th>1.1 - 1.5</th>
<th>1.6 - 2</th>
<th>2.1 - 2.5</th>
<th>2.6 - 3</th>
<th>3.1 - 3.5</th>
<th>3.6 - 4</th>
<th>4.1 - 4.5</th>
</tr>
</thead>
</table>

Gulf Alumina Limited

No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and as such no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.

7.4 Description of Proposed Rehabilitation Activities

7.4.1 Native Vegetation on Bauxite Mining Areas

The predominant regional ecosystem within areas to be mined for bauxite is the *Eucalyptus tetrodonta* and *Corymbia nesophila* association (RE 3.5.2), commonly known as Darwin stringybark or *Eucalyptus tetrodonta* woodland. A detailed description of vegetation within the proposed mining area, mapped under this RE, is provided in the Appendix 5. As provided in Section 3.6 Regional Ecosystem Mapping the REDD (Queensland Herbarium, 2011) description for this community is as follows:

RE 3.5.2: “*Eucalyptus tetrodonta* (Darwin Stringybark) predominates forming a distinct but discontinuous canopy (22-32 m tall) with *Corymbia nesophila* (Melville Island Bloodwood) present as a subdominant to co dominant canopy species. Large *Erythrophleum chlorostachys* (Cooktown Ironwood) trees may be present. These occur just below the canopy. A very sparse to sparse sub canopy layer (8-25 m tall) is dominated by *Eucalyptus* spp. and *Grevillea glauca* (Bushman's Clothes Pegs). Scattered low trees (4-8 m tall) are sometimes present. *Acacia* spp. and *Eucalyptus* spp. dominate the sparse to very sparse shrub layer (0.5-2 m tall). The ground layer is usually sparse to mid-dense and dominated by the grasses, *Sarga plumosum* (Plume Sorghum), *Heteropogon triticeus* (Giant Speargrass), *Alloteropsis semialata* (Cockatoo Grass) and *Eulalia mackinlayi* (Silky Browntop) occurs on deeply weathered plateaus and remnants.”

Chapter 15 provides a detailed description of the vegetation in the Project area.

7.4.2 Vegetation Responses to Disturbance in Open Eucalyptus Woodland

The following description has been drawn from an unpublished discussion paper which was prepared by Reddell and Meek of EWL Sciences for Energy Resources of Australia (ERA) in March 2004. This paper provides a Revegetation strategy for the final landform at Ranger Mine, which was approved by the Commonwealth Department of Environment and Heritage. While the regeneration processes on hard rock at Ranger are very different from Western Cape bauxite mining, the vegetation dynamics are similar.

The long-lived (>100 years) trees, which dominate woodlands of the wet-dry tropics, are referred to as framework species. The dominant species on the bauxite plateau are *Eucalyptus tetrodonta* (Darwin stringybark), *Eucalyptus nesophila* (Melville Island bloodwood) and *Erythrophleum chlorostachys* (Cooktown ironwood) (Gunness 1987). The framework species control much of the nutrient and water resources and provide the core habitat conditions for other plants and animals as well as long-term stability (Reddell and Hopkins 1994).

Reddell (2004) points out how ‘understanding native vegetation responds to and recovers from disturbance is fundamental in designing ecologically based re-vegetation programs’. Plants of the *Eucalyptus* dominated woodlands of the wet-dry tropics persist through disturbance events, primarily fire and secondarily cyclone and wet season variations caused by weather changes such as the El-Nino drought effects. The strategies adopted by the floral groups can be categorised under the two tactics of ‘persistence’ and ‘opportunism’.

7.4.2.1 Persistence

All of the long-lived framework species of the woodlands rely on the ‘persistence’ strategy of re-sprouting from lignotubers and root suckers after fire or cyclone damage (Lacey and Whelan 1976, Fensham and Bowman 1992, cited in Reddell 2004). Although the framework species produce seed, the vast majority of new recruits come from woody sprouts, long-term survival only achieved by a minority of individuals that rise above the 3m fire-suppressed ground layer – usually happening intermittently with changing...
conditions. Depending on local growing conditions, it takes 3-5 years of fire exclusion for young plants to exceed 3m in height (Williams et al. 2003, cited in Reddell 2004).

The competitive advantage of root sprouts over seedlings, being able to draw on stored and distant resources provided from developed and extensive root systems, enables young plants to overcome the following factors of the hostile environments of woodlands:

- high fire frequency
- infertile soils
- extended dry seasons
- competition from fast growing grasses and forbs

The persistence tactic enables the framework species to survive the less frequent, but more damaging disturbances of intense wildfires, cyclone or reduced rainfall from El Nino events.

Young plants need 3-5 years free from fire to grow above 3 m, which means that individual patches of woodland systems probably require 3-5 years of fire exclusion. Reddell (2004) points out that a fire management strategy of regular control burning can result in continued suppression of woody sprouts and seedlings in the ground layer with potential to have long-term effects on composition, structure and functioning of woodland communities. This factor has relevance for control burning around bauxite mines. However, if intense wildfires enter regeneration areas, they can damage or destroy most of the tree species.

7.4.2.2 Opportunism

The grasses and forbs of the ground layer and the under-storey short-lived shrubs and trees, notably Acacia and Grevillea species, rely on an opportunism tactic for regeneration. This tactic is to rapidly colonise a disturbed area with high seedling growth rates, capturing resources in the soil that have been made available from the disturbance, as well as using resources of characteristically larger seeds. Such seeds are produced in large numbers, persist in the soil seed bank and germination is often triggered by fire. The opportunism tactic results in year-to-year changes in the ground layer and under-storey shrub and tree component of the woodlands.

The long-term dynamics of the wet-dry tropic or savanna woodlands results from interaction between the groups of plants using the two tactics of persistence and opportunism. Persistent framework species dominate and provide functional stability while the ‘opportunist’ species form a dynamic ground, shrub and sub-canopy tree layer driven by frequent fire and suppressed by intense fire. While this group contributes little to the overall stability of the plant community, it provides variable habitat and food resources for fauna and soil nutrients, notably nitrogen.

When the soil profile is removed (as in strip-mining) the underground perenniating organs are destroyed resulting in the framework species losing their competitive advantage. Natural re-colonisation by these species is slow by growth of suckers from adjacent undisturbed areas and some seedling recruitment. Such recruitment is dependent on availability of micro-sites providing water, nutrients and protection from heat, as well as minimal competition for light and nutrients by faster-growing ‘opportunists’ and protection from fire for 3-5 years. The predictability of a successful re-establishment of a dominant and stable population of framework species is the critical factor in mine-site regeneration.

Reddell (2004) questioned a widely held perception that Acacia-dominated plant communities in disturbed areas are an early stage in a natural succession to a ‘climax’ community of the framework species (Foster 1985) promoted ‘climax’ theory in Weipa). This has resulted in the widespread practice of planting large numbers of Acacia species in mine-site regeneration to ‘initiate’ succession (and build up soil organic matter). Reddell (2004) noted that “there is no convincing evidence from re-vegetation efforts to support this point of view”. Instead, Acacia-dominated sites have rapid accumulation of leaf
litter and creation of shady conditions, with replacement of dead trees by more *Acacia*, or in the case of fire damage, mass germination and re-colonisation by *Acacia* from the soil seed bank, as well as grass and weedy species.

Only a presence of established (>3 m) *Eucalyptus* species can break this cycle and then there might be a minimum threshold population that could achieve domination (at least in a not too distant time-frame), such as the minimum of 225 stems per hectare recommended for Weipa sites by Mulligan (2000) in the monitoring work done with the University of Queensland. Reddell (2004) believes that “revegetation strategies based on the assumption of *Acacia*-initiated successions are conceptually flawed and actually impede and inhibit the future development of key framework species on grossly disturbed areas”. Reddell pointed out that while *Acacia* species fix nitrogen and contribute soil organic matter they occur as low density scattered under-storey opportunists in the frequently burnt native woodlands. Reddell suggested that regeneration strategies using *Acacia* need to mimic this ecology.

### 7.4.3 Revegetation Type Prediction Post Bauxite Mining

Even when the 50-60 cm topsoil and subsoil layer is stripped off by scrapers during mining and placed immediately on open mine floor for rehabilitation, there is a loss in soil quality. From various field studies in Weipa, Schwenke (1992) noted a 45% reduction in surface-soil carbon (C) and nitrogen (N) in the first year after mining. He reported that microbial biomass C declined by 19% in topsoil, 34% in mixed soil and 61% in exposed subsoil, while organic C declined by 26% in topsoil, 18% in mixed soil and 12% in subsoil. Phosphorus (P) declined with organic content while S has been found to be unaffected, probably due to its natural presence in the subsoil (Schwenke 1992). Most soil quality is lost when stockpiled.

Bauxite mining lowers the ground level and removal of bauxite from the profile places subsoil on ironstone, creating a profile similar to that found on ironstone ridges. Figure 7-2 provides a schematic representation of pre and post bauxite mining land units (same land units defined by Gunness *et al.* 1987) in relation to depth to ‘wet season’ water table. Note that the geological and geomorphological relationships are highly stylized and not to scale, in order to enhance the illustration. The upper diagram represents pre-mining land units, while the lower presents hypothesized land units anticipated post mining by Reddell and Hopkins (1994).

Reddell and Hopkins (1994) suggest that changes in the depth of the soil profile and hydrology will have the effect of creating a new vegetative land unit. This is easiest explained by referring to Figure 7-2 in conjunction with Table 7-1. The diagrams show the effect of mining on the soil profile, i.e. reduction of depth of B horizon and water table from surface, while the table indicates changes in dominant plant species. Reddell and Hopkins (1994) predict that plant species predominating in the land unit 5k, describing vegetation on laterite slopes with ironstone outcrops, are more likely to succeed than species found on the pre-mining bauxitic red earths (land unit 2b). Further, the post-mining areas that lie below the wet season water table are likely to support plant species found in land units 7b and 3b – this has been verified in the Weipa mining operation.
Land Units – pre-mine:

![Diagram of Land Units - Pre-mine](image)

Land Units – post mine:

![Diagram of Land Units - Post-mine](image)

**Key:** Cross-hatch = bauxite profile; black = ironstone; stippled = sands and clays overlying Mesozoic sediments.

**Figure 7-2 Schematic Representation of Pre and Post Bauxite Mining Land Units**

Note: Upper diagram before mining lower diagram with hypothesized land units anticipated post mining, both in relation to depth to ‘wet season’ water table (Redell & Hopkins, 1994).
### Table 7-1  Land Units on Laterite/Bauxite Plateau and Slopes and Low Lying Clay Soil Areas (Source: Gunness et al. 1987)

<table>
<thead>
<tr>
<th>Land Units:</th>
<th>2b</th>
<th>5k</th>
<th>2c</th>
<th>7b</th>
<th>3b</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RE Type &amp; VMA Status</strong></td>
<td>RE 3.5.2: Not of concern</td>
<td>RE 3.7.3: Not of concern</td>
<td>RE 3.5.7 &amp; 3.5.10: Not of concern</td>
<td>RE 3.3.9 &amp; 3.3.50: Not of concern</td>
<td>RE 3.3.14: Not of concern</td>
</tr>
<tr>
<td><strong>Soil Structure/Topography</strong></td>
<td>laterite/bauxite plateau red earths</td>
<td>eroding gentle laterite slopes with ironstone outcrops</td>
<td>bauxite plateau</td>
<td>alluvium/colluvium deposits podzolics/clays</td>
<td>alluvium/colluvium deposits podzolics/clays</td>
</tr>
<tr>
<td><strong>Soil Profile</strong></td>
<td>&gt;1.5m</td>
<td>shallow</td>
<td></td>
<td>mottled below 0.5m</td>
<td></td>
</tr>
<tr>
<td><strong>Hydrology</strong></td>
<td>excessive internal drainage</td>
<td>no surface run-off</td>
<td>excessive surface run-off</td>
<td>moderately permeable with watertable at surface in wet</td>
<td>water-logged for long periods</td>
</tr>
<tr>
<td><strong>pH</strong></td>
<td>slight-strong acidity</td>
<td></td>
<td></td>
<td></td>
<td>strongly acid</td>
</tr>
<tr>
<td><strong>Vegetation Structure</strong></td>
<td>Grassy tall layered woodland</td>
<td>Open scrubby woodland</td>
<td>Grassy tall woodland</td>
<td>Tall shrubland/low woodland</td>
<td>Closed/open forest</td>
</tr>
<tr>
<td><strong>Foliage protective cover</strong></td>
<td>15%</td>
<td>25%</td>
<td>25%</td>
<td>30%</td>
<td>54%</td>
</tr>
<tr>
<td><strong>Framework/Canopy</strong></td>
<td>Eucalyptus tetrodonta (d)</td>
<td>Eucalyptus nesophila</td>
<td>Eucalyptus tetrodonta</td>
<td>Melaleuca viridiflora</td>
<td>Melaleuca viridiflora</td>
</tr>
<tr>
<td><strong>Species</strong></td>
<td>Ery. Chlorostachys; Eucalyptus nesophila</td>
<td>Eucalyptus tetrodonta; Eucalyptus dicromophloia</td>
<td>Eucalyptus nesophila; Ery. Chlorostachys (uc)</td>
<td>Lophostemon suaveolens; Calycopeplus casuarinoides; Melaleuca stenostachya</td>
<td>Melaleuca cauputi &amp; leucaendra; Lophostemon suaveolens; Calycopeplus casuarinoides</td>
</tr>
<tr>
<td><strong>Understorey Species</strong></td>
<td>Ery. Chlorostachys; Parinari nonda; Planchnia careya; Grevillia pararallela &amp; glauca; Coelospernum reticulatum; Acacia rothii; Livistona muelleri</td>
<td>Acacia rothii; Xylomelum scottianum; Planchnia careya; Parinari nonda; Ery. Chlorostachys; Grevillia pararallela &amp; glauca; Lophostemon suaveolens</td>
<td>Acacia rothii; Grevillia pararallela &amp; glauca; Planchnia careya; Parinari nonda; Lophostemon suaveolens; Livistona muelleri</td>
<td>Melaleuca symphyocarpa may form sub-canopy or understorey, if present</td>
<td></td>
</tr>
<tr>
<td><strong>Ground Cover</strong></td>
<td>Heteropogon triticeus; Sorghum plumosum; Schizachyrium sp; Thamastochloa sp; Alloteropsis semialata; annual herbs and legumes</td>
<td>Heteropogon triticeus; Sorghum plumosum; Coelachis rotboeliioides; Enachne sp. Pandanus sp; Spermacoce sp; annual herbs and legumes</td>
<td>Heteropogon triticeus; Alloteropsis semialata; annual herbs and legumes</td>
<td>Philydrum lanuginosum; Eragrostis interna; Ectrosis leporina</td>
<td>Philydrum lanuginosum; Sponobulus virginicus; Eleocharis dulcis</td>
</tr>
</tbody>
</table>
7.4.4 Soil Preparation & Revegetation Process

Bauxite mining areas are prepared for re-vegetation in the mining process of strip-to-floor and deep ripping. Topsoil is stripped by scrapers and placed in a holding stockpile. Either scrapers or loaders and trucks strip the subsoil and immediately place on open mine floor. Scrapers then take the topsoil from the holding pile and place over the subsoil. The ironstone floor is deep ripped through the placed soil. Deep ripping cannot be conducted prior to soil placement due to it creating too rough a surface for earth moving machinery to operate. Where both topsoil and subsoil have been stockpiled, due to non-availability of open mine floor at time of stripping, the soil is placed on the mine floor by scrapers in the correct sequence.

As far as practicable, all exposed bauxite mined areas will be prepared and sown with native vegetation seed in October and November of each year of operation. Avoidance of compacting moist soil is a priority, thus soil will be worked in the late dry season before December, when storms can set in. Soil health will be considered at all stages – also realizing the greenhouse value of preserving or increasing soil carbon.

Re-vegetation will be conducted on two basic post mining landscapes: low lying seasonally flooded mine floor areas and higher ground, both with lateritic subsoil. Appendix 5 provides a comprehensive list of potential plant species suitable for the bauxite mining areas. Table 7-2 provides a list of plant species obtainable in the region, though with varying degree of difficulty. Tree species can be purchased from local seed collectors, while grass seed might be harvested by a small agricultural tractor. The bauxite mined areas will be sown with seed of plants representative of bauxite and lateritic subsoil areas (Column B in Table 7-2), as well as species in Column A, due to predictions of creation of low lying seasonally flooded areas.

Analysis of post mining soils in Weipa, along with fertilizer response trials, indicated deficiencies in nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), sulphur (S), copper (Cu), zinc (Zn) and molybdenum (Mo), with P identified as the most limiting to plant growth (Lawrie 1985, Schwenke 1992 and Mulligan 1996).

On Skardon River mining leases, operational soil testing will be conducted prior to bauxite mining, using the specialised services of the Environmental Analysis Laboratory (EAL) at Southern Cross University. This laboratory uses Albrecht and total nutrient methods for analysis. This testing includes assessment of levels of major nutrient elements; calcium to magnesium ratio (Ca:Mg); cation exchange capacity; organic matter (OM) and carbon to nitrogen ratio (C:N). As an example of this soil testing, Table 7-3 provides results of samples taken on three sites at Skardon River, each having different soil texture and colour. Note that most elements are at low levels, aluminium being an exception, as would be expected in a bauxite area. The soil carbon levels are at a level expected in poor soils, around 2%. Soil testing, post mining and revegetation, will reveal changes in carbon and nutrient levels from pre-mining.

Should post-mining soil tests indicate further decline in levels of key macro and trace minerals found in pre-mining soil tests, minerals may be applied. It is expected with strip-to-floor mining that soil carbon levels will not drop significantly and will recover with revegetation.
## Table 7-2  Plants Species Suitable for Rehabilitation on Skardon River Mine

<table>
<thead>
<tr>
<th>A: Low Lying Clay Soil Areas</th>
<th>B: Bauxite &amp; Lateritic Subsoil Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tree/Shrub Species:</strong></td>
<td><strong>Tree/Shrub Species:</strong></td>
</tr>
<tr>
<td>Asteromyrtus symphyocarpa</td>
<td>Acacia rothii (4-7 m)</td>
</tr>
<tr>
<td>Banksia dentata (5-7 m)</td>
<td>Acacia torulosa (thanacoupie; 4-7 m)</td>
</tr>
<tr>
<td>Melaleuca acacoides</td>
<td>Alphitonia excelsa (red ash; 5-10 m)</td>
</tr>
<tr>
<td>Melaleuca caqipati</td>
<td>Alstonia actinophylla (milky pine; 15-20 m)</td>
</tr>
<tr>
<td>(paperbark; 10-30 m)</td>
<td>Banksia dentata (5-7 m)</td>
</tr>
<tr>
<td>Melaleuca leucadendra</td>
<td>Cleodendrum costatum</td>
</tr>
<tr>
<td>(weeping paperbark; 10-30m)</td>
<td>Erythrophleum chlorostachys</td>
</tr>
<tr>
<td>Melaleuca stenostachya</td>
<td>Corymbia (Eucalyptus) clarksoniana</td>
</tr>
<tr>
<td>Melaleuca symphocarpa (4-10 m)</td>
<td>Corymbia (Eucalyptus) nesophila</td>
</tr>
<tr>
<td>Melaleuca viridifolia</td>
<td>Eucalyptus tetrodonta (stringybark; 10-30 m)</td>
</tr>
<tr>
<td>(broad leafed paperbark 3-10-15m)</td>
<td>Eucalyptus stockeri</td>
</tr>
<tr>
<td>Lophostemon suaveolens</td>
<td>Ficus oposita (sandpaper fig; 3-8 m)</td>
</tr>
<tr>
<td>(swamp mahogany)</td>
<td>Grevillea glauca (bushman’s peg; 4-7 m)</td>
</tr>
<tr>
<td>Pandanus spiralis (10 m)</td>
<td>Grevillea parallela (3-7 m)</td>
</tr>
<tr>
<td>Petalostigma banksii</td>
<td>Livistona muelleri (Livistona palm)</td>
</tr>
<tr>
<td><strong>Ground Cover:</strong></td>
<td>Lophostemon suaveolens</td>
</tr>
<tr>
<td>Alloteropsis semialata, (cockatoo grass)</td>
<td>Melaleuca stenostachya</td>
</tr>
<tr>
<td>Bothriochloa bladhii (blady grass)</td>
<td>Melaleuca viridifolia</td>
</tr>
<tr>
<td>Chloris inflata (purpletop chloris grass)</td>
<td>Neofabricea myrtifolia</td>
</tr>
<tr>
<td>Heteropogon contortus (black spear grass)</td>
<td>Pandanus spiralis(10 m)</td>
</tr>
<tr>
<td>Panicum mindanaense</td>
<td>Parinari nonda (nonda plum; 10 m)</td>
</tr>
<tr>
<td>Pseudopogonatherum contortum</td>
<td>Petalostigma banksii</td>
</tr>
<tr>
<td>Themeda arguens</td>
<td>Planchonia careya (cocky apple ; 4-10 m)</td>
</tr>
<tr>
<td>All grass species harvested from analogues</td>
<td>Smilax calophylla</td>
</tr>
<tr>
<td></td>
<td>Xanthostemon crenulatus</td>
</tr>
<tr>
<td><strong>Ponded Swamp:</strong></td>
<td></td>
</tr>
<tr>
<td>Eleocharis dulcis (water chestnut, edible)</td>
<td></td>
</tr>
<tr>
<td><strong>Vines:</strong></td>
<td></td>
</tr>
<tr>
<td>Dioscorea bulbifera (‘cheeky’ yam, edible)</td>
<td></td>
</tr>
<tr>
<td>Dioscorea transversa (long yam, edible)</td>
<td></td>
</tr>
<tr>
<td>Grow in low lying woodland</td>
<td></td>
</tr>
<tr>
<td><strong>Ground Cover:</strong></td>
<td></td>
</tr>
<tr>
<td>Heteropogon contortus (black spear grass)</td>
<td></td>
</tr>
<tr>
<td>Heteropogon triticeus (giant spear grass)</td>
<td></td>
</tr>
<tr>
<td>Schizachyrium fragile</td>
<td></td>
</tr>
<tr>
<td>Sorghum plumosum (native sorghum)</td>
<td></td>
</tr>
<tr>
<td>All grass species harvested from analogues</td>
<td></td>
</tr>
</tbody>
</table>
### Table 7-3  Examples of Operational Soil Analysis to be Conducted on Mining Areas

<table>
<thead>
<tr>
<th>Sample Date: 13-15 February 2015; Test 20 February</th>
<th>Coords:</th>
<th>E:606700</th>
<th>E:609661</th>
<th>E:614846</th>
<th>Minimum Levels Recommended For Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Date: 20 February 2015</td>
<td>Ref No:</td>
<td>Sample 1</td>
<td>Sample 2</td>
<td>Sample 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basic texture</td>
<td>Sandy Soil</td>
<td>Clay Loam</td>
<td>Clay Loam</td>
<td></td>
</tr>
<tr>
<td>Soil Analysis</td>
<td>Basic colour</td>
<td>brownish red</td>
<td>brownish grey</td>
<td>red</td>
<td></td>
</tr>
<tr>
<td>Total Exchange Capacity (TEC)</td>
<td>cmol+/Kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cation Exchange Capacity (CEC)</td>
<td>cmol+/Kg</td>
<td>1.69</td>
<td>1.87</td>
<td>3.26</td>
<td>4</td>
</tr>
<tr>
<td>pH level (1:5 water)</td>
<td></td>
<td>7.64</td>
<td>7.14</td>
<td>6.76</td>
<td>6.3</td>
</tr>
<tr>
<td>Conductivity (1:5 water)</td>
<td>dS/cm</td>
<td>18</td>
<td>19</td>
<td>19</td>
<td>100</td>
</tr>
<tr>
<td>Organic Matter (Humus)</td>
<td>OM %</td>
<td>2.5</td>
<td>4.0</td>
<td>4.1</td>
<td>&gt;2.5</td>
</tr>
<tr>
<td>Total Carbon (Labile Carbon)</td>
<td>C %</td>
<td>1.45</td>
<td>2.30</td>
<td>2.34</td>
<td>&gt;1.4</td>
</tr>
<tr>
<td>Nitrate (NO₃⁻)</td>
<td>N mg/kg(ppm)</td>
<td>1.4</td>
<td>1.0</td>
<td>1.1</td>
<td>10</td>
</tr>
<tr>
<td>Ammonium (NH₄⁻)</td>
<td>N mg/kg(ppm)</td>
<td>3.3</td>
<td>3.9</td>
<td>2.9</td>
<td>12</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>N %</td>
<td>0.05</td>
<td>0.09</td>
<td>0.10</td>
<td>&gt;0.15</td>
</tr>
<tr>
<td>Carbon/Nitrogen Ratio</td>
<td>C:N ratio</td>
<td>28.6</td>
<td>27.0</td>
<td>23.4</td>
<td>10-12</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>avail(Bray1) P mg/kg</td>
<td>1.4</td>
<td>0.8</td>
<td>0.8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>avail(Colwell) P mg/kg</td>
<td>6.9</td>
<td>3.7</td>
<td>3.4</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>avail(Bl) P mg/kg</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>- soluble P mg/kg</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
<td>5</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>- total P mg/kg</td>
<td>&lt;50</td>
<td>72</td>
<td>59</td>
<td>400-1,500</td>
</tr>
<tr>
<td>Sulphur</td>
<td>- soluble S mg/kg</td>
<td>2.8</td>
<td>31.65</td>
<td>17.96</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>- total S mg/kg</td>
<td>&lt;50</td>
<td>197.5</td>
<td>113.0</td>
<td>100-1,000</td>
</tr>
<tr>
<td>Chloride estimate (salt conc)</td>
<td>Cl equiv ppm</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>&lt;23</td>
</tr>
<tr>
<td>Silicon (CaCl₂)</td>
<td>- available Si mg/kg</td>
<td>14</td>
<td>10</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>- total Si mg/kg</td>
<td>1277</td>
<td>1150</td>
<td>808</td>
<td>1,000-3,000</td>
</tr>
<tr>
<td><strong>Base Saturation - Cations</strong></td>
<td>Ca:Mg Ratio units</td>
<td>2.3</td>
<td>1.0</td>
<td>1.4</td>
<td>3.0</td>
</tr>
<tr>
<td>Calcium</td>
<td>- available Ca mg/kg</td>
<td>201</td>
<td>169</td>
<td>363</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td>- soluble Ca mg/kg</td>
<td>121</td>
<td>108</td>
<td>238</td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>- total Ca mg/kg</td>
<td>333</td>
<td>439</td>
<td>614</td>
<td>1,000-10,000</td>
</tr>
<tr>
<td></td>
<td>- available Ca kg/ha</td>
<td>450</td>
<td>380</td>
<td>814</td>
<td>1,000-10,000</td>
</tr>
<tr>
<td></td>
<td>- available Ca cmol/Kg</td>
<td>1.00</td>
<td>0.85</td>
<td>1.81</td>
<td>860</td>
</tr>
<tr>
<td></td>
<td>- percent TEC Ca %</td>
<td>59.5</td>
<td>45.3</td>
<td>55.6</td>
<td>&gt;60%</td>
</tr>
<tr>
<td>Magnesium</td>
<td>- available Mg mg/kg</td>
<td>52</td>
<td>105</td>
<td>153</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>- soluble Mg mg/kg</td>
<td>47</td>
<td>84</td>
<td>128</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>- total Mg mg/kg</td>
<td>131</td>
<td>225</td>
<td>266</td>
<td>500-5,000</td>
</tr>
</tbody>
</table>
## Sample Date: 13-15 February 2015; Test 20 February

### Test Date: 20 February 2015

- **Sample 1**
  - Basic texture: Sandy Soil
  - Coords: E:606700 N:8684465
  - Basic colour: brownish red
  - Available Mg kg/ha: 117
  - Available Mg cmol/Kg: 0.43
  - Available K mg/kg: 19
  - Available K cmol/Kg: 0.05
  - Available Na mg/kg: 12
  - Available Al mg/kg: 14
  - Available B mg/kg: 0.14
  - Available Fe mg/kg: 58
  - Available Mn mg/kg: 2
  - Available Cu mg/kg: 0
  - Available Zn mg/kg: 0.5
  - Available Mo mg/kg: 0.33
  - Available Co mg/kg: 0.5
  - Available Se mg/kg: <0.5

- **Sample 2**
  - Basic texture: Clay Loam
  - Coords: E:609661 N:8684608
  - Basic colour: brownish grey
  - Available Mg kg/ha: 236
  - Available Mg cmol/Kg: 0.87
  - Available K mg/kg: 24
  - Available K cmol/Kg: 0.06
  - Available Na mg/kg: 15
  - Available Al mg/kg: 2
  - Available B mg/kg: 0.18
  - Available Fe mg/kg: 24
  - Available Mn mg/kg: 8
  - Available Cu mg/kg: 0
  - Available Zn mg/kg: 2.4
  - Available Mo mg/kg: 2.10
  - Available Co mg/kg: 6.5
  - Available Se mg/kg: <0.5

- **Sample 3**
  - Basic texture: Clay Loam
  - Coords: E:614846 N:8695174
  - Basic colour: red
  - Available Mg kg/ha: 342
  - Available Mg cmol/Kg: 1.26
  - Available K mg/kg: 46
  - Available K cmol/Kg: 0.12
  - Available Na mg/kg: 11
  - Available Al mg/kg: 2
  - Available B mg/kg: 0.22
  - Available Fe mg/kg: 27
  - Available Mn mg/kg: 28
  - Available Cu mg/kg: 1
  - Available Zn mg/kg: 0.4
  - Available Mo mg/kg: 2.07
  - Available Co mg/kg: 13.3
  - Available Se mg/kg: <0.5

### Minimum Levels Recommended For Agriculture
- **Potassium**
  - Available K kg/ha: 43
  - Available K cmol/Kg: 0.05
  - Available K %: 2.9

- **Sodium**
  - Available Na kg/ha: 27
  - Available Na cmol/Kg: 0.05
  - Available Na %: 3.1

- **Aluminium**
  - Available Al kg/ha: 31
  - Available Al cmol/Kg: 0.15
  - Available Al %: 9.0

- **Trace Elements**
  - **Boron**
    - Available B mg/kg: 0.14
  - **Iron**
    - Available Fe mg/kg: 58
  - **Manganese**
    - Available Mn mg/kg: 2
  - **Copper**
    - Available Cu mg/kg: 0
  - **Zinc**
    - Available Zn mg/kg: 0.5
  - **Molybdenum**
    - Available Mo mg/kg: 0.33
  - **Cobalt**
    - Available Co mg/kg: 0.5
  - **Selenium**
    - Available Se mg/kg: <0.5

### Notes
- Test 20 February 2015
- Minimum levels recommended for agriculture

---

**Skardon River Bauxite Project**

**Chapter 7 – Rehabilitation and Decommissioning**

---

**Greencap**
Most re-vegetation will be from sowing of seed from native plants. Strip-to-floor soil handling may preserve some seed, as well as tube and root stock. Native grass seed will be introduced, possibly post tree seedling germination and establishment - this may require on-site trials. Quality will be ensured and maintained in seed collection, as well as avoidance of over-exploitation of stands of native plants. The practice of boiling of seed will be avoided to ensure survival of some seed beyond one season. This is especially important now that wet season rainfall appears to be becoming more erratic with climate change.

Successful regeneration of native vegetation depends on exclusion of fire. Firebreaks will be constructed and maintained around regeneration areas. Some back burning will be required to fend off wild bushfire. Continuous learning and improvement will be achieved by maintaining contact with other revegetation operators.

7.4.5 Seeding

7.4.5.1 Seed Collection & Storage

The seed collection and storage process will include:

- Grass seed collected locally using a small tractor mounted collector.
- Seed collected from trees and shrubs by hand or purchased from suppliers collecting from local provenances.
- Seed collected locally will be separated from chaff and dried.
- Short-term storage of seed will be in air-conditioning at 18°C, with fumigation if necessary to kill insects.
- Long-term storage of seed beyond the wet season following collection will be stored in a cold room at 5°C.
- As far as practicable, seed collected or purchased in a dry season will be sowed the following wet season to maintain maximum viability.
- Viability tests will be conducted and recorded for seed batches prior to sowing.

7.4.5.2 Seedbed Preparation

Soil will be worked in dry condition to avoid compaction. Thus site preparation, fertility treatment and seed sowing will be completed in October/November before wet season storms set in. Seedbed preparation is as follows:

- Disturbed surfaces are profiled and battered to have slopes less than 1 in 3 m. Back sloped benching is done on high steep slopes.
- Topsoil and subsoil placed in strip-to-floor mining operations as far as possible.
- In some strategic locations, retain or add logs and rocks for fauna habitat.
- Topsoil and subsoil stockpiled in bauxite mining operations will be placed on mined floor in sequence and at the original thickness (30-50 cm).
- Topsoil stockpiled in mining operations will be spread at a depth of 100 mm to 200 mm depending on pre-mining thickness and quantity of soil available.
- The bauxite mine floor will be deep ripped with a single tine.
- Mineral and microbial soil treatments may be applied prior to seeding.
7.4.5.3 Seed Sowing

Seed sowing will be conducted in November prior the storm season. Seed will be sown using a tractor mounted spreader. The practice of seed boiling will generally not be adopted to avoid damage to seed, enable dry season sowing and natural staggering of seed germination.

7.4.6 Fire Management

The long-term success of regenerating vegetation on the mine depends on fire management. In the first 10 years (less if growth is rapid) fire needs to be excluded from regeneration areas. This is to ensure that saplings exceed 2-3 m in height, as well as to avoid harming soil quality through fire.

The effects of various human induced fire regimes have the potential to affect non-mined stands of native vegetation. Generally in natural woodland and savannah systems disturbance is by grazing animals and/or fire. In the Western Cape Peninsula area fire is the main agent of disturbance. Fire started by storm season lightening is the natural disturbance factor. Fire removes carbon, nitrogen, sulphur and other minerals to the atmosphere.

The woodland systems of the Western Cape are dependent on fire. Thus mature regenerated vegetation needs to be fire tolerant. This should be the case beyond 10 years of planting, though as mentioned in Section 7.4.2 timing depends on Eucalyptus versus Acacia composition. Firebreaks need to be maintained around all regeneration areas for at least 10 years.

Natural fire resulting from lightning strikes in the storm season (November-December), usually do not travel far due to patches of rainfall. However, early electrical storms prior to the storm season settling in, can cause extensive damage. The vegetation recovers rapidly with onset of storms and the arrival of the monsoon wet season in late December or early January. Hot fires in August to October travel far and expose soil to baking sun for weeks to months. Hot fires driven by wind can infiltrate and damage fire sensitive vegetation, as found in vine thickets, riparian and coastal vegetation types. People light fires in the Western Cape area from early to late dry season.

Frequent early dry season burns can lead to tree thickening at the expense of low shrubs and grass. This is due to repeated suppression of these ground cover plants types, while tree saplings survive. This type of burning is practiced by casual lighters of fires, particularly along roadsides, as well as on the outskirts of towns and communities to protect property. Unfortunately early season hazard reduction fires often have to be lit in areas surrounding mine areas to protect infrastructure and regenerating vegetation from wild fire.

Compromising on conflicting effects of fire and the need to protect property and regenerating vegetation, Gulf will conduct a fire management program as follows:

- Construct and maintain fire breaks for protection of infrastructure and mine regeneration areas.
- Conduct hazard reduction back-burns of native vegetation to protect human health, infrastructure and revegetation areas when wild fires are approaching, expected from the south west.
- Conduct such fires when mosaic burning is initiated by a third party, such as the Old Mapoon Aboriginal Corporation (OMAC) or Rio Tinto.
- Conduct education programs to increase the awareness of harmful effects of fire.
- Engage or work with OMAC on fire management.

7.4.7 Vegetation Monitoring

Monitoring of re-vegetation sites will be conducted in the early dry season as follows:

- Small sites (infrastructure areas): Observations will be recorded noting percentage bare earth, grass and litter ground cover and native perennial grass cover, as well as shrub and tree recruitment.
Large sites (bauxite mining areas): Tree species and stem density counts will be made along 100 x 5m transects, as well as recording percentage bare earth, litter and grass ground cover and native perennial grass cover within 1m² quadrats placed at 10 m intervals along the transect. For established vegetation, canopy cover and average tree height will be recorded. Transects will be spaced at one per 20 ha, with at least one per regeneration area.

7.4.8 End Point Criteria in Mine Site Rehabilitation

Key species indicators of regeneration success will be adopted. These include the presence of framework species. A mature upper canopy should be made up of around 70% of the naturally dominant tree species, mainly Eucalyptus species and Cooktown Ironwood in the bauxite mined areas. However, as mentioned in Section 7.4.3, different vegetation types are expected post mining, especially at Skardon River where increased wet season inundation is expected post mining. Wattle domination often occurs in young or unsuccessful regeneration stands. With increased focus on soil carbon and soil health by strip-to-floor mining, it is anticipated that the regeneration process will be more rapid. Early indicator species will be used to determine whether regeneration processes are progressing towards a sustainable end-point ecosystem. It is expected that a sustainable ecosystem will be achieved in ten years.

7.5 Impacts, Emissions and Releases

Rehabilitation and decommissioning are key measures to mitigate the impacts of mining. Both positive and negative impacts may occur across the disturbance domains during Project rehabilitation and closure, including:

- **Land:**
  - increased incidence of erosion – unlikely as area of low erosion potential
  - unstable landforms – unlikely as landscape lowered

- **Fauna:**
  - increased abundance of pest animal species, although pest management should result in a reduction of pest species
  - reduced native species abundance and/or diversity – likely in the first 10 years of regenerating vegetation
  - increased native species abundance and/or diversity in comparison to the mining stage
  - increased sediment loads in watercourses resulting from ineffective restoration of drainage lines, with adverse effects on aquatic fauna and habitats, although this is unlikely as the landscape is lowered and stormwater exits as base flow (groundwater seepage)

- **Flora:**
  - reduced native species abundance and/or diversity - likely in the first 10 years of regenerating vegetation
  - increased native species abundance and/or diversity – possible after 10 years of regenerating vegetation, if rehabilitation areas form a different vegetation type
  - introduction of new weed species and increased weed density and distribution, however this is controllable with successful revegetation

- **Surface water:**
  - increased sediment loads for surface waters - with turbidity the only potential contaminant and unlikely to impact water quality as the landscape is lowered and stormwater exits as base flow
Groundwater:
- contamination of groundwater caused by contaminated seepage, with management measures in place to prevent or remediate oil contamination in infrastructure areas

Potential impacts that may remain after mine closure:

Fauna:
- revegetated habitat not suitable for native fauna to colonise – insufficient cover and nesting sites in the first 10 years of regenerating vegetation

Flora:
- failure to achieve self-sustaining vegetation mine areas, leading to reduced ecological function and curtailed ecosystem development, although successful rehabilitation is expected after 10 years
- potential for weed species to colonise areas unsuitable for native vegetation establishment, however all areas post mining will be suitable for revegetation

Groundwater:
- contamination of groundwater by seepage from site infrastructure areas with management measures in place to prevent or remediate oil contamination in infrastructure areas, if these are not decommissioned

Surface water:
- retention of surface water flow after rainfall in rehabilitated mine pits, with consequent downstream impacts, although this is unlikely as the landscape is lowered and stormwater exits as base-flow
- Sediment run-off from mine areas and turbidity, although this is unlikely as landscape lowered and stormwater exits as base flow and revegetation will limit sediment run-off

Rehabilitation of mined areas in conjunction with the retention of infrastructure for use by Traditional Owners, will allow for improved access to the land where vegetation is similar to that prior to mining.

7.6 Management Measures and Plans

This section describes the monitoring program that will be undertaken to measure the effectiveness of rehabilitation.

7.6.1 Progressive Rehabilitation

Progressive rehabilitation will be achieved through a suite of environmental management plans including (but not limited to):

- Rehabilitation Management Plan
- Soils Management Plan
- Erosion and Sediment Control Plan
- Pest Management Plan
- Water Management Plan

The main features of the rehabilitation process are:

- maintaining or constructing a stable land form in the mine areas
- respreading of topsoil and subsoil across the mine floor
- ripping the mined floor, immediately after soil placement to facilitate root penetration and water absorption
- seeding with appropriate seed mix prior to the wet season to maximise the benefits of rainfall
- ensuring no surface water run-off from the mine floor, both pre and post revegetation.

Progressive rehabilitation will minimise the amount of land disturbed at any one time and will be scheduled as part of day to day mining operations. Generally, most mined areas, especially those with strip-to-floor soil placement, will be rehabilitated within 12 months. Indicative schedules for progressive rehabilitation will be part of the RMP. Figures showing the progressive mine schedule have been provided in Chapter 5. Rehabilitation of these mined areas will occur in 12 months following mining of a particular area.

Progressive rehabilitation will also include the rehabilitation of areas disturbed during construction that are not required for ongoing operations.

The following decommissioning strategies are proposed for various remaining structures post-mine closure:

- Conduct a contaminated land assessment of relevant locations. This may involve engaging a suitably qualified person (SQP) approved by EHP as a contaminated land specialist.
- Remediation or ongoing management of contaminated land as required. Ongoing management may include retaining parcels of the land on EHP’s Environmental Management Register.
- Removal (or sale and removal if appropriate) of all items of mine infrastructure, and any temporary buildings and facilities, unless agreed with the post-mining landowner.
- Ripping, application of topsoil, and seeding of land.

7.6.2 Completion Criteria and Indicators

As mentioned in Section 7.4.8 key framework species will be used as indicators of revegetation success. The species targeted will depend on post mining hydrology, i.e. whether seasonal inundation occurs. This will vary for each area of mining. Completion criteria are an agreed set of environmental indicators which, upon being met, will demonstrate successful rehabilitation of the site. Completion criteria will be developed that are specific to the mine, and reflect the unique set of environmental, social and economic circumstances of the site. Traditional Owners will be engaged in this process.

The complexity of revegetation of bauxite mining areas is described and discussed in Section 7.4 setting out proposed vegetation, soils and landform assessment, revegetation, seeding and fire management practices. There are two types of post mining landform that will determine the flora species for rehabilitation:

- low lying clay soil areas (more typically associated with the former kaolin mine operations)
- bauxite and lateritic subsoil areas, further subdivided into:
  - low lying seasonally flooded post mining landforms
  - higher ground within post mining landforms

Soil quality and soil thickness will be similar in all bauxite pit rehabilitation areas as mining occurs on the bauxite plateau with Red Kandosol soil type, having a topsoil depth of 10 - 20 cm and subsoil depth of 40 - 50 cm (refer to Chapter 10). These soils will be replaced in mining areas in the same sequence as pre-

---

2 For the purposes of preparing site investigation and validation reports and draft site management plans, an SQP is defined in the Environmental Protection Regulation 2008.
mining. Therefore the post mining landform topography and potential for inundation affects the selection of species for rehabilitation. The species proposed for rehabilitation in each of these areas is presented in Table 7-2, with:

- low lying clay soil areas – column A
- low lying seasonally flooded post mining landforms – Column B, with some species from column A
- higher ground within post mining landforms – Column B

Standards and completion criteria will recognise the legislative framework and consider all relevant industry codes of practice existing at the time of closure. Completion criteria are the basis on which successful rehabilitation is determined and will be developed in consultation with stakeholders.

Specific performance indicators will be developed to measure progress in meeting the completion criteria. The environmental indicators are intended to demonstrate whether the ecological processes which will lead to successful rehabilitation are trending in the right direction. This will enable early intervention and remedial actions where trends are not positive. This is evidenced by the proposed monitoring and criteria described in Sections 7.4.7 and 7.4.8.

A RMP will be developed for the Project within one year of the effective date of the environmental authority. In accordance with the Strategic Framework for Mine Closure, the RMP will describe completion criteria and establish a set of indicators which will demonstrate the successful completion of the closure process.

For all indicators that are selected, the RMP will:

- state what objective(s) the indicator relates to
- justify selection of the indicator, including the relationship between the indicator and the objective
- state how the indicator is to be measured
- state how the results will be reported and interpreted.

Completion criteria and indicators will be developed for:

- vegetation cover
- erosion and sediment loss
- soil quality
- geotechnical stability of rehabilitated areas
- quality of water runoff
- engineering standards and certifications for decommissioned and rehabilitated infrastructure
- remediation of any contaminated land.

Indicators of rehabilitation success that are applicable to revegetation include plant and litter cover, plant density and species composition, plant yields, presence and content of weeds, soil erosion, soil carbon, soil nutrient status, soil salinity and microbial population.

Where the intention is to reinstate a natural ecosystem, nearby undisturbed vegetation communities can be used as a reference to assess the success of rehabilitation. This will provide analogue information for completion criteria such as percentage foliage cover, species diversity and presence of key species. It is not intended, nor is it reasonably practicable, to create native vegetation communities with the same abundance and distribution of undisturbed native vegetation. Completion criteria will be nominated to represent rather than recreate exactly representative native vegetation communities. For areas that are

---

to be revegetated with native species, completion criteria and indicators may include a comparison relative to a representative site.

Where water infrastructure is retained for the future benefit of landholders, completion criteria and indicators will be developed to establish the quality of the water and the risk posed by future changes in water quality.

Completion criteria to determine success of final rehabilitation and hence surrender of the mining lease will be developed in conjunction with the administering authority.

7.6.3 Final Land Use and Rehabilitation Schedule

Rehabilitation objectives for the Project will ensure the post-mining land use will be a similar land use as that prior to mining. The following tables describe, for each mine domain, the proposed rehabilitation goals, rehabilitation objectives, completion criteria and indicators:

- Mined areas - Table 7-4
- Port infrastructure area, roads, airstrip and camp - Table 7-5.
### Table 7-4  Final Rehabilitation Requirements – Mined Areas

<table>
<thead>
<tr>
<th>Mine Domain</th>
<th>Rehabilitation Goal</th>
<th>Rehabilitation Objectives</th>
<th>Indicators</th>
<th>Completion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine Floor</td>
<td>Long term safety</td>
<td>Structurally safe with no hazardous materials.</td>
<td>Safety assessment of landform stability (geotechnical studies).</td>
<td>Landform design meets the following design requirements. Slope angle does not exceed 7°. Edges battered to 1:3 slope.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Erosion.</td>
<td>Evidence in the Final Rehabilitation Report (FRR) that the runoff management systems area stable at closure and exhibit characteristics for long term stability.</td>
</tr>
<tr>
<td></td>
<td>Site is safe for humans and animals now and in the foreseeable future.</td>
<td>Safety assessment of landform stability (geotechnical studies).</td>
<td>Certification by an appropriately qualified person in the FRR that slopes are safe and exhibit characteristics for long term stability.</td>
<td></td>
</tr>
<tr>
<td>Non-polluting</td>
<td>Seepage and surface runoff will not cause environmental harm.</td>
<td>Runoff, surface and groundwater quality is monitored for ‘standard’ water quality parameters</td>
<td>Monitoring meets trigger criteria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mine affected water contained on site until water quality suitable for release.</td>
<td>Downstream surface water quality.</td>
<td>Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Groundwater quality.</td>
<td>Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mine Domain</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final landform water storages are contained on-site, with no overflows into external surface water systems until water quality suitable for release.</td>
<td>Final landform water storages are contained on-site, with no overflows into external surface water systems until water quality suitable for release.</td>
<td>Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.</td>
</tr>
<tr>
<td>Stable landform</td>
<td>Erosion rates are managed to levels that do not compromise post-mine land use</td>
<td>Slope angle and length.</td>
<td>Slope angle and length.</td>
<td>Evidence in the FRR that the rehabilitated slopes have been designed to the following specifications. Slope gradient of &lt;7% with a top soil cover. (Applicable to edges only).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Erosion is managed in accordance with an Erosion and Sediment Control Plan.</td>
<td>Erosion is managed in accordance with an Erosion and Sediment Control Plan.</td>
<td>Erosion controls functioning as intended, monitored and amended as required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineered structures to control water flow.</td>
<td>Engineered structures to control water flow.</td>
<td>Evidence in the FRR that required water control measures are in place and functioning as intended.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rates of soil loss.</td>
<td>Rates of soil loss.</td>
<td>Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimensions and frequency of occurrence of erosion of rills and gullies.</td>
<td>Dimensions and frequency of occurrence of erosion of rills and gullies.</td>
<td>Evidence in the FRR that the dimensions and frequency of occurrence of erosion of rills and gullies are no greater than that in comparable reference site(s).</td>
</tr>
<tr>
<td>Mine area slopes are geotechnically stable</td>
<td>No geotechnical failure.</td>
<td>No geotechnical failure.</td>
<td>No geotechnical failure.</td>
<td>Mine edges will be designed, shaped and capped with topsoil and revegetated in accordance with RMP.</td>
</tr>
<tr>
<td>Mine Domain</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetation cover sufficient for a self-sustaining community and to minimise erosion.</td>
<td>Scarified surface to be seeded with an appropriate seed mix and weed species to be controlled</td>
<td>Percent foliage cover recorded in line with RMP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Native fauna species.</td>
<td>Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetation type and density.</td>
<td>Evidence that the vegetation type and density are of species suited to the sites characteristics including soil type, topography and climate and that soil erosion meets the goals set in the RMP.</td>
<td>Vegetation types and densities are comparable with the relevant reference site.</td>
</tr>
<tr>
<td>Self-sustaining</td>
<td>Soil properties support the desired land-use.</td>
<td>Chemical properties, e.g. pH, salinity, nutrient content, sodium content of topsoil to support the proposed vegetation and land-use.</td>
<td>Certification in the FRR that the topsoil chemical properties do not limit the suitability of the land for the intended land use and are consistent with the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- soil salinity content is &lt;0.6 dS/m;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- soil pH is between 5.5 and 8.5;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- soil exchange sodium percentage (ESP) is &lt;15%;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts; and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- adequate macro and micro-nutrients are present according to pre mining levels.</td>
<td></td>
</tr>
<tr>
<td>Mine Domain</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physical properties of topsoil to support the proposed vegetation and land-use.</td>
<td>Suitable topsoil and subsoils that have been stripped prior to mining will be applied to the surface of the dump. Certification in the FRR that the soil physical properties, e.g. rockiness, depth of soil, wetness and plant available water capacity are adequate for plant growth.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Topsoil thickness.</td>
<td>Surface and subsoils are rehabilitated in accordance with Soils Management Plan. Certification in the FRR that topsoil has been re-spread according to pre-mining depths or within depth range described in the Soils Management Plan.</td>
<td></td>
</tr>
<tr>
<td>Establish self-sustaining natural vegetation or habitat.</td>
<td>Presence of key plant species.</td>
<td>Certification by an appropriately qualified person that key plant species identified in the comparable reference site occur on the rehabilitation site. The presence of key plant species may also be guided by future vegetation trials for rehabilitation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Density of key plant species.</td>
<td>Certification by an appropriately qualified person that the density of key plant species in comparable reference sites is similar to the rehabilitation site. The density of key plant species may also be guided by future vegetation trials for rehabilitation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Structure of vegetation habitat.</td>
<td>Certification by an appropriately qualified person that the structure of vegetation, i.e. groundcover, shrub and canopy structure is trending towards being similar to comparable reference sites.</td>
<td></td>
</tr>
<tr>
<td>Self-sustaining natural vegetation or habitat.</td>
<td>Native fauna species.</td>
<td>Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plant regeneration.</td>
<td>Certification by an appropriately qualified person that plants in rehabilitated areas show evidence of flowering, seed setting and seed germination.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abundance of declared plants (weeds) identified through surveys.</td>
<td>Certification by an appropriately qualified person that the abundance of declared plants (weeds) identified in rehabilitated areas in no greater than comparable reference sites.</td>
<td></td>
</tr>
<tr>
<td>Mine Domain</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Actions taken to eradicate plants declared under local or State legislation.</td>
<td>Evidence to demonstrate that action has been taken to eradicate declared plants (weeds) under local or State legislation should they occur on the site.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abundance of declared animals identified through surveys.</td>
<td>Certification by an appropriately qualified person that the abundance of declared animals identified in rehabilitated areas is no greater than comparable reference sites.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management actions taken to control animals declared under local or State legislation.</td>
<td>Evidence to demonstrate that action has been taken to control declared animals under local or State legislation should they occur on the site.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weed hygiene procedures.</td>
<td>Records indicating that appropriate weed and seed hygiene procedures were implemented during rehabilitation.</td>
<td></td>
</tr>
<tr>
<td>Mine Domain / Feature Name</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Port infrastructure area, roads, airstrip and camp</td>
<td>Safe</td>
<td>Structurally safe with no hazardous materials.</td>
<td>Safety assessment of landform stability (geotechnical studies). Structural, geotechnical and hydraulic adequacy of any dams is considered.</td>
<td>Certification by an appropriately qualified person in the FRR that slopes are safe and exhibit characteristics for long term stability. A risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards. For infrastructure that is not retained, landform design meets the following design requirements. Slope angles not to exceed 5° – 6°. For any dams, landform design meets the following design requirements. Walls left in place will be graded where necessary such that slope angles do not exceed 10°.</td>
</tr>
<tr>
<td>Site is safe for humans and animals now and in the foreseeable future.</td>
<td>Appropriate decommissioning of infrastructure.</td>
<td>Certification by an appropriately qualified person in the FRR that the infrastructure has been decommissioned and rehabilitated. Infrastructure has been removed unless stakeholders have entered into formal written agreements for their retention. Access to the area is conducive of the intended purpose of the post-mining land use.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-polluting</td>
<td>Runoff from infrastructure areas contained on site until water quality</td>
<td>Downstream surface water quality.</td>
<td>Certification by an appropriately qualified person that surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform. Receiving water affected by surface water runoff has contaminant limits in accordance with the environmental authority.</td>
<td></td>
</tr>
<tr>
<td>Mine Domain / Feature Name</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suitable for release.</td>
<td></td>
<td>Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundwater quality.</td>
<td></td>
<td>Certification by an appropriately qualified person that groundwater quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the 5 years previous to mine closure are compared to monitoring results for the rehabilitated landform.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final landform water storages, if any, are contained on-site, with no overflows into external surface water systems until water quality suitable for release.</td>
<td></td>
<td>Certification by an appropriately qualified person that surface water runoff has contaminant limits in accordance with the environmental authority.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hazardous or contaminated material or areas identified and managed.</td>
<td></td>
<td>Certification by an appropriately qualified person that the FRR includes predictions about future changes and that the specified cover thickness is in place.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exposure to and availability of heavy metals and other toxic materials.</td>
<td></td>
<td>Evidence in the FRR that monitoring results for dust and particulate matter indicate compliance with the limits in the environmental authority.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wastes that have the potential to cause contamination through seepage will be disposed of in cells within the landfill that will contain any contaminated seepage.</td>
<td></td>
<td>Any metals or materials that may contaminate the site (e.g. batteries, waste oils etc.) will be removed from site and disposed of at an appropriately licensed waste disposal facility.</td>
</tr>
<tr>
<td>Mine Domain / Feature Name</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Removal of potential sources of contamination.</td>
<td>Results of site contaminated land investigation report.</td>
<td>Contaminated areas may undergo on-site remediation, removal to an appropriately licensed waste disposal facility or encapsulation on-site to prevent the release of contaminants. Any contaminated land is remediated. Evidence in the FRR that measures required in site contaminated land investigation report have been implemented. Certification of remediation.</td>
</tr>
<tr>
<td></td>
<td>Stable landform</td>
<td>Landform design achieves erosion rates that do not compromise post-mine land use.</td>
<td>Slope angle and length.</td>
<td>Evidence in the FRR that the rehabilitated slopes have been designed to the following specifications. Slope angles not to exceed 5° – 6°. Erosion is managed in accordance with an Erosion and Sediment Control Plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineered structures to control water flow.</td>
<td>Evidence in the FRR that required water control measures are in place and functioning. Drainage control through ripping, profiling or the provision of erosion control structures will be undertaken.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rates of soil loss.</td>
<td>Certification by an appropriately qualified person that land disturbed by mining activities does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site. The comparable reference site must have similar chemical and physical characteristics including slope as the rehabilitated landform. Scarified surface to be seeded with an appropriate seed mix and weed species to be controlled.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimensions and frequency of occurrence of erosion of rills and gullies.</td>
<td>Evidence in the FRR that the dimensions and frequency of occurrence of erosion rills and gullies are no greater than that in comparable reference site(s).</td>
<td></td>
</tr>
<tr>
<td>Mine Domain / Feature Name</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetation cover</td>
<td>Vegetation type and density.</td>
<td>Evidence that the vegetation type and density are of species suited to the site characteristics including soil type, topography and climate and that soil erosion meets the goals set in the RMP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sufficient for a self-sustaining community and to minimise erosion.</td>
<td>Foliage cover.</td>
<td>Vegetation types and densities are comparable with the relevant reference site.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Minimum of 70% groundcover is present (or 50% if rocks, logs or other features are present). No bare surfaces &gt;20 m² in area or &gt; 10 m in length down slope.</td>
<td></td>
</tr>
</tbody>
</table>
| Self-sustaining           | Soil properties support the desired land-use. | Chemical properties, e.g. pH, salinity, nutrient content, sodium content of topsoil to support the proposed vegetation and land use. | Certification in the FRR that the topsoil chemical properties do not limit the suitability of the land for the intended land use and are consistent with the following:  
  - soil salinity content is <0.6 dS/m;  
  - soil pH is between 5.5 and 8.5;  
  - soil exchange sodium percentage (ESP) is <15%;  
  - nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts; and  
  - adequate macro and micro-nutrients are present according to pre-disturbance levels. |
<p>|                           |                     | Physical properties of topsoil to support the proposed vegetation and land use. | Certification in the FRR that the soil physical properties, e.g. rockiness, depth of soil, wetness and plant available water capacity are adequate for plant growth. |
|                           |                     | Topsoil thickness.       | Certification in the FRR that topsoil has been re-spread according to the depths required in the Soils Management Plan. |</p>
<table>
<thead>
<tr>
<th>Mine Domain / Feature Name</th>
<th>Rehabilitation Goal</th>
<th>Rehabilitation Objectives</th>
<th>Indicators</th>
<th>Completion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Site soil characteristics.</td>
<td>Certification in the FRR that the site's soil characteristics have acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the Australian Soil and Land Survey Field Handbook (National Committee on Soil and Terrain 2009).</td>
<td></td>
</tr>
<tr>
<td>Establish self-sustaining natural vegetation or habitat.</td>
<td>Presence of key plant species.</td>
<td>Certification by an appropriately qualified person that key plant species identified in the comparable reference site occur on the rehabilitation site. The presence of key plant species may also be guided by future vegetation trials for rehabilitation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Density of key plant species.</td>
<td>Certification by an appropriately qualified person that the density of key plant species in comparable reference sites is similar to the rehabilitation site. The density of key plant species may also be guided by future vegetation trials for rehabilitation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Structure of vegetation habitat.</td>
<td>Certification by an appropriately qualified person that the structure of vegetation, i.e. groundcover, shrub and canopy structure is trending towards being similar to comparable reference sites.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-sustaining natural vegetation or habitat.</td>
<td>Native fauna species.</td>
<td>Certification by an appropriately qualified person that native fauna species identified in pre-mining baseline studies and the five years of reference site monitoring prior to the completion of rehabilitation are present or indicators of these species or habitat elements are developing within the rehabilitated areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plant regeneration.</td>
<td>Certification by an appropriately qualified person that plants in rehabilitated areas show evidence of flowering, seed setting and seed germination.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abundance of declared plants (weeds) identified through surveys.</td>
<td>Certification by an appropriately qualified person that the abundance of declared plants (weeds) identified in rehabilitated areas in no greater than comparable reference sites.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mine Domain / Feature Name</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Actions taken to eradicate plants declared under local or State legislation.</td>
<td>Evidence to demonstrate that action has been taken to eradicate declared plants (weeds) under local or State legislation should they occur on the site.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abundance of declared animals identified through surveys.</td>
<td>Certification by an appropriately qualified person that the abundance of declared animals identified in rehabilitated areas in no greater than comparable reference sites.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management actions taken to control declared animals under local or State legislation.</td>
<td>Evidence to demonstrate that action has been taken to control declared animals under local or State legislation should they occur on the site.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weed hygiene procedures.</td>
<td>Records indicating that appropriate weed and seed hygiene procedures were implemented during rehabilitation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Infrastructure is dismantled / decommissioned and removed unless approved</td>
<td>No infrastructure remains on site unless requested by the landholder for beneficial use.</td>
<td>Mining support infrastructure will be decommissioned, dismantled and removed upon completion of the mining operations. Any concrete bases and footings will be removed and the area ripped, reshaped and topsoil applied before revegetation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Following decommissioning, infrastructure areas will require deep ripping, profiling, application of topsoil and seeding.</td>
<td></td>
</tr>
<tr>
<td>Mine Domain / Feature Name</td>
<td>Rehabilitation Goal</td>
<td>Rehabilitation Objectives</td>
<td>Indicators</td>
<td>Completion Criteria</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>for use by another party.</td>
<td></td>
<td>Water pipelines may be retained, by agreement, for future use by landholders, local government or another project; or where removal of buried infrastructure would create more environmental damage than leaving in-situ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If they are not retained, infrastructure will be removed from site and disturbance corridors will undergo deep ripping, profiling, application of topsoil and seeding.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water in any water storages will meet water quality objectives for the intended water use.</td>
</tr>
</tbody>
</table>
7.6.4 Mine Closure Planning

The proponent will develop a Mine Closure Plan (MCP) prior to final bauxite extraction to achieve ecologically sustainable development as required by the EP Act, the fundamental objective of which is to attain operationally and economically feasible closure while taking into account community priorities, environmental requirements and sustainability of the rehabilitation and the final land use. Rehabilitation and decommissioning strategies will be implemented to meet the criteria agreed upon as part of the RMP.

The proponent will prepare a MCP which will list the specific operational activities required to be undertaken in order to complete rehabilitation and decommissioning of the Project. The criteria for achieving self-sustaining final landforms will be developed as part of the MCP calling upon site specific rehabilitation trials, monitoring and research programs.

The MCP will:

- identify stakeholders and interested parties, enabling them to have their interests considered, which may include employees, management, shareholders, local businesses and services providers, landholders, neighbours and nearby residents, local government, NGOs and community groups, conservation organisations, regulators and other government agencies.
- ensure the process of closure occurs in an orderly, cost-effective and timely manner.
- ensure that cost of closure is allowed for by the company.
- ensure there is clear accountability and adequate resources to implement the closure plan.
- establish a set of indicators which will demonstrate the successful completion of the closure process.
- achieve agreed completion criteria to the satisfaction of the Responsible Authority.

7.6.4.1 Closure Planning

Mine closure planning will adopt a risk based approach and will incorporate technical, economic social and long term considerations. The MCP will include a number of subsidiary plans which typically include a final rehabilitation plan and a decommissioning plan.

The RMP is considered as the first stage of planning for land use post mining activities, requiring consideration of longer term objectives during operation. The RMP is intended to be a “living” document that will be reviewed and updated during mining operations and will be part of the MCP.

Adequate financial provision will be made for the cost of mine closure.

7.6.4.2 Implementation

The accountability for resourcing and implementing the MCP will be clearly identified. Adequate resources will be provided to assure conformance with the MCP.

7.6.4.3 Relinquishment

The proponent will provide financial assurance for the decommissioning and rehabilitation costs associated with disturbances during the operational period. Relinquishment of this financial assurance will only occur once the regulator is satisfied that decommissioning and rehabilitation is successful.

7.6.5 Monitoring Program

Monitoring and auditing will be undertaken to assess the effectiveness of the management strategies identified and compliance with the criteria outlined in Section 7.6.2 and Section 7.6.3 as applicable to the management of rehabilitation and decommissioning activities.

The auditing will include aspects of:
roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

Progressive rehabilitation will commence as soon as soil is placed on the mine. Monitoring and assessment of progressive rehabilitation processes will be undertaken throughout the Project life. Assessment involves measuring indicators of rehabilitation success against established criteria.

In the initial years of revegetation, monitoring will occur a number of times per year, but once vegetation is established monitoring may occur as required until completion criteria indicate successful revegetation. From this point monitoring may occur as required until the surrender of the mining lease.

Monitoring of rehabilitation success, including survival of regrowth and return of fauna species, will be conducted at locations representative of the range of conditions impacting the rehabilitating areas. Reviews will be conducted of monitoring data to assess trends and monitoring program effectiveness.

Monitoring of soil erosion in rehabilitated areas will be included as part of the rehabilitation program.

If monitoring and assessment results indicate that the rehabilitation objectives may not be achieved, then the rehabilitation plan will be modified. Non-compliance with the established criteria and indicators will trigger a review of processes such as planning and design, and/or repair and maintenance of failed rehabilitation work.

As rehabilitation technologies, strategies and monitoring techniques change and/or are improved over time, the proponent will review and update the Project’s rehabilitation and monitoring procedures to include the most effective processes and strategies.

7.7 Conclusion

Geological, soils and landform data for the Project were gathered for the Project area to inform rehabilitation objectives and strategies for the various mine domains. These were based on the guidelines ‘Rehabilitation requirements for mining projects’ (EHP, 2014b) and the ‘Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland’ (DME, 1995).

An RMP will be developed to ensure that land disturbed by mining operations is effectively rehabilitated such that:
- the agreed post-mining land use is achieved
- the site is stable, non-polluting and safe to humans and animals
- stable environmental conditions are established which are able to be sustained
- all relevant statutory requirements are complied with.

Progressive rehabilitation will occur throughout the life of the Project. Decommissioning and final rehabilitation of areas used for mining will be outlined in a Mine Closure Plan (MCP) and specific rehabilitation completion criteria, indicators and monitoring methods, will be provided in the RMP. Rehabilitation of each mine domain will occur on a staged basis over a number of years.

On the completion of mining, the following treatments will be undertaken:
- Infrastructure will be removed and dismantled where required unless the landholder (Traditional Owners) requests otherwise.
- Vegetation cover will be restored and land will be returned to its agreed post-mining land use.
- Erosion and sediment control structures will be constructed to maintain topsoil cover, landform stability and prevent sedimentation of waterways.
- Contaminated land will be remediated and assessed for any potential future contamination issues.
- Infrastructure such as roads, water dams and pipelines will be retained for landholders or other projects unless specifically requested to be removed.

Rehabilitated areas will be monitored in order to identify any areas in need of maintenance at an early stage and any areas not responding to rehabilitation methods will be addressed in accordance with the RMP.

Following mine closure in accordance with the MCP and RMP, all rehabilitation goals and objectives are expected to be achieved.