

Appendix K

Mine Closure and Rehabilitation Strategy

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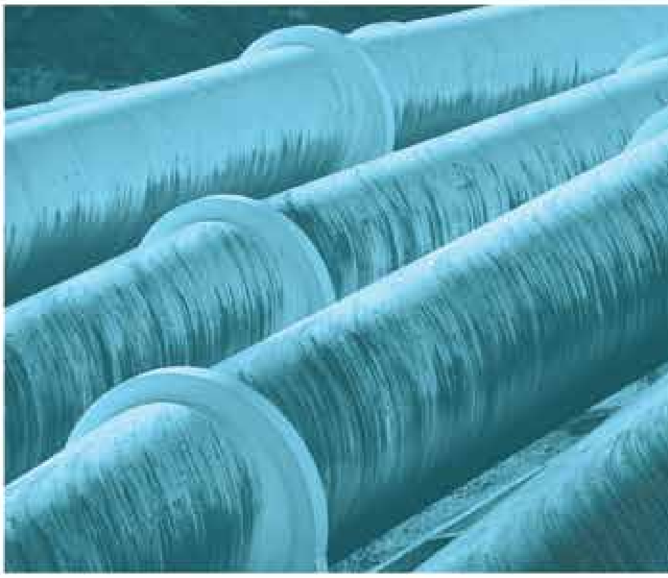
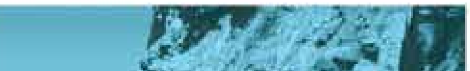
Cowal Gold

Mine Closure and Rehabilitation Strategy

Prepared for Evolution Mining
September 2020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Cowal Gold

Mine Closure and Rehabilitation Strategy

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Client

Evolution Mining

Date

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10 September 2020	10 September 2020

Executive Summary

This Mine Closure and Rehabilitation Strategy (the strategy) forms part of the Environmental Impact Statement to support a State Significant development application for an underground mine (SSD-10367) and a modification application for associated surface infrastructure for the existing Cowal Gold Mine (Modification 16).

The proposed underground mine and associated surface infrastructure does not change the existing approved mine closure planning, rehabilitation planning, post mine land uses and rehabilitation techniques currently used successfully at the mine.

Anticipated differences in decommissioning activities to that currently approved are provided in Table ES1.

Table ES1 Comparison of decommissioning activities

Rehabilitation Domain	Key assets	Approved decommissioning activities	Approved PMLU	Additional assets for underground mine	Additional decommissioning activities	PMLU
Domain 1A – Final Void	• open pit mine fleet • pit dewatering bores, pumps and pipelines	• Removal of all plant and equipment • Construction of pit safety bunding, fencing and signage • Stabilisation and revegetation of upper benches	Water filled void	• Underground mining fleet • portals/ adits • dewatering pumps and pipelines • ventilation fans	Removal of underground fleet, pumps and pipework, ventilation fans and sealing of portals	No change
Domain 2B – Permanent water management infrastructure	• up catchment diversion system • internal catchment drainage system	Nil	Permanent diversion drains	Nil	Nil	No change

Table ES1 Comparison of decommissioning activities

Rehabilitation Domain	Key assets	Approved decommissioning activities	Approved PMLU	Additional assets for underground mine	Additional decommissioning activities	PMLU
Domain 3C – Infrastructure area	• processing plant including crushing circuit, grinding circuit, milling circuit, leaching circuit, flotation circuit, tailings circuit, gold room and other facilities including RO plant, high voltage compound and laydown yard • mine fleet workshop • reagent and fuel storage area • administration buildings • contractor yards and buildings • exploration facilities buildings • TSF and IWL depot buildings and associated plant • Explosive magazine • Orica facility • Contained water storages D1, D2, D3, D4, D5, D6, D8B, D9 and southern stilling and outfall basin, associated pumps and pipelines • Service corridor to TSF's and IWL • Internal roads, • Electrical substation and transmission lines	• Internal roads and TSF/IWL removed and rehabilitated unless retained for landholder use • Water management infrastructure including contained water storages and associated may be retained and transferred to local landholder following lease relinquishment, otherwise removed • Electricity transmission lines and substation is likely to remain. • All other plant, equipment and buildings to be removed • Any contaminated materials removed to IWL • Landforms reshaped to stable grades • Subsoil ameliorated, topsoil respread and revegetation	Grazing - grassland/ scattered Eucalypt woodland	• Paste plant and conveyors • Tailings desliming plant and associated pipelines • Underground ore hopper and conveyor	• Removal of paste plant, tailings desliming plant and underground ore hopper	No change

Table ES1 Comparison of decommissioning activities

Rehabilitation Domain	Key assets	Approved decommissioning activities	Approved PMLU	Additional assets for underground mine	Additional decommissioning activities	PMLU
Domain 4D – Integrated Waste Landform	• Northern and Southern TSF's and IWL decant towers and associated plant and equipment • TSF/IWL fleet	• TSF/IWL decent towers plant and equipment removed. • Decants will be capped and underdrains grouted • Discharge pipes and monitoring systems removed • IWL will be capped, revegetated and fenced to exclude stock	Biodiversity - grassland/ scattered Eucalypt woodland	Nil	Nil	No change
Domain 5D – Waste Rock Emplacements	Waste rock emplacement mine fleet	• Shaping and amelioration of subsoil • Spreading of rock/topsoil matrix • Revegetation • Fencing to exclude stock	Biodiversity - Eucalypt woodland	• Underground mining fleet workshop, laydown and refuelling area • Underground offices and associated facilities	• Removal of underground mining fleet workshop, underground offices and associated equipment • Removal of any contaminated materials to the IWL	No change
Domain 6D – New Lake Foreshore	Nil	• Breaching and stabilisation of the temporary isolation bund.	Biodiversity – riverine wetland/ freshwater communities	Nil	Nil	No change

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Overview

Evolution is seeking SSD consent under Division 4.1 of Part 4 of the EP&A Act to develop and operate an underground gold ore mining domain at CGO using stope mining methods, to extract ore from the GRE46 Mineralisation and deliver the ore to the surface.

It is also seeking to develop supporting underground mine infrastructure, including an underground access decline, underground ore conveyor system, access tunnels, mine ventilation system and dewatering infrastructure. The application also seeks to backfill the extracted stopes using a paste made from tailings and waste rock.

Evolution is also seeking to modifying the existing Development Consent DA 14/98 (DA 14/98) for changes to existing surface infrastructure which are required to support the underground mining domain.

The project application area is shown in Figure 1.1.

The underground mine will produce approximately 1.8 megatonnes per annum (Mtpa) of ore over a life of 20 years. The mine development project area and indicative mine layout; including the underground mine extent is shown in Figure 1.1.

The underground mine has been designed to maximise the extraction of the ore resource in the project area within identified environmental constraints as efficiently and economically as possible, while minimising adverse impacts to the environment and community, and delivering a range of socio-economic benefits to the region.

The major project components of the SSD application are summarised in Table 1.1 and MOD 16 are summarised in Table 1.2.

Detailed descriptions of mine development components, including their construction and operation, are provided in Sections 1.3 to 1.10.

Table 1.1 SSD CGO Underground Development Project overview

Aspect	Description
General description	Construction and operation of an underground mine at the Cowal Gold Mine to extract the GRE46 mineralisation, which includes: • a box-cut entry to the underground workings; • a decline from the box-cut to provide access for personnel and maintenance; • six access points to the decline for access, ore haulage, ventilation circuit, underground services and emergency egress; • a network of underground tunnels to provide access to the ore, transportation to the surface and ventilation; • use of sub-level open stoping (SLOS) to extract the ore; • production of up to 27 Mt of ore at a rate of 1.8 Mtpa; • production of approximately 5.74 Mt of waste rock; • delivery of extracted ore and waste rock to the surface by truck; • development of a paste fill plant, and the delivery of paste fill via a borehole and the backfilling underground stopes with the paste; and • development of ancillary underground infrastructure to support the underground operation, including dewatering infrastructure, ventilation system, electrical reticulation.

Table 1.1 SSD CGO Underground Development Project overview

Aspect	Description
Project duration	• construction of the decline and development drives over a period of up to two years; and • ore production of the currently known economic resource until the end of the 2039.
Mining method	• Top down SLOS to a depth of -850 m AHD with approximately 1106 stopes developed over the life of the mine.
Stope backfill	• Stopes to be fully backfilled with paste material made from dewatered tailings and cement. • Paste material to be produced in a purpose-built paste plant on the surface. • Paste material will be delivered to the underground workings via a borehole near the paste fill plant.
Ore transport	Ore will be transported to the surface by truck.

Table 1.2 Proposed modification components

Development Component	Approved CGO	Proposed Modification
Life of Mine	CGO is approved to operate to the end of 2032.	Extension to the end of 2040.
Gold Production	Production of approximately 6.1 million ounces (Moz) of gold over the life of the CGO.	Production of a further 1.8 Moz of gold (approximate).
On-site ore Transportation	Ore is transported from the open-cut by truck to a temporary stockpile prior to rehandling to the primary crusher.	No change. Underground ore trucked from the underground run-of-mine stockpile to the temporary ore stockpile.
Ore processing Facility	Ore processing is undertaken at the ore processing facility at a rate up to 9.8 Mtpa. A secondary ore crushing circuit within existing process plant is approved to be constructed.	No change to processing rate. The existing processing facility would be modified to include: • a tailings desliming and tailings thickener circuit; • an ore receival bin and mill feed conveyor; and • an upgraded elution circuit.
Cyanide Consumption	Use of a primary ore conventional carbon-in-leach circuit, which includes recovery of gold from flotation tailings.	No change. Increase in annual cyanide consumption associated with the higher grade ore.
Site Water Management Infrastructure	The existing CGO water management infrastructure is comprised of the following key components: • Up-catchment Diversion System (UCDS) and the ICDS (including the contained water storages); • lake isolation system (comprising the temporary isolation bund, lake protection bund and perimeter waste rock emplacement); • integrated erosion, sediment and salinity control system; and • open pit sump and dewatering borefield.	No change to UCDS and ICDS. Pipeline from the tailings deslimer to the paste fill plant and a return water pipeline from the paste fill plant to the processing facility. Augmentation of dam D5A. This augmentation would not change the overall catchment area of the dam. Augmentation of other on-site water storages from time to time depending on water supply and on-site requirements.

Table 1.2 Proposed modification components

Development Component	Approved CGO	Proposed Modification
Tailings storage	Tailings are deposited in two (Northern and Southern) tailings storage facilities (TSFs). NTSF and STSF are allowed to be constructed to approximately 240 mAHD and 248 mAHD, respectively. These TSFs are also approved to be combined with the northern waste rock emplacement to form the integrated waste landform (IWL), which would provide a life of mine tailings strategy. The IWL is approved to be developed to a final rehabilitated height of 245 mAHD.	A height increase from 245 mAHD to 246 mAHD to the final rehabilitated height of the IWL.
Waste rock	Approximately 299 Mt of waste rock would be produced over the life of the approved CGO and emplaced in the Northern, Southern and Perimeter waste rock emplacements.	Approximately 5.74 Mt of additional underground mine waste rock would be managed.
Ancillary surface infrastructure	A range of ancillary surface infrastructure is operated to support open-cut mining operations, including that related to administration, water management, maintenance, pipelines, magazines and other functions.	Development of additional surface infrastructure and augmentation of existing infrastructure, all within the existing approved disturbance areas, including (but not limited to): administration facilities, offices and car parking, warehouses and stores, vehicle washdown facilities, heavy vehicle and light vehicle maintenance workshop and maintenance bays, control room, fuel farm, core yards and drill sheds, hard stands and go lines, ablutions, bathhouse and changerooms, communications infrastructure, access tracks, water storages and other minor ancillary infrastructure.

1.2 Mine geology

CGO will extract from the Lake Cowal Volcanics, which comprise massive and stratified nonwelded pyroclastic debris, overlying a partly brecciated lava sequence, overlying volcanic conglomerate interbedded with siltstone and mudstone. The stratigraphic units at the site consistently strike at 215° and dip 50° to the north-west (Miles and Brooker, 1998).

Within the Lake Cowal Volcanic Complex are diorite and gabbro intrusions, one of which is intersected by the CGO open pit. Within the ore body there are several north-south oriented, near vertically dipping faults and fractured dykes.

There are four key hydrogeological units that have been identified at the CGO site (Coffey 2020):

- The Transported unit, which represents the near surface layers and comprises alluvium (thick clay sequences and more permeable zones of gravel within sandy clay, of the Quaternary-aged Cowra Formation.
- The Saprolite unit, which underlies the Transported unit and is of relatively low hydraulic conductivity, and comprises extremely weathered rock and weathered clay.

- The Saprock unit, which underlies the Saprolite unit and occurs in the weathered fractured surface of the Lake Cowal Volcanics and comprises highly to moderately weathered rock with some zones of clay.
- The Primary Rock unit, which consists of the fresh rock underlying the Saprock unit. This unit is generally considered to be less fractured and less permeable than the Saprock.

1.3 Mining

1.3.1 Mining method

Stope mining methods will be used to extract the ore. Stope mining involves the development of underground extraction rooms (stopes), which allows a great degree of flexibility in how the mine is developed. Stope mining is a selective mining method which ensures the targeted extraction of ore, while leaving significant barrier pillars of rock behind which ensures that the surrounding rock remains stable and the roof does not cave.

This mining method is a relatively low intensity method, as it is directed towards targeting the orebody and leaves most of the surrounding rock in situ.

The GRE46 mineralisation is planned to be extracted by Sub Level Open Stoping (SLOS) using conventional drill and blast techniques and backfill. SLOS is a large scale, but selective mining method which is easily adaptable to ore bodies typically ranging between 6–30 metres wide(mW) and dipping between 70–90 degrees (as is the case of the GRE46 deposit), and is compatible with backfill methods to assist the long term stability of the surrounding strata.

The advantages of using SLOS include, but are not limited to:

- the ability to extract higher amounts of ore, which maximises economic recovery;
- the ability for stopes to be backfilled to ensure long-term stability and allow adjacent stopes to be safely developed;
- easy adaptation by using other geotechnical controls (ie the use of pillars);
- it allows extraction to be highly mechanised; and
- it is a proven, highly safe method of extraction.

SLOS is the largest scale, most cost effective and highest recovery extraction method available prior to adapting caving techniques, inducing surface subsidence. The bulk nature of operations reduces mining costs and allows for the economic extraction of the highest proportion of the resource, without inducing caving.

1.3.2 Mining sequence

Extraction will occur in a top-down end-on retreat sequence for the entirety of the project. There will be around 1,106 stopes developed across the life of the project. The following general extraction sequence will be consistent for the whole project:

- firstly, initial development of the stope will be completed, which involves developing an access roadway to the stope;
- an initial slot void is established and trimmed/stripped;
- trim/stripping blast (to establish full free firing face);

- regular production blasting would be undertaken until the entire stope is developed;
- the stope will then be bogged (ie waste rock material removed from the stope with an underground loader);
- the stope will be prepared to be backfilled, which involves constructing a wall to contain the paste fill material; and
- the stope will be backfilled with the pastefill material and left to cure.

1.3.3 Stope backfill

Following the extraction of each stope, the void will be prepared to be backfilled. It will then be backfilled with a cemented paste prior to the next stope being extracted. The cement paste would be prepared in a purpose-built pastefill plant.

Backfilling the stopes is undertaken for two key reasons. Firstly, it makes sure that the rock above the stopes remains stable and is not subject to subsidence impacts. Secondly it allows the adjacent stopes to be safely extracted while limiting the risk of caving in the workings.

Each stope will be backfilled with a cemented paste made from cement, waste rock from the open-cut and underground mining operations and tailings from ore processing. The pastefill will be delivered to the underground stopes using the ore conveyor. Each stope would be expected to take around 2 weeks to backfill.

1.4 Mine entry and access

The proposed underground mine will be accessed via a box-cut and decline from the surface. The box-cut, will be located adjacent to the southern boundary of the open-cut pit (refer Figure 1.1).

There are three primary access points and three secondary access points proposed for the underground mine, and each has its own associated underground tunnel system.

The primary access points are used where regular worker and/or vehicle access is required, and include the Main Portal, the Fresh Air Intake/Haulage Decline Portal and the Ore haulage box-cut.

The Main Portal is the main service entry for the underground mine. It would be located at 1,070 m reduced level (RL) and would be accessed from the eastern wall of the open-cut pit.

The Fresh Air Intake/Haulage Decline Portal is located at 1,070 m RL and would allow a fresh air connection for lower working areas, an emergency egress route from underground workings and an Alternate haulage route. This portal would be located adjacent to the Main Portal.

The Box-Cut will be located at 1,215 m RL. It would be accessed from the surface at the south side of the open-cut pit, and will provide access for the ore haulage and provide access for maintenance light vehicles.

The secondary access points are used for mine ventilation, and include the Fresh Air Intake Adit 1, the Fresh Air Intake Adit 2 and the Exhaust Adit.

The Fresh Air Intake Adit 1 will be located at 930 m RL and accessed from inside the open-cut pit off the Fresh Air Intake/Haulage Decline. It would provide a fresh air ventilation for the lower stope working areas.

The Fresh Air Intake Adit 2 will be located at 900 m RL and also would be accessed from inside the open-cut pit, off the Fresh Air Intake/Haulage Decline. It will provide a fresh air ventilation for the material transfer points and used for atmospheric dust control.

The Exhaust Adit will be located at 965 m RL and will be accessed from inside the underground mine. The Exhaust Adit will be used for exhaust air connection for material transfer points and for atmospheric (dust and air quality) control.

1.5 Blasting

Small blasts will be required to develop the underground stopes. This will require a small increase in the consumption of blasting consumables, including ammonium nitrate and ammonium nitrate emulsion.

The decline to the underground mine will be developed via the open cut pit blasting technique in accordance with conditions approved under DA 14/98.

Blasting activities will be designed and carried out to meet EPA blasting criteria and manage potential impacts upon adjacent land uses.

Blasting material, including explosives and ammonium nitrate emulsion will be stored approximately 1 km to the north north-west of the open cut, as shown in Figure 1.1, in a facility which is designed to meet the separation and design requirements in AS2187.2 2006 Explosives – Storage, Transport and Use. Underground workings dewatering

Hydrogeological investigations indicate that the water table in the area subject to mining is approximately 15 m to 35 m below existing ground level. As material below the water table is removed, groundwater will seep into the workings from the intersected saturated strata. Collection of this water to facilitate dry and safe mining conditions will be carried out via sumps and pipelines to the surface.

Since the commencement of the CGO, the underlying aquifers surrounding and intercepting the open-cut pit have been depressurised as a result of inflows to the open pit and active pit dewatering. Despite Lake Cowal becoming inundated, groundwater inflows to the open pit are assessed to have remained below or consistent with historical records and are relatively stable. This is likely because the lacustrine sediments that form the lake bed have a very low vertical permeability and act as a low permeability layer between the lake water and underlying aquifers (Coffey, 1997).

The workings will be dewatered using a series of dewatering bores and pumping infrastructure installed in the mine. Dewatering will be required as the mine is developed to ensure the safe operations of the underground workings. The water will be used to wet the ore and for dust suppression in the underground workings. Some of the water will be pumped to the surface for use in the processing facility.

Predicted mine dewatering rates for the open-cut and underground combined will peak in around Year 11 at approximately 2.8 megalitres per day (ML/day). The open-cut pit will need to be continually dewatered for the life of the underground project, given that the pit will be used to access the underground mine. However, the dewatering rate will decline as the operations in the open-cut cease after 2026 and remain steady thereafter as inflows and rainfall are managed in the pit.

1.6 Life of mine

The project will be operated for 20 years. It is anticipated that ore will be produced until the end of 2039. This will extend the life of the operations at CGO from 31 December 2032, as approved under DA 14/98, to 31 December 2039.

1.7 Mining extent

The development of the underground mine will be staged, as the main declines are progressively extended and the mine progresses deeper. The orebody is generally a narrow cylinder shape, and the overall footprint of the underground mine will therefore not be very wide.

The stoping will cover an underground area approximately 1.6 km long running north from the eastern edge of the open pit and extending to approximately 800 m past the northern edge of the lake protection bund. The zone of stoping will be approximately 100 m in width. The network of access tunnels will extend approximately 200 m further west of the western edges of the stopes.

The lateral extent of the underground mine when viewed from the surface is estimated to be approximately 135 hectares (ha) and it will have a final depth of approximately -850 m RL.

1.8 Waste rock management

Approximately 5.74 Mt of waste rock will be produced at the underground mine over its life.

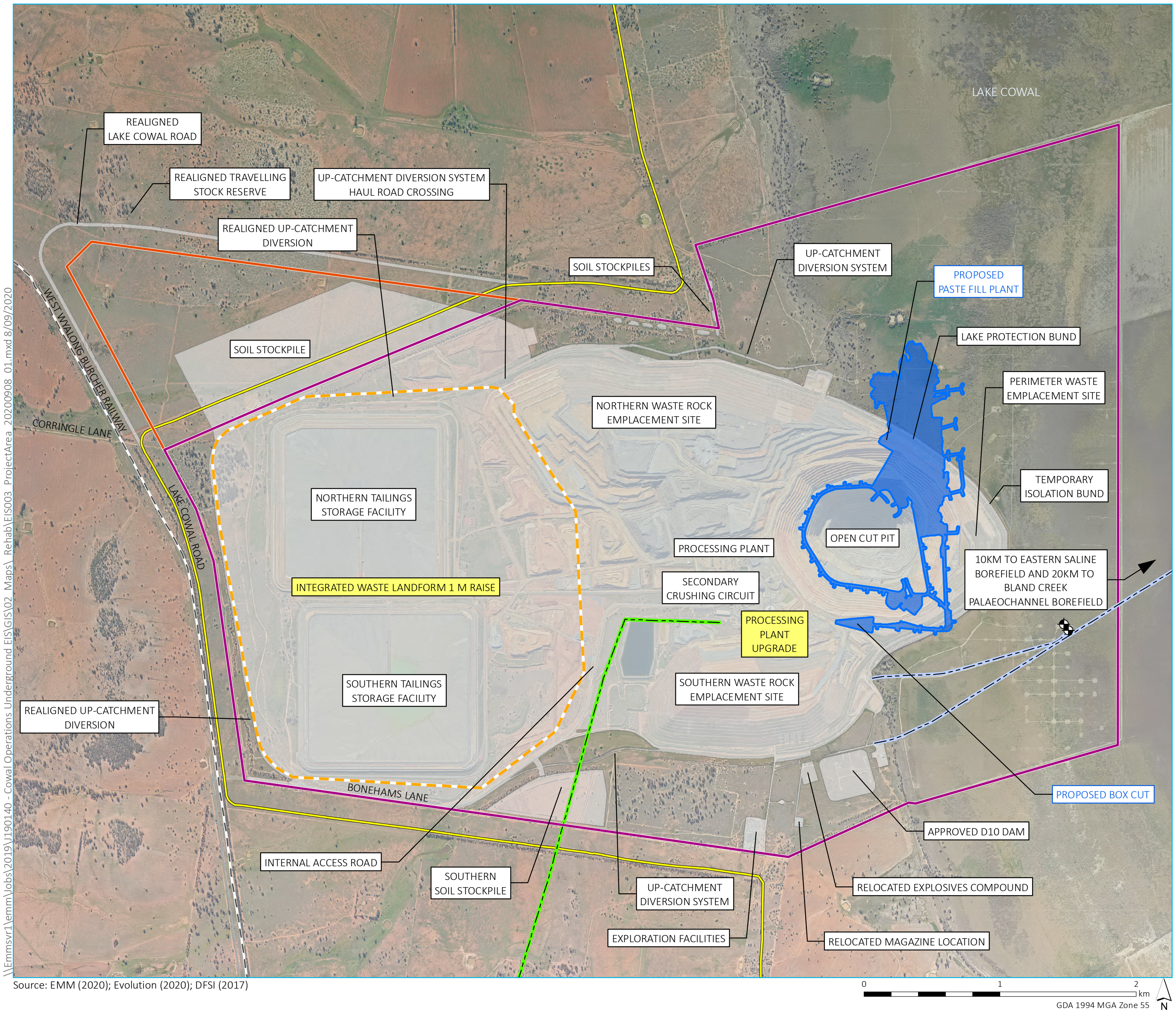
During mining operations, overburden and material that has insufficient gold mineralisation to justify processing, will be removed and either hauled to the waste rock emplacement area for disposal or used to make paste fill to backfill the underground stopes.

The majority of the waste rock is contained in the upper strata, so material movement requirements will be steady while the haulage decline is developed to the underground workings. The waste rock rate should decrease once extraction of ore is being undertaken as the mining will target the orebody.

The surface handling and emplacement of waste rock is being considered under Modification 16.

1.9 Project tenement

The underground mining domain will be located adjacent to and north of the existing open-cut pit. The project area is wholly located in ML 1535.



KEY
- Proposed underground development
- Mining lease (ML1535)
- Mining lease (ML1791)
- DA14/98 approved surface disturbance
- Indicative integrated waste landform perimeter
- Electricity transmission line
- Water supply pipeline
- Saline groundwater supply bore
- Rail line
- Main road
- xxx Underground development elements
- xxx Mod 16 surface elements
- xxx Approved surface elements

Source: EMM (2020); Evolution (2020); DFSI (2017)

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Project area

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Figure 1.1

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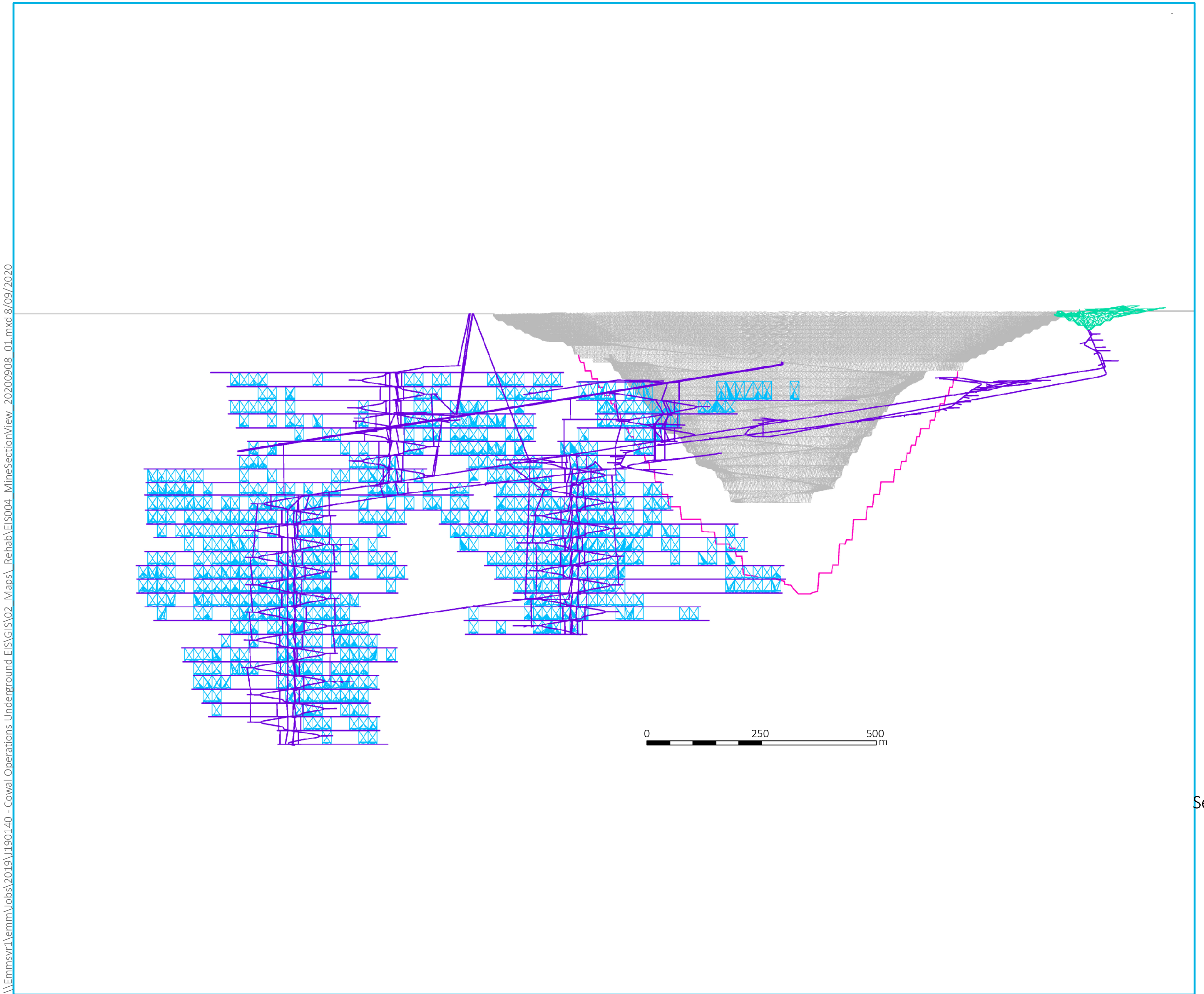

KEY

Existing E42 open-cut pit

Currently approved final open-cut pit shell

Proposed underground access infrastructure

Proposed stopes

Proposed box-cut

Section view of the underground mine

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Figure 1.2

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Source: EMM (2020); Evolution (2020)

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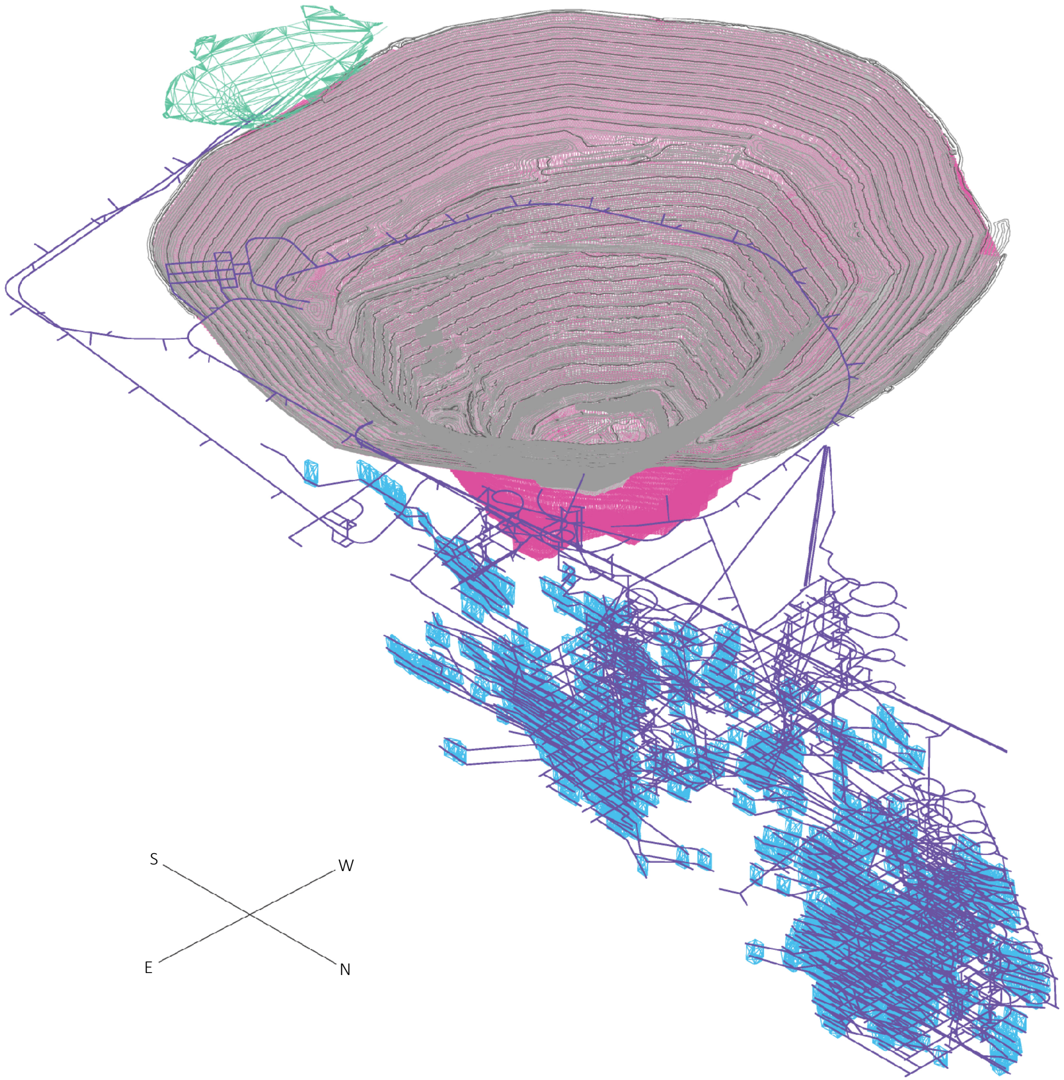

KEY

Existing E42 open-cut pit

Currently approved final open-cut pit shell

Proposed underground access infrastructure

Proposed stopes

Proposed box-cut

Layout of the underground mine

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Figure 1.3

creating opportunities

Source: EMM (2020); Evolution (2020)

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1.10 Employment

The peak construction work force is anticipated to be up to approximately 225 full time equivalents (FTE). The operational work force is estimated to be up to approximately 160 FTE.

The initial operation of the underground mine will need to be operated by a specialised workforce with skills that are at present unavailable at the mine or in the regional area. The workforce will comprise a contract FIFO/DIDO workforce initially for a duration of up to approximately 3−5 years. The workforce will be housed in a purpose-built mine village in West Wyalong, which will be developed under a separate DA with Bland Shire Council.

During this initial period, Evolution will look to upskill a local workforce to operate the underground mine for the duration of the project. This workforce will be sourced where possible from the existing CGO workforce and from local areas.

Evolutions aim is to transition the operation to an owner-operator residential based work force which does not rely on FIFO/DIDO to any great extent.

1.11 Rehabilitation and mine closure

Open cut mining operations commenced at CGO in April 2005 (Evolution 2020) as such rehabilitation planning and implementation as well as closure planning are well advanced and understood. The detail of which is provided in the following approved key documents and sections 3,4 and 5 of this Mine Closure and Rehabilitation Strategy (MCRS):

- *Cowal Gold Operations Mine Operations Plan (ML 1535 & ML 1791) 1 July 2020 to 30 June 2021* (MOP); and
- *Cowal Gold Operations Rehabilitation Management Plan* August 2017 (RMP)

The proposed modification and SSD will not increase the disturbance footprint of the mine and requires no changes to current approved post mine land uses and rehabilitation methods. other than extending the time frames for rehabilitation and closure

1.12 Assessment requirements

This strategy has been prepared in accordance with requirements of the NSW Department of Planning, Industry and Environment (DPIE). These were set out in DPIE's letter of 27 August 2019 for modification 16 (MOD 16) of DA 14/98 endorsing the level of assessment proposed for the modification and the Secretary's Environmental Assessment Requirements (SEARs) for the SSD-10367, initially issued on 27 September 2019 and re-issued on 26 August 2020.

The SEARs identify matters which must be addressed in the Environmental Impact Statement (EIS) and essentially form its terms of reference. Table 1.3 lists individual requirements relevant to this strategy and where they are addressed in this report.

DA 14/98 also has existing conditions for rehabilitation and closure and these are provided in Table 1.4.

There were no specific rehabilitation and closure related criteria in DPIE's letter 27 August 2019 other than the requirements from other agencies including the Environment Protection Authority (EPA) and Resources Regulator. These are detailed in Table 1.5 and Table 1.6 respectively.

Table 1.3 SSD-10367 rehabilitation and closure related SEARs

Requirement	Section addressed
General Requirements: In particular, the EIS must include: • a full description of the development including: – a mine closure and rehabilitation strategy	This document
Key Issues The EIS must address the following specific issues: • Land – including: – an assessment of the likely impact of the development on landforms (topography), including the long-term geotechnical stability of any new landforms on site; and	Section 3.1
– an assessment of the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements of Clause 12 of *State Environmental Policy (Mining, Petroleum Production and Extractive Industries) 2007*, paying particular attention to the agricultural land use in the region;	Section 4.2
• Rehabilitation and Final Landform – including: – a conceptual final landform design, including justification of the final landform design, long-term geotechnical stability, and nominated final land uses, having regard to relevant strategic land use planning, resource management plans or policies;	Section 4.3
– progressive rehabilitation measures that would be implemented for the development;	Section 4.4
– rehabilitation objectives, performance standards and completion criteria; and	Section 4.1 and Section 6
– decommissioning of surface infrastructure.	Section 4.4

Table 1.4 DA 14/98 rehabilitation and closure conditions

Condition		Section addressed
Schedule 2, condition 2.4 Rehabilitation (a) Rehabilitation Objectives The Applicant shall rehabilitate the site to the satisfaction of the DRE. This rehabilitation must be generally consistent with the proposed rehabilitation in the EIS (which is depicted in the Figure in Appendix 2) as amended by the approved rehabilitation strategy (see condition 3.8),and comply with the objectives in Table 1. **Table 1: Rehabilitation objectives**		
Mine site (as a whole)	• Safe, stable and non-polluting	Section 4.1.1 and 4.1.2
	• Final landforms designed to incorporate micro-relief and integrate with surrounding natural landforms	Section 4.1.1 and 4.1.2
	• Constructed landforms are to generally drain to the final void	Section 4.3.1, Section 4.3.2, and 4.4.5
	• Minimise long term groundwater seepage zones	Section 1.5

Table 1.4 DA 14/98 rehabilitation and closure conditions

Condition		Section addressed
	• Minimise visual impact of final landforms as far as is reasonable and feasible	Section 4.1.1 and 4.1.2
Final void	• Minimise to the greatest extent practicable: – the size and depth of final void – the drainage catchment of final void – risk of flood interaction for all flood events up to and including the – Probable Maximum Flood	Section 4.3.1
	• To be permanently separated from Lake Cowal by the Lake Protection Bund	Section 4.4.6
	• Highwall to be long-term stable	Section 4.3.1
Surface infrastructure	• To be decommissioned and removed, unless DRE agrees otherwise	Section 4.4.3
Agriculture	• Restore or maintain land capability generally as described in the EIS	Section 4.2.2
Rehabilitation areas and other vegetated land	• Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems	Section 4.2.1
Community	• Ensure public safety	Section 5.5.4
	• Minimise adverse socio-economic effects associated with mine closure	Section 3.8
b) Progressive Rehabilitation The Applicant shall rehabilitate the site progressively as soon as reasonably practicable following disturbance. All reasonable and feasible measures must be taken to minimise the total area exposed for dust generation at any time. Interim stabilization and rehabilitation strategies shall be employed when areas prone to dust generation cannot be permanently rehabilitated. Note: It is accepted that some parts of the site that are progressively rehabilitated may be subject to further disturbance at some later stage of the development.		Section 4.1.3
(c) Rehabilitation Management Plan The Applicant shall prepare and implement a Rehabilitation Management Plan for the development to the satisfaction of the DRE. This plan must: (i) be prepared in consultation with the Department, DPI(Water), OEH, DPI, BSC and the CEMCC; (ii) be prepared in accordance with any relevant DRE guideline; (iii) describe how rehabilitation of the site would be integrated with the biodiversity offset strategy for the development; (iv) include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, and triggering remedial action (if necessary); (v) describe the measures that would be implemented to ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including mine closure, final landform (including final voids) and final land use; (vi) include interim rehabilitation where necessary to minimise the area exposed for dust generation; (vii) include a program to monitor, independently audit and report on the effectiveness of the measures, and progress against the detailed performance and completion criteria; and (viii) build to maximum extent practicable on the other management plans required under this consent.		Refer to the approved *Rehabilitation Management Plan* September 2017. This will be updated once the underground mine is approved in consultation with the listed agencies and CEMCC and submitted to DPIE for approval.

Table 1.4 DA 14/98 rehabilitation and closure conditions

Condition	Section addressed
3.8 Rehabilitation Strategy The Applicant shall develop a strategy for the long term land use of the DA area on decommissioning of the mine site. This strategy shall include, but not be limited to: appropriate land uses within the DA area, which may include areas for conservation, agriculture or recreation, long term management of the area, environmental impacts of any uses and maintenance of necessary drainage characteristics and other features of the site. The strategy for long term land use of the DA area shall be submitted by Year 7 of mining operations or five years before mine closure, whichever is the sooner, in consultation with DRE, DPI(Water), OEH, BSC, CEMCC, and to the satisfaction of the Secretary.	Section 3.2 of the CGO Rehabilitation Management Plan and sections 4.2.1 and 4.2.2.

To inform the preparation of MOD 16 Modification Report, DPIE invited government agencies to recommend matters to be addressed. Agency requirements are detailed in Table 1.5 and 1.6 below.

Table 1.5 EPA assessment requirements MOD 16

Requirement	Section addressed
Potential impacts on land	
The goals of the project should include the following:	
• No pollution of land, except to the extent authorised by EPA (ie in accordance with an Environment Protection Licence); and	Section 3.3.2 and Chapter 4
• The potential impact of land erosion from the development is mitigated.	Section 3.3.2
The EIS should document the measures that achieve the above goals.	Chapter 16 of the EIS

Table 1.6 Resources regulator assessment requirements MOD 16

Requirement	Section addressed
Post-mining land use	
a) Identification and assessment of post-mining land use options;	Section 4.2. and Chapter 4
b) Identification and justification of the preferred post-mining land use outcome(s), including a discussion of how the final land use(s) are aligned with relevant local and regional strategic land use objectives;	Section 4.2. and Chapter 4
c) Identification of how the rehabilitation of the project will relate to the rehabilitation strategies of neighbouring mines within the region, with a particular emphasis on the coordination of rehabilitation activities along common boundary areas;	Not applicable as there are no neighbouring mines.
Rehabilitation objectives and domains	
d) Inclusion of a set of project rehabilitation objectives and completion criteria that clearly define the outcomes required to achieve the post-mining land use for each domain. Completion criteria should be specific, measurable, achievable, realistic and time-bound. If necessary, objective criteria may be presented as ranges;	Section 4.1 and Chapter 6
Rehabilitation methodology	
	Chapter 4 and Chapter 5

Table 1.6 Resources regulator assessment requirements MOD 16

Requirement		Section addressed
e)	Details regarding the rehabilitation methods for disturbed areas and expected time frames for each stage of the rehabilitation process.	
f)	Mine layout and scheduling, including maximising opportunities for progressive final rehabilitation. The final rehabilitation schedule should be mapped against key production milestone (i.e. ROM tonnes) of the mine layout sequence before being translated to indicative timeframes through the mine life. The mine plan should maximise opportunities for progressive rehabilitation;	Section 4.1.3
Conceptual final landform design		
g)	Inclusion of a drawing at an appropriate scale identifying key attributes of the final landform, including final landform contours and the location of the proposed final land use(s)	Figure 4.1
Monitoring and research		
h)	Outlining the monitoring programs that will be implemented to assess how rehabilitation is trending towards the nominated land use objectives and completion criteria	Section 5.5.1 and Section 6
i)	Details of the process for triggering intervention and adaptive management measures to address potential adverse results as well as continuously improve rehabilitation practices;	Section 5.5.1
j)	Outlining any proposed rehabilitation research programs and trials, including their objectives. This should include details of how the outcomes of research are considered as part of the ongoing review and improvement of rehabilitation practices;	Section 6.2.2
Post-closure maintenance		
k)	Description of how post-rehabilitation areas will be actively managed and maintained in accordance with the intended land use(s) in order to demonstrate progress toward meeting the rehabilitation objectives and completion criteria in a timely manner;	Section 5.5
Barriers or limitations to effective rehabilitation		
l)	Identification and description of those aspects of the site or operations that may present barriers or limitations to effective rehabilitation, including:	
i)	evaluation of the likely effectiveness of the proposed rehabilitation techniques against the rehabilitation objectives and completion criteria	Section 4.1.3
ii)	an assessment and life of mine management strategy of the potential for geochemical constraints to rehabilitation (e.g. acid rock drainage, spontaneous combustion etc.), particularly associated with the management of overburden/interburden and reject material;	Section 3.1.2 Note given that this is not a coal mining proposal, spontaneous combustion is not a risk for this project.
iii)	the process that will be implemented throughout the mine life to identify and appropriately manage geochemical risks that may affect the ability to achieve sustainable rehabilitation outcomes;	Section 3.1.2

Table 1.6 Resources regulator assessment requirements MOD 16

Requirement		Section addressed
iv)	a life of mines tailings management strategy, which details measures to be implemented to avoid the exposure of tailings materials that may cause environmental risk, as well as promote geotechnical stability of the rehabilitated landform; and	Sections 2.2.4, 3.1.3 and 4.3.3 Chapter 16 of the EIS Section 6.11 of the Modification 16 Assessment Report
v)	existing and surrounding landforms (showing contours and slopes) and how similar characteristics can be incorporated into the post-mining final landform design. This should include an evaluation of how key geomorphological characteristics evident in stable landforms with the natural landscape can be adapted to the materials and other constraints associated with the site.	Section 4.3, Figure 4.1
m)	Where a void is proposed to remain as part of the final landform include:	
i)	A constraints and opportunities analysis of final void options, including backfilling, to justify that the proposed design is the most feasible and environmentally sustainable option to minimise the sterilisation of land post-mining;	Section 4.3.1
ii)	A preliminary geotechnical assessment to identify the likely long term stability risks associated with the proposed remaining high wall(s) and low wall(s) along with associated measures that will be required to minimise potential risks to public safety; and	Sections 3.3.1, 4.2.3 and 4.3.4
iii)	outcomes of the surface and groundwater assessments in relation to the likely final water level in the void. This should include an assessment of the potential for fill and spill along with measures required to be implemented to minimise associated impacts to the environment and downstream water users.	Sections 2.2.1 and 4.4.1 Chapters 10 and 11 of the EIS Sections 6.4 and 6.5 of the Modification 16 Assessment Report
n)	Where the mine includes underground workings:	
iv)	Determine (with reference to the groundwater assessment) the likelihood and associated impacts of groundwater accumulating and subsequently discharging (e.g. acid or neutral mine drainage) from underground workings post cessation of mining; and	Sections 2.2.1 and 4.4.1 Chapter 10 of the EIS Section 6.4 of the Modification 16 Assessment Report
v)	Consideration of the likely controls required to either prevent or mitigate against these risks as part of the closure plan for the site.	Sections 2.2.1 and 4.4.1
o)	Consideration of the controls likely to be required to either prevent or mitigate against rehabilitation risks as part of the closure plan for the site;	Chapter 6
p)	Where an ecological land use is proposed, demonstrate how the revegetation strategy (e.g. seed mix, habitat features, corridor width etc) has been developed in consideration of the target vegetation community(s);	Sections 4, 5.2, 5.5 and 6
q)	Where the intended use is agriculture, demonstrate that the landscape, vegetation and soil will be returned to a condition capable of supporting this; and	Sections 4, 5.2, 5.5 and 6
r)	Consider any relevant government policies	Section 1.4

1.13 Other legislation, guidelines and leading practice

1.13.1 Legislation and environmental planning instruments

i Mining Act 1992

The Cowal Gold Operations (CGO) operates within mining lease numbers ML 1535 and ML 1791 granted under the *Mining Act 1992* (the Mining Act*)*. The Mining Act defines rehabilitation as the 'treatment or management of disturbed land or water for the purpose of establishing a safe and stable environment'. ML 1535 ML 1791 outline specific conditions for rehabilitation and these are provided in Table 1.7.

Table 1.7 ML 1535 rehabilitation conditions

Condition	Section addressed
Rehabilitation	
12. (a) Land disturbed must be rehabilitated to a stable and permanent form suitable for a subsequent land use acceptable to the Director-General and in accordance with the Mining Operations Plan so that:	
• there is no adverse environmental effect outside the disturbed area and that the land is properly drained and protected from soil erosion.	Sections 3.3.2 and 5.4
• the state of the land is compatible with the surrounding land and land use requirements.	Section 4.2
• the landforms, soils, hydrology and flora require no greater maintenance than that in the surrounding land.	Section 5.5
• in cases where revegetation is required and native vegetation has been removed or damaged, the original species must be re-established with close reference to the flora survey included in the Mining Operations Plan. If the original vegetation was not native, any re-established vegetation must be appropriate to the area and at an acceptable density.	Section 5.2.1
• the land does not pose a threat to public safety.	Section 4.4
(b) Any topsoil that is removed must be stored and maintained in a manner acceptable to the Director-General.	Section 5.1.2
13. The lease holder must comply with any direction given by the Director-General regarding the stabilisation and revegetation of any mine residues, tailings or overburden dumps situated on the lease area.	N/A
Prevention of Soil Erosion and Pollution	Section 3.3.2 and 5.4
14. Operations must be carried out in a manner that does not cause or aggravate air pollution, water pollution (including sedimentation) or soil contamination or erosion, unless otherwise authorised by a relevant approval, and in accordance with an accepted Mining Operations Plan. For the purpose of this condition, water shall be taken to include any watercourse, waterbody or groundwaters. The lease holder must observe and perform any instructions given by the Director-General in this regard.	

Table 1.7 ML 1535 rehabilitation conditions

Condition	Section addressed
Roads 18. Access tracks must be kept to a minimum and positioned so that they do not cause any unnecessary damage to the land. Temporary access tracks must be ripped, topsoiled and revegetated as soon as possible after they are no longer required for mining operations. The design and construction of the access tracks must be in accordance with specifications fixed by the Department of Land and Water Conservation.	Section 4.4.3

ii Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act* 1997 (POEO Act) establishes the State's environmental regulatory framework and includes licensing requirements for certain activities. The objectives of the POEO Act that relate to decommissioning and rehabilitation include '*...to protect, restore and enhance the environment, to reduce risks to human health and prevent degradation of the environment'*.

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

1.13.2 Guidelines, policies and plans

This strategy has been prepared generally in accordance with relevant State and Commonwealth guidelines, policies and plans. The relevance and requirements of each of the guideline, policy and plan is discussed briefly in the following sections.

i Guidelines

a Borehole Sealing Requirements on Land

The guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells (the drilling guideline) provides an overview of the process for rehabilitation of boreholes not licensed under the *Water Management Act 2000* or the *Water Act 1912*.

If any boreholes remain open at completion of the operational phase, Evolution will rehabilitate any remaining boreholes, having regard to the borehole sealing requirements in the drilling guideline.

b Mining Operations Plan Guidelines

The *ESG3 – Mining Operations Plan (MOP) Guidelines, September 2013* (the MOP guidelines) (NSW Department of Trade and Investment – Division of Resources and Energy 2013) provide a process for managing and monitoring progression towards successful rehabilitation of a mine site. The guidelines provide content and formatting requirements for MOPs and annual reviews. The purpose of these documents is to '*ensure that all mining operations are safe, the resources are efficiently extracted, the environment is protected and rehabilitation achieves a stable and satisfactory outcome.'*

CGO has an approved MOP which expires 30 June 2021. A revised MOP will be prepared to include the underground mining operations as well as the existing approved operations.

The current and revised MOP will include objectives and criteria for rehabilitation, rehabilitation plans, risks to rehabilitation that need to be addressed, rehabilitation controls and methodologies, and monitoring programs and these are detailed in this MCRS.

The MOP also forms the basis for the estimation of the security deposit imposed to ensure compliance with conditions of authorisation granted under the Mining Act*.* The security deposit will be revised to include rehabilitation cost estimates for the underground mine when the Project is determined and submitted with the revised MOP.

c Strategic Framework for Mine Closure

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

The main objectives of the SFMC are to:

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

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

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

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

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

ii Policies

a NSW Wetlands Policy 2010

The NSW Wetlands Policy (DECCW 2010) aims to provide for the protection, ecologically sustainable use and management of NSW wetlands (Department of Environment, Climate Change and Water [DECCW], 2010). The policy provides a set of guiding principles that all government agencies will adopt, and all stakeholders can refer to when making decisions on wetland management and conservation.

The principles relevant to this strategy include:

- natural wetlands should not be destroyed or degraded;
- degraded wetlands and their habitats should be rehabilitated and their ecological processes improved as far as is practicable; and
- the conservation and management of wetlands are most appropriately considered at the catchment scale.

Sections 2.2.6 and 4.4.6 of this strategy describes the rehabilitation of the New Lake Foreshore. In particular, the objectives of the rehabilitation programme include the expansion of habitat opportunities for wetland and terrestrial fauna species. This includes the design and implementation of rehabilitation works at the New Lake Foreshore in a manner consistent with the NSW Wetlands Policy.

b Policy and Guidelines for Fish Habitat Conservation and Management

The DPI’s *Policy and Guidelines for Fish Habitat Conservation Management* (Update 2013) outlines the policies and guidelines aimed at maintaining and enhancing fish habitat for the benefit of native fish species, including threatened species, in marine, estuarine and freshwater environments. In relation to this strategy, the policy outlines key concepts for habitat rehabilitation. As described above, sections 2.2.6 and 4.4.6 of this strategy describes the rehabilitation concepts for the New Lake Foreshore and identifies that a key objective of the CGO rehabilitation programme is the expansion of habitat opportunities for wetland (and terrestrial) fauna species.

iii Plans

a Jemalong Land and Water Management Plan

The Jemalong Land and Water Management Plan (Jemalong Land and Water Management Plan Steering Plan Committee [JLWMPSPC], 2000) provides for the alleviation of land and water degradation, improvement of natural resource management and sustainability of agriculture and the environment in the Jemalong Irrigation District. The Plan recommends the remediation of any degraded lands and the reduction of water erosion and sedimentation to reduce salinisation of land and waterbodies (JLWMPSPC, 2000). This strategy details the measures relevant to rehabilitation of disturbed land within ML1535 in sections 2, 3 and 4 and specifically the management of water erosion and sedimentation in section 3.3.2.

b Lake Cowal Land and Water Management Plan

The Lake Cowal Land and Water Management Plan (Australian Water Technologies Pty Ltd, 1999) aims include maintaining vegetation cover and maintaining soil structure of Lake Cowal's ecosystem.

Measures that will be implemented to revegetate/regenerate the New Lake Foreshore within ML 1535 are detailed in sections 2.2.6 and 4.4.6 of this strategy. Section 5.1 describes measures that will be implemented to manage and ameliorate the CGO's soil resources.

c Lachlan Catchment Action Plan

The Lachlan Catchment Action Plan provides a framework for the investment in works, projects, planning and research that are considered necessary to achieve sustainable and productive landscapes in the catchment (Lachlan Catchment Management Authority, 2006). Consistent with the Natural Resources Commission Standards, the Lachlan Catchment Action Plan provides specific catchment and management targets, which reflect broader state-based targets (Lachlan Catchment Management Authority, 2006).

The themes underpinning Lachlan Catchment Action Plan management targets relevant to this strategy include biodiversity and native vegetation, water and aquatic ecosystems and land management. The rehabilitation methods and measures outlined in sections 2 and 4 of this strategy are considered to address these themes.

1.14 Adoption of leading practices

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

- Adoption of a waste rock emplacement design that avoids structural drainage features and incorporates microrelief to increase the visual amenity of the landform.
- The use of topsoil/rock matrices to provide critical shear protection in sloping areas of the waste rock emplacements (WRE).
- Establishing a biodiversity post mining land-use on the waste rock emplacement that will help account for previous clearing for agricultural purposes and maximises the function and stability of the cover system.
- Scheduling the construction of the waste rock emplacement so that it will be progressively rehabilitated over the life of the mine.
- Using cemented pastefills to backfill underground mine stopes to minimise the potential for subsidence and chimney failure.

1.15 Purpose and scope of this strategy

The purpose of this MCRS is to prepare a strategy that addresses applicable regulatory requirements, standards and guidelines for the closure and rehabilitation management of both MOD16 and SSD-10367. The overall existing rehabilitation approach and strategy for the mine will not change from what is currently approved other than extending some of the timelines and addressing specific requirements resulting from the underground mine and associated surface infrastructure.

This MCRS has been prepared recognising that once SSD-10367 and MOD16 have been approved, a new MOP will be prepared and submitted to the Resources Regulator.. The MOP will be consistent with the rehabilitation and closure commitments described in the approved MOP and this MCRP.

The objectives of this MCRS are:

- to describe the proposed post-mining land uses;
- identify potential risks and impacts which will impact on closure and rehabilitation management and success;
- to describe the methods for establishing stable post-mining landforms; and
- describe rehabilitation criteria and outlining the monitoring requirements that assess whether or not these criteria are being accomplished.

2 Rehabilitation domains

2.1 Overview

CGO has six existing primary closure domains, with each domain having similar bio-physical characteristics. These domains have been assigned in accordance with the requirements of the MOP guidelines. It will not be necessary to assign any new domains as all underground infrastructure will be in existing domains. Detailed descriptions of the domains are provided in the approved RMP and MOP, a summary description of the domains with additional detail for the underground mine and associated infrastructure is provided in the following sub-sections.

2.2 Primary and secondary domains

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

The secondary domains (Post Mining Land Use Domains) are defined as land management units characterised by a similar post mining land use objective (ie following mining). The primary and secondary domains are defined together with codes allocated for each domain (Table 2.1).

Table 2.1 CGO rehabilitation domains

Primary Domains	
Code	**Domain**
1	Void
2	Permanent water management infrastructure
3	Infrastructure area
4	Integrated waste landform
5	Waste rock emplacements
6	New lake foreshore
Secondary Domains	
Code	**Post mine land use**
A	Final void
B	Permanent water management infrastructure
C	Grassland/scattered Eucalypt woodland
D	Eucalypt woodland
E	Riverine woodland/freshwater communities

In summary, the following rehabilitation domains have been developed for GCO and are shown in Figure 2.1:

- Domain 1A – Final Void;
- Domain 2B – Permanent Water Management Infrastructure;

- Domain 3C – Infrastructure – Grassland/Scattered Eucalypt Woodland;
- Domain 4D – Integrated Waste Landform – Eucalypt Woodland;
- Domain 5D – Waste Rock Emplacements - Eucalypt Woodland; and
- Domain 6E – New Lake Foreshore – Riverine Woodland/Freshwater Communities.

Primary and secondary domains

Evolution Mining

Mine closure and rehabilitation strategy

Figure 2.1

2.2.1 Domain 1A – Final void

The surface area of the final void will be approximately 131 ha, and at the end of mining, the void is approved to a maximum depth of approximately -331 metres Australian Height Datum (m AHD) (ie approximately 540 m below the natural surface level). The berm widths and slope angles will continue to be reviewed and monitored through ongoing geotechnical studies and data collection during mine development.

Modelling indicates that the approved final void would reach an estimated equilibrium water level between 125 and 130 m AHD (approximately 80 m below spill level) (Hydro Engineering and Consulting, 2016).

The existing exploration underground portal is at 102m AHD and the proposed southern and northern portals are at 77 m AHD and 127 m AHD respectively and therefore there is a possibly that all three portals will be flooded when the void fills to its equilibrium water level.

A 52 m deep box cut will be excavated on the southern edge of the void to facilitate the extraction of ore from the underground mine and allow access for maintenance purposes (Figure 2.1).

The central portal will be the primary access portal and the southern and northern portals will be for ventilation purposes.

Predictions of average void salinity confirm that salt concentrations in void waters would slowly increase towards hyper-salinity (Hydro Engineering and Consulting, 2016).

As approved by DA 14/98, a bund will be constructed around the perimeter of the final void which will be planted with an initial cover crop (to assist in stabilising the bund following construction) and will be seeded with native and/or endemic Eucalypt woodland species. The final void will be screened from public views on Lake Cowal Road by the IWL and WRE and will be fenced upon completion of mining. Signposted warnings to the public will also be placed along the fence.

A strategy for the long-term management of the final void (and the lake protection bund) has been prepared in accordance with Development Consent DA 14/98 Condition 4.4(b) and is included in the CGO Water Management Plan.

The rehabilitation objectives for the final void are to (Barrick, 2013a):

- create habitat opportunities for waterbirds at the approximate level at which void water will reach equilibrium, where feasible; and

- leave the void surrounds safe (for humans and stray stock).

At the completion of mining, the portals will be sealed, box cut backfilled and final void will be surrounded on three sides by the revegetated mine WRE.

2.2.2 Domain 2B – Permanent water management infrastructure

The permanent water management structures for the CGO comprise:

- up-catchment diversion system (UCDS); and

- internal catchment diversion system (ICDS) (including the existing low mounds associated with the permanent catchment divide).

The UCDS has been constructed to simulate natural drainage features in the region and includes a low flow drainage path within a wider floodplain (approximately 65 m wide). The channel includes constructed features such as low flow and overbank zones, meanders and pool/riffle sequences. The northern extent of the UCDS includes constructed rock outfalls at confluences with existing natural drainage lines to minimise erosion. At the completion of construction, the UCDS was revegetated with riparian vegetation including rapid germinating pasture species to assist in stabilising the channel.

The UCDS will remain to facilitate permanent drainage of adjacent areas upslope of the site to Lake Cowal and the low mounds associated with the ICDS will remain to contain runoff generated within the site catchment.

The Lake Isolation System (including the Temporary Isolation Bund, Lake Protection Bund and Perimeter Waste Rock Emplacement) has also been constructed to hydrologically isolate the open pit from Lake Cowal (and vice versa) during mining and post-mining.

Although some components of the Lake Isolation System are permanent water management features, these are included in Domain (6E) for the New Lake Foreshore (Section 2.2.6) considering the rehabilitation objectives for the New Lake Foreshore are different from the rehabilitation objectives for the UCDS and ICDS. The remainder of the Perimeter Waste Rock Emplacement (ie excluding the first outer batter) is incorporated within Rehabilitation Domain 5D (Waste Rock Emplacements) (Section 2.2.5).

The rehabilitation objective for the permanent water management structures is to create stable systems (ie with acceptably low risk of environmental harm to Lake Cowal).

2.2.3 Domain 3C – Infrastructure areas

Domain 3C includes:

- Mine fleet workshop;
- Reagent and fuel storage areas;
- Process plant and administration area;
- Paste plant and associated conveyors
- Tailings deslimers and pipework;
- Internal access roads and other roads;
- Transmission line and substation;
- Water supply infrastructure;
- Contained water storages; and
- Exploration areas.

The key additional infrastructure for the underground operation will be the paste plant which will be located in the process plant area and the mine portals, vent fans, fuel storage and office facilities that will be located in the pit.

Post-operations, the rehabilitation objectives for the infrastructure areas are to:

- remove all infrastructure to ensure the site is safe and free of hazardous materials (unless an alternative arrangement is agreed by Evolution, the ultimate landholder and relevant regulatory authorities); and

- establish vegetative communities (including scattered Eucalypt woodland species and native pasture species) that are endemic to the region and suitable for managed grazing.

2.2.4 Domain 4D – Integrated waste landform (IWL)

Modification 14 to DA 14/98 in 2018 approved the modification of the existing tailings storage facility (TSF) to form the IWL. Prior to commissioning the IWL the existing Northern Tailings Storage Facility (NSTF) and Southern Tailings Storage Facility (STSF) will continue to be used to store tailings. The final heights of these facilities will be raised to STSF Stage 7 (248.4 m AHD) and NTSF Stage 6 (240.5 m AHD). The proposed underground operations will require an increase in height to the approved IWL of approximately 1m via a downstream lift to a maximum height of 251 m AHD.

The NTSF and STSF will continue to be staged constructed with the height of the embankments raised in advance of the storage requirements. As the storages fill, the embankments will be raised in a series of upstream lifts, at a rate of approximately 5 m per year. Each lift would comprise an earth/rock fill embankment, with a clay basal zone, supported by the dry tailings beach.

Construction of each lift will continue to involve placement of an interim rock buttress cover on the outer slope of the embankment to enhance stability.

Rehabilitation materials (eg rock mulch and topsoil) on the existing TSF embankments will continue to be stripped prior to placement of the interim rock buttress. The stripped rehabilitation materials will be either transferred to a new rehabilitation area or stockpiled proximal to the IWL for use during ongoing or final rehabilitation activities.

The tailings will be covered and revegetated as described in the MOP with the rehabilitation objectives which are:

- to establish permanently stable landforms;
- during operations, stabilise batters so that they provide minimal habitat value for bird life (ie rock mulch or pasture cover);
- post operations; cap and fill the decant towers and grout the underdrains;
- post-operations, to establish vegetation communities (including Eucalypt and Riverine Woodland species and understorey species such as Rush sp. and pasture species) which are suited to the hydrological features and substrate materials of the top surface of the landform;
- post-operations, to establish vegetation communities (including native and/or endemic Eucalypt Woodland, shrubland and grassland species) similar to those remnants in the surrounding landscape which are suited to the substrate materials and slope of the embankments; and
- to exclude grazing and agricultural production.

2.2.5 Domain 5D – Waste rock emplacements (WREs)

Domain 5D includes the Northern, Southern and Perimeter WREs. The proposed underground project will produce an additional 5.74 Mt of waste rock but this can be accommodated within the existing height limits of 308 m AHD, 283 m AHD and 233 m AHD, respectively.

The additional waste rock will not change the proposed landform design of the WREs with batter slopes of approximately 11° with top of emplacement drainage away from the batters to minimise the potential for erosion as described in the MOP and approved Rehabilitation Strategy (CGO, 2018).

The underground development will not change the proposed revegetation design of the WRE's which includes a biodiversity post mine land-use with the establishment of native Eucalypt woodland, shrub and grassland communities and the exclusion of stock.

The approved rehabilitation objectives for the WRE are to (Evolution, 2018a):

- stabilise batter slopes with rock armour (primary waste rock/soil matrix) to control surface water runoff downslope and reduce erosion potential in the long-term;
- provide a stable plant growth medium able to support long-term vegetation growth including native and/or endemic Eucalypt woodland, shrubland and grassland species suited to slope and elevated positions similar to those remnants in the surrounding landscape; and
- exclude grazing and agricultural production.

2.2.6 Domain 6E – New lake foreshore

The New Lake Foreshore includes the Temporary Isolation Bund, Lake Protection Bund and the first batter of the Perimeter Waste Rock Emplacement.

There will be no changes to New Lake Foreshore from the underground development or MOD 16. Construction of the lake isolation embankments has been completed and the Temporary Isolation Bund and the Lake Protection Bund have been topsoiled and revegetated with native and exotic grass species and scattered aquatic species such as Lignum, Rush sp., River Cooba and River Red Gums. The outer batter slopes of the Lake Protection Bund have been rock armoured to further protect against wave action from lake level rises.

As described in the approved Rehabilitation and Landscape Management Strategy, the Temporary Isolation Bund is a short-term feature and at the completion of operations is proposed to be reworked (breached) by light machinery (ie small excavator and bob cat) when the level of the lake is lower than the bund, to create a series of low mounds (Evolution, 2018a). The mounds would comprise a mixture of inert bund rock and lakebed sediments (Evolution, 2018a).

Once the Temporary Isolation Bund has been reworked during the post-closure phase, the New Lake Foreshore would then comprise the Lake Protection Bund and the first batter of the Perimeter Waste Rock Emplacement.

This domain will have a biodiversity post mine land-use with the establishment of riverine woodland and freshwater communities as detailed in the approved Rehabilitation Strategy, Compensatory Wetland Management Plan and MOP.

3 Environmental and socio-economic risk management

3.1 Geology and environmental geochemistry

3.1.1 Description of mine geology

The Cowal mineralisation is hosted within a sequence of Ordovician volcaniclastic rocks (informally named the Lake Cowal Volcanic Complex). The volcaniclastic sequence is intruded by several Late Ordovician diorite/gabbro stocks and mafic to intermediate dykes. There are numerous faults and shear zones which transect the orebody. The host rocks do not outcrop and are overlain by a Tertiary aged lateritic profile and Quaternary sediments.

Gold mineralisation primarily occurs in dilational quartz-carbonate-sulphide and carbonate ± quartz-sulphide veins. The veins occur throughout the deposit, yet observations during the 1995 feasibility study indicate that the proximity to faults and shear zones is the primary control. The veins have a consistent and similar strike orientation of 305^{o} - 310^{o} and dip 30^{o} - 35^{o} to the south-west. The veins are parallel-sided and range in thickness from less than 1 mm to 10 mm.

Sulphide mineralisation in the veins consists of pyrite with minor sphalerite, chalcopyrite, pyrrhotite and galena. Adularia is a common auxiliary mineral.

3.1.2 Environmental geochemistry

i Waste rock

The waste rock materials (weathered rock, oxide and primary rock) excavated by CGO activities have been assessed for their geochemical properties and suitability for reclamation purposes.

Primary Waste Rock is defined as the unweathered, mined volcanic waste rock from the pit and underground operation.

Oxide Waste Rock is defined as the weathered rock and hard oxidised volcanic/saprolitic material mined from the pit. Following is the current understanding of the characteristics of the waste rock types that occur at the CGO.

The proposed underground development waste rock is geochemically similar to the waste rock from the current open pit operations, indicating that the management strategies currently employed for the WRE would not need to be modified to accommodate the development waste (GEM,2020).

Using representative development waste rock samples GEM (2020) found that:

- Oxide waste rock is expected to be saline and sodic. Due to the low reactive sulfide content and low Acid Neutralising Capacity, this material is expected to be non-acid forming (NAF) and barren in terms acid generation and neutralisation, and the development of increased salinity.

- General (primary) waste rock is expected to be non-saline, non-sodic to slightly sodic and NAF. However, some moderately and highly sodic materials are likely to be encountered. Although the general waste rock is expected to be non-saline, due to a relatively high reactive sulfide content, it has a risk of becoming saline when oxidised.

- Waste rock is expected to be significantly enriched with arsenic and, and antimony may be moderately soluble under the prevailing quasi-neutral pH conditions.

Although the waste rock characterisation assessment conducted for the CGO has predicted waste rock will be non-acid forming, the potential for saline seepage occurring was identified. The design and construction of the WRE has been conducted to facilitate the direction of any permeating waters towards the open pit.

Specific to rehabilitation, GEM prepared a Rock Armour Suitability Geochemical Assessment for the Cowal Gold Mine (GEM, 2008) to assess the suitability of the CGO's oxide and primary waste rock for use as rock armouring on CGO landform slopes.

The main findings of the assessment indicated (GEM, 2008):

- the oxidised waste rock typically contains low sulphur and low acid neutralising capacity (ANC) and in terms of acid generation these materials are likely to be benign. However, a large proportion of the oxidised waste (70%) is likely to be saline;
- all of the primary waste rock types are typically non-saline; and
- the primary waste rock contains reactive sulphides; however, due to their moderate to high ANC, all of the primary waste rock types are expected to be NAF.

Most of the waste rock samples assayed were found to be enriched in arsenic and some of the samples were found to be enriched in cadmium, lead, antimony and zinc (GEM, 2008). However, water extract testing showed that under the prevailing near-neutral pH condition these elements are not soluble and provided these pH conditions are maintained, element solubility and release from these materials is not expected to be a concern (GEM, 2008).

Based on these findings, the following recommendations were made (GEM, 2008):

- due to the expected salinity of the oxidised waste rock, this material is not suitable for armouring the batter slopes of the WRE and TSFs; and
- the primary waste rock is typically non-saline and NAF and the majority of this material is expected to be suitable rock armour material. However, materials with higher reactive sulphide contents (greater than 0.5% sulphur) are likely to present a risk of developing saline conditions when oxidised and these materials should either be excluded from use as rock armour or blended with the lower sulphur material in order to dilute the reactive sulphides.

GEM (2008; 2013, 2016, 2018) recommended either of the following quality control programmes be implemented to either exclude high sulphur material or to blend the high sulphur material with the lower sulphur material in order to dilute the reactive sulphides:

- as materials with reactive sulphur contents greater than 0.5% sulphur would contain significant visible sulphide, and therefore would be identifiable in the field, a quality control programme which involves training site personnel to identify materials with visible sulphide could be implemented to exclude these materials;
- alternatively, if materials with higher reactive sulphide contents are blended with the lower sulphur material to dilute the reactive sulphides, a quality control programme should be implemented which involves collecting samples of the blended waste rock for geochemical testing prior to use as rock armouring to confirm the waste rock has been adequately blended; and

- GEM (2008; 2013, 2016, 2018) has also recommended that should the CGO blend the primary waste rock, the site water quality monitoring programme should include the parameters arsenic, cadmium, lead, antimony and zinc (if not included already) given these elements have been found to be significantly enriched in some of the primary waste types.

As a result of the geochemical assessments of waste rock conducted to date (GEM, 2008; 2009; 2013, 2016, 2018, 2020), the following is undertaken at CGO to manage any geochemical related risk to rehabilitation:

- testing of primary waste rock material is undertaken to assess sulphur content;
- only benign primary waste rock is used as rock armouring for mine landform slopes; and
- the parameters arsenic, cadmium, lead, antimony, selenium and zinc are included in the CGO's surface water monitoring programme.

3.1.3 Tailings

Ore from the proposed underground mine is generally considered to be geochemically similar to that from the previous investigations, however geochemical investigations by GEM,2020 have identified the possible occurrence of a small quantity of potentially acid forming (PAF) and/or PAF-LC material within the ore. Because of this, there will be an increased risk of some of the tailings being PAF or PAF-LC.

Because of the risk that some of the tailings from the proposed underground operations would be PAF or PAF-LC, it is recommended that a program be undertaken to geochemically characterise any pilot plant tailings that may be available and the process tailings when they are available. The characterisation program for the process tailings would most likely involve the routine collection of the discharge tailings over a period of time.

Previous investigations have identified the risk of the tailings from the open-pit operations being saline and developing saline conditions within the TSF. GCO's TSF rehabilitation design includes a cover in order to avoid development of a salt-pan.

Based on the similar geochemical characteristics of the ore between the previous and current investigations, it is predicted that the tailings would be enriched in silver, arsenic, cadmium, lead, antimony, selenium and zinc, GCO's existing TSF water quality monitoring program will be amended to include the additional metals

3.2 Subsidence

An assessment of surface deformation due to underground mining and continued mining by Beck Engineering (2020) indicates thatsurface displacement is predicted to be around 10−15 mm of subsidence and around 25 mm of upsidence. Upsidence is where the land surface rises slightly due to elastic deformation effects from removing large volumes of material from the pit. The movement is inwards toward the pit and upwards. These movements are consistent with natural ranges of shrink and swell during wetting and drying cycles.

The assessment also identified the stoping on the upper levels of the underground mine near major faults could result in unravelling and chimney type failure to the surface. In response, CGO modified the underground mine design to remove 19 upper stopes to mitigate the risk of chimney type failures.

All stopes during will be filled with cemented pastes made from CGO tailings, using fully supported overhead drives and the use of large crown pillars (Mining one, 2020).

Subsidence monitoring will be undertaken in the underground mining precinct and water inflow will be monitored to identify any potential inflows.

3.3 Soils

3.3.1 Soil landscapes

The dominant soils of the area within ML 1535 are red earths and red podzolic soils (North Limited, 1998).

The soil survey undertaken by Soil Management Designs (2017) determined the soil landscapes within the supplementary BSAL Site Verification Certificate area are Sodosol Zone and Gilgai Complex. The dominant soil types of Sodosol Zone and Gilgai Complex are red sodosol and kandosols, respectively.

The remainder of the mining lease area consists of Wah Way, Marsden and Euglo soil landscapes (King, 1998) (refer to Figure 3.1).

Sampling works and characterisation of the stockpiled soil resources at the CGO has been undertaken to determine the availability of suitable material for rehabilitation activities (McKenzie Soil Management, 2013), the findings are outlined in the following sections.

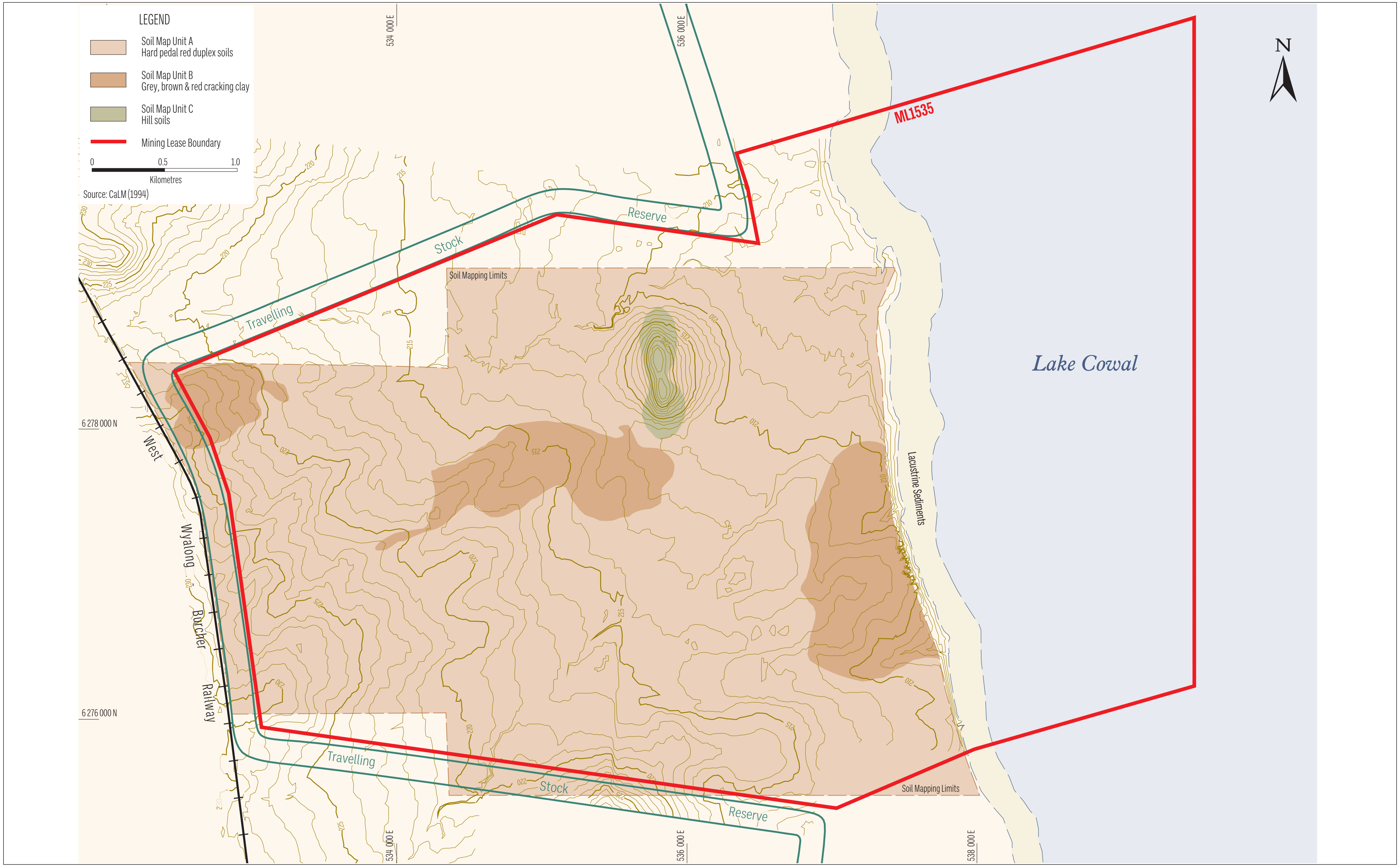
i Soil physical and chemical limitations

a Topsoil

The majority of stockpiled topsoil resources at the CGO fall within the hard-pedal red duplex soils associated with the majority of the mining lease area. The soils have a fine sandy clay loam to medium heavy clay loam texture and are hard setting (McKenzie Soil Management, 2013). These soils are dispersive (where non-saline), have variable pH, are partially phosphorus deficient, range from non-saline to strongly saline and are sodic (McKenzie Soil Management, 2013).

Some small patches of topsoil stocks (within Topsoil Stockpiles 02 and 06); however, are strongly saline in the upper profile and are therefore recommended to be discarded. In addition, some topsoil stocks show physical and chemical characteristics typical of subsoil and have been recommended for inclusion with subsoil stocks to be treated with gypsum (ie Topsoil Stockpile 19 and Topsoil Stockpile 10) (McKenzie Soil Management, 2013).

To enhance the suitability of topsoil stocks for plant growth, gypsum is incorporated at rates recommended by McKenzie Soil Management (2013).



EMM creating opportunities

CGO soil landscapes

Evolution Mining

Mine closure and rehabilitation strategy

Figure 3.1

b Subsoil

The majority of stockpiled subsoil resources also reflect the hard-pedal red duplex soils associated with the majority of the ML area. The soils have a light medium clay texture and are extremely hard setting when dry (McKenzie Soil Management, 2013). The subsoil stocks are dispersive, strongly saline, strongly sodic, Phosphorus deficient and have variable pH ranging from neutral to alkaline (McKenzie Soil Management, 2013).

To enhance the suitability of subsoil stocks for plant growth and to reduce the erosion risk due to dispersion, gypsum is incorporated into the subsoil at rates recommended by McKenzie Soil Management (2013) or subsequent soil testing.

3.3.2 Erosion and sediment control

i Erosion hazard analysis

Erosion potential of a soil is determined by its physical and chemical properties and this is expressed as its K-factor measured in t ha h $ha^{-1}MJ^{-1}mm^{-1}$ (Rosewell, 1993). Table 3.1 provides a soil erodibility ranking for K-factor from Rosewell (1993).

Table 3.1 Rosewell (1993) Soil Erosion Ranking

K factor (t ha h $ha^{-1}MJ^{-1}mm^{-1}$)	Erosion Potential
<0.02	Low
>0.02 to <0.04	Moderate
>0.04	High

K-factors for this site range from 0.051 to 0.06 (North Limited, 1998) which is consistent with the measurement of K-factors in dispersive soils (undertaken by Loch et al, 1998) that recommends a minimum K-factor of 0.06 for dispersive soils.

Applying the soil erosion ranking in Table 3.1 to the site derived K factors indicates that the project soil has a high erosion risk.

Soils where the dominant cations are sodium or magnesium tend to be dispersive when wet. The potential for the soil to disperse is reduced as soil salinity increases and the relationship between the two is the Electrochemical Stability Index (ESI).

A ranking of clay dispersion hazard from IECA 2015 is provided in Table 3.2 below.

Table 3.2 Clay dispersion hazard ranking IECA 2015

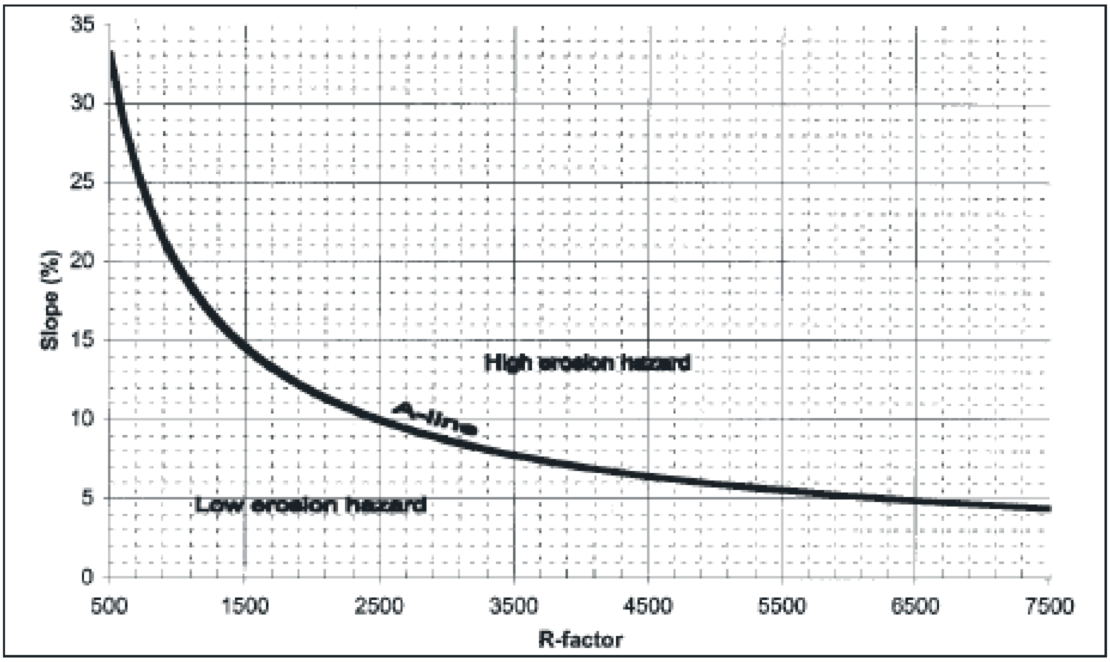
Dispersion Hazard Rating	Emmerson Class Number	ESP	Ca:Mg ratio	ESI ($EC_{1:5}$ in dS/m)/ESP	Clay content (%)	Cation : Clay ratio
Low	4 - 8	<6%	>0.5	>0.1	<10%	<0.2
Moderate	3	6 to 15%	0.5	<0.05	10–30%	>0.2
High	1 - 2	>15%	<0.5	<0.05	>30%	>0.2

The clay dispersion hazard for the soils in the project area ranges from medium to high based on exchangeable sodium percentages alone.

The soil erosion risk will be mitigated by:

- gypsum treating dispersive soils using the methods described in the CGO Soil Stripping Plan, CGO Rehabilitation Management Plan and MOP;
- selectively handling and placing the more erodible soils such that they are covered by less erodible soils; and
- utilisation of rock and soil matrices to provide necessary critical shear protection for rill initiation.

Erosion hazard for the project area has been determined using the procedure described in section 4.4.1 of Landcom 2004. The first step in the hazard assessment is a simple process using Figure 4.6 from Landcom 2004 (reproduced as Figure 3.2) that considers the slope of the land and the Rainfall Erosivity or R factor.



Source: Figure 4.6 Landcom 2004

Figure 3.2 Assessment of potential erosion hazard

For the project, the slope gradient of disturbed areas ranges from less than 1% for mine infrastructure areas, 23% in the upper sections of the box cut, to 90% in the primary rock in the mining void. As the primary rock is erosion resistant the maximum slope for the erosion hazard assessment is the oxide material in the void which is 100% (45°). The R-factor is approximately 1,100 (Appendix A2, Landcom 2004). R-factor values vary between 600 in parts of western NSW to over 10,000 on the far north coast of NSW. Given this range, the Rainfall Erosivity for the site can be considered low.

Applying these numbers to the erosion hazard nomograph results in an erosion hazard from low to high. A high erosion hazard requires further detailed assessment in accordance with section 4.4.2 of Landcom 2004 to determine soil loss classes (Table 3.3). Soil loss classes are described in Table 3.3 and are based on a nominal 80m slope length. The Revised Universal Soil Loss Equation (RUSLE) is used to predict the soil loss to determine the soil loss classes. RUSLE calculates the annual average erosion in tons per hectare from rill and interrill (sheet) erosion. It does not consider gully or tunnel erosion and does not calculate peak erosion.

The landforms within the final landforms with the greatest erosion hazard are the WREs, IWL and the and upper section of the void and box cut, due to slope lengths and gradients. The maximum slope steepness that can be used to determine the RUSLE length-slope (LS) factor is 40%. Using site specific K-factors of 0.051 and 0.06, and a nominal slope length of 80 m, and a maximum slope gradient of 40%, the calculated soil loss ranges from 14t/ha/y to 995t/ha/y which equates to an erosion hazard ranging from very low to very high.

Table 3.3 Soil loss classes (*adapted from Table 4.2 Landcom 2004)*

Soil Loss Class	Calculated Soil Loss (t/ha/y)	Erosion Hazard
1	0 to 150	Very low
2	151 to 225	low
3	226 to 350	Low-moderate
4	351 to 500	moderate
5	501 to 750	high
6	751 to 1500	Very high
7	>1,500	Extremely high

ii Erosion and sediment control management and mitigation

Due to the low annual average rainfall (470 mm) effective erosion control by vegetative means alone for CGO is unlikely (Loch, 2008). CGO has subsequently adopted a methodology for stabilising batters using a rock soil/matrix. This method was proposed by Loch (2008) and the rock sizing was refined based on recommendations by Gilbert and Associates (2009).

Primary waste rock is placed on the slope and then topsoil is spread over the top and contour ripped to mix the rock and topsoil, forming a binary mixture that provides the necessary critical shear protection to prevent rill initiation. This process combined with the amelioration of dispersive materials reduces the risk of tunnel and gully erosion that could occur if just a rock mulch was applied over the soil surface. This process is described in detail in the RMP, CGO Soil Stripping Management Plan and MOP.

This method has been modelled on other mine sites to achieve annual average erosion rates of less than 2t/ha/y and a peak erosion rate of less than 5t/ha/y (pers.comm, R Loch), reducing the erosion hazard of the WREs, IWL and New Lake Foreshore to very low.

The UPCD is used to divert clean water from the north and south of the mine around disturbed areas (refer to Figure 3.3).

Sediment basins (in accordance with DECC, 2008) have been constructed downstream of all major disturbed areas to trap any eroded sediments. Water collected in the sediment basins is pumped to the process water supply storage (D6) for re-use as detailed the CGO Erosion and Sediment Control Plan. The sediment basins will remain in place until 70% soil surface cover has been achieved and/or Total Suspended Solids (TSS) levels in runoff are less than 50 mg/L.

Rehabilitation monitoring at the CGO also includes monitoring of erosion incidence on rehabilitation areas (section 6.2). Erosion monitoring and measures to control erosion on rehabilitation areas will continue to be undertaken.

CGO will continue to implement measures to prevent land degradation (ie erosion, salinity, and loss of soil structure and nutrients) and rehabilitate previously degraded land or land affected by land disturbing activities.

EMM creating opportunities

CGO erosion and sediment control systems

Evolution Mining

Mine closure and rehabilitation strategy

Figure 3.3

3.4 Weed control

CGO's existing weed management programme is aimed at minimising the possibility of new weed incursion and controlling the spread of any existing noxious weeds on-site (including rehabilitation areas) and on all Company-owned land.

The weed management programme includes the following measures:

- identification of noxious weeds by annual site inspections;
- communication with other landholders/leaseholders and regulatory authorities to keep weed management practices in line with regional weed control activities;
- mechanical removal of identified noxious weeds and/or the application of approved herbicides in authorised areas (herbicide use in wetland areas would be strictly controlled);
- implementation of follow-up site inspections to determine the effectiveness of the weed control measures;
- where practicable, prevention of the establishment of new weeds on company-owned land by minimising seed transport of weed species through the use of a vehicle wash bay; and
- pest control activities.

Rehabilitation monitoring at the approved CGO also evaluates floristic diversity and documents the presence of exotic plant species in the rehabilitation areas. If present, weed incursion is recorded and control measures implemented where necessary.

3.5 Fauna

3.5.1 Habitat enhancement

CGO's Vegetation Clearance Protocol also includes procedures where during the preliminary habitat assessment phase, trees are examined to identify roosting/nesting habitat resources that may be impacted by the vegetation clearance activities.

Where available, habitat features (ie hollows and logs) are salvaged for use in rehabilitation or habitat enhancement programmes within ML 1535 and/or within the Offset Areas and Remnant Vegetation Enhancement Programme (RVEP) areas.

3.5.2 Threatened species

Potential impacts to fauna are currently managed through implementation of measures included in the Flora and Fauna Management Plan, Threatened Species Management Protocol, RMP, Compensatory Wetland Management Plan, Land Management Plan and Air Quality Management Plan.

Measures have been developed to keep threatened waterbirds away from the TSFs which include:

- minimising the area of open water in the TSFs to reduce the attractiveness of the TSFs to threatened waterbirds; and
- making the area non-conducive to the establishment of wildlife habitats (ie during operations revegetation of the outer batters of the TSFs is limited to pasture/grass cover only to provide minimal habitat for bird life).

Avifauna deterrence mechanisms would continue to be utilised at the TSFs (and the IWL once deposition commences) (eg audio and visual stimuli to scare/repel birds).

3.5.3 Pest control

GCO will continue to undertake pest control activities including:

- regular property inspections to assess the status of pest populations on-site (including rehabilitation areas) and for all company-owned land;
- mandatory pest control for declared pests (ie rabbits, feral pigs, wild dogs and foxes) in accordance with Pest Control Orders under the *Local Land Services Act,* 2013, and management of plague locust species including the Australian Plague Locust, Migratory Locust and the Spur-throated Locust; and
- inspections to assess the effectiveness of control measures implemented and review these if necessary.

3.6 Air quality

Air quality management and monitoring at the CGO is conducted in accordance with the Air Quality Management Plan which describes air quality management measures that are implement during the operational phase of the mine and will be implemented during the closure phase. This includes:

- watering or using polymer dust suppressants on unsealed roads;
- applying suitable speed limits;
- minimising freefall height during dumping and topsoil spreading operations; and
- progressively rehabilitating disturbed areas including stockpiles.

CGO's dust monitoring network consists of one high volume air sampler located near the Coniston residence measuring total suspended particulate concentrations and 12 dust deposition gauges.

3.7 Bushfire

Management measures relevant to bushfire hazards are detailed in an internal Bushfire Management Plan, including details on operational arrangement, on-site fire protection, hazard management and the implementation of fuel management strategies.

3.8 Community

A Community Environmental Monitoring and Consultative Committee (CEMCC) has been established and regular meetings held in accordance with Condition 9.1(d) of DA 14/98.

The CEMCC will continue to provide opportunities for members of the community to attend CEMCC meetings to discuss specific issues relevant to them including rehabilitation and closure. This will be achieved by landholders making a request to the CEMCC regarding a particular issue, or by the landowner registering a complaint in the complaints register. Landowners who register complaints may be invited to join in discussion of the issue at the next CEMCC meeting.

In the event that dispute resolution is necessary, the resolution process will be one of informed discussion involving the complainant and CGO/Evolution. CGO may also refer the dispute (with the complainant's agreement) to the CGO's CEMCC for mediation. In the event that the complainant is still dissatisfied, the matter may be referred to the Secretary of the DPIE for resolution. Every effort will be made to ensure that concerns are addressed in a manner that results in a mutually acceptable outcome.

A Social Impact Assessment (SIA) has been undertaken by Elton Consulting (2020) to assess the impacts of the underground development on key social aspects (including amenity, community identity, economy, education, social infrastructure and the indigenous community) and to assess the potential impacts of closure of the CGO. Future social closure planning will continue to inform the long-term land uses for the site..

Condition 9.1(d)(iii) of DA 14/98 requires CGO to prepare a Mine Closure Workforce Phase Out Plan (MCWPOP) at least four years prior to mine closure. MCWPOP will be developed in consultation with the CEMCC. The MCWPOP will identify and describe post-mining issues, particularly in relation to reduced employment and the consequent impacts on West Wyalong.

4 Land use options following closure

4.1 Rehabilitation principles and objectives

The CGO rehabilitation philosophy is to operate as a non-intrusive land user and to create stable rehabilitated landforms that increase the areas of endemic vegetation in the mine area and the status of land-lake habitats (Evolution, 2018a).

The above philosophy has led to the rehabilitation principles and objectives described below.

4.1.1 Rehabilitation principles

CGO's rehabilitation program includes the following general principles (Evolution, 2018a):

- The rehabilitation of landforms is to be progressive (where possible) and conducted in accordance with approved, verified plans.
- Final landforms are to be stable in the long-term and include native and/or endemic vegetation characteristic of remnant vegetation within the surrounding landscape.
- Native and/or endemic groundcover, understorey, tree seeds and seedlings are to be used in the rehabilitation program.
- Rehabilitation concepts are to be flexible to allow for adjustments, based on investigations, to improve the rehabilitation program.
- The annual rehabilitation program and budget is to be prepared by a site team incorporating senior management representatives.

4.1.2 Rehabilitation objectives

The rehabilitation objectives for CGO's rehabilitation program include (Evolution, 2018a):

- The water quality of Lake Cowal is not detrimentally affected by the new landforms.
- Revegetating the new landforms with selected native and/or endemic vegetation that is suited to the physiographic and hydrological features of each landform, and which expand on the areas of remnant endemic vegetation in the surrounding landscape.
- Designing final landforms so that they are stable and include revegetation growth materials that are suited to the landform and support self-sustaining vegetation.
- The placement (wherever possible) of soils on final landforms to enable the progressive establishment of vegetation.
- The expansion of habitat opportunities for wetland and terrestrial fauna species. This includes the design and implementation of rehabilitation works at the New Lake Foreshore in a manner consistent with the *NSW Wetlands Policy* (DECCW, 2010).
- The selection of revegetation species in accordance with accepted principles of long-term sustainability (e.g. genotypic variation, vegetation succession, water/drought tolerances).

- Grazing of land within ML 1535 to be excluded during operations and during rehabilitation of the site. At lease relinquishment, rehabilitated final landforms are excluded from grazing, with some areas suitable for grazing surrounding the rehabilitated final landforms.

Specific rehabilitation objectives have been developed for the CGO's rehabilitation domains which are described in Section 4.3.

4.1.3 Rehabilitation undertaken to date

Rehabilitation of disturbed lands has been undertaken progressively and successfully at CGO throughout the mine's life. At the end of 2019 approximately 355 ha of previously disturbed land within ML 1535 was under rehabilitation (ie either shaped and covered or rehabilitated and under maintenance (CGO MOP)).

Areas currently under rehabilitation include:

- temporary Isolation Bund (shaped, topsoiled and revegetated with native and exotic grass species including scattered aquatic species such as Lignum [*Duma florulenta*], Rush [*Eleocharis* sp.] and River Red Gum [*Eucalyptus camaldulensis*]);
- Lake Protection Bund (shaped and lower batter rock armoured, topsoiled and revegetated with native and exotic grass species including scattered aquatic species such as Lignum, Rush sp. and River Red Gum);
- UCDS (rehabilitated and under maintenance);
- components of the ICDS, including:
  - outer embankments of contained water storages D1 and D4 (shaped and rock armoured);
  - outer embankments of contained water storage D9 (shaped, rock armoured, topsoiled and revegetated with native and exotic grass species); and
  - ICDS low mounds (rehabilitated with stabilising cover crop including native and exotic grass species);
- Northern TSF (embankments shaped and rock armoured);
- Southern TSF (embankments shaped and rock armoured, with lower embankment topsoiled [with gypsum] and revegetated with native and exotic grass species);
- Perimeter Waste Rock Emplacement – lower and majority of upper outer batter slopes (shaped, rock armoured and topsoiled [with gypsum] with revegetation including native and exotic grass species establishing across majority of rehabilitation areas);
- Southern Waste Rock Emplacement – lower, mid and upper outer batter slopes of western, southern and eastern sections (shaped, rock armoured and topsoiled [with gypsum] with revegetation including native and exotic grass species establishing across rehabilitation areas);
- Northern Waste Rock Emplacement – northern lower, mid and upper outer batter slopes (shaped, rock armoured and topsoiled [with gypsum] with revegetation including native and exotic grass species establishing across north-eastern extent of rehabilitation area and plantings of Eucalypt and Acacia species within the rehabilitation trial areas); and
- Bland Creek Palaeochannel Borefield water supply pipeline (rehabilitated and under maintenance).

Significant rehabilitation trials have been undertaken over the life of the mine to inform and improve rehabilitation practices and outcomes.

Key findings of the rehabilitation investigations and trials conducted at the CGO to date include the following (Evolution, 2018a):

- The surface cover treatment/method most likely to stabilise final landform slopes and support long-term vegetation growth includes (DnA Environmental, 2013a, 2013b; 2015):
  - rock mulch and gypsum-treated topsoil cross-ripped along the contour of the slope (rock/soil matrix); and
  - a light to medium application of native pasture hay or clean wheaten straw hay as an immediate protective soil cover, if vegetation establishment is not adequate.
- The annual exotic grass *Lolium rigidum* (Wimmera Ryegrass) present in the topsoil seed bank establishes rapidly in high abundance across rehabilitation areas, providing extensive vegetation cover and soil/surface protection, and a mulch/litter cover once it desists. As a result, hay mulch is only considered necessary in areas where *Lolium rigidum* (Wimmera Ryegrass) has not established.
- Direct seeding onto freshly topsoiled and deep ripped rocky surfaces has resulted in higher seedling densities compared with deep ripped grassland areas (DnA Environmental, 2018a).
- Successful seedling establishment can be obtained in areas where a Wimmera Ryegrass cover crop has established by deep ripping prior to direct seeding (DnA Environmental, 2018a).
- No obvious effects have been observed on the growth rates of the tubestock in the Northern Waste Rock Emplacement trial as a result of the different topsoil depths or mulch treatments (DnA Environmental, 2018b).
- The inclusion of rock mulch in the surface cover placed on CGO landform slopes provides resistance to erosion and reduces surface water flow velocities on landform slopes during high rainfall events (Gilbert and Associates, 2009).
- Primary waste rock is suitable for use as rock armour (or rock mulch) on landform slopes due to the material being typically non-saline and NAF (GEM, 2008; 2013; 2016). However, primary waste rock materials with higher reactive sulphide contents (greater than 0.5% sulphur) are likely to present a risk of developing saline conditions when oxidised and these materials should either be excluded from use as rock armour or blended with the lower sulphur material in order to dilute the reactive sulphides (GEM, 2008; 2013; 2016).
- Due to the expected salinity and sodicity of the oxide waste rock, this material is not suitable for armouring the batter slopes of the WRE or IWL (GEM, 2008; 2013; 2016).
- Due to the sodic and dispersive nature of the oxide waste rock material, gypsum needs to be spread on the surface of oxide waste rock material (i.e. in particular on the Southern Waste Rock Emplacement) prior to the application of the rehabilitation cover materials (e.g. rock mulch and gypsum-treated topsoil) to assist with stabilising the underlying substrate material (GEM, 2008; 2013; 2016; Barrick, 2014).
- The majority of stockpiled soil resources at the CGO are typically sodic and dispersive and therefore require treatment with gypsum to improve the soil structure and suitability for plant growth (some soil stocks however may require treatment with lime or a gypsum-lime blend to reduce the acidity of the soil) (McKenzie Soil Management, 2013).

- Various methods for treating or ameliorating soil at the CGO have been recommended by McKenzie Soil Management (2013), including treating soil stockpiles with gypsum (or other relevant treatment material), treating strongly sodic and dispersive soil stocks with gypsum in a dedicated soil amelioration farm, treating soil when re-applied to rehabilitation areas and spreading gypsum on the surface of original soil profiles prior to soil stripping.

- Ameliorated soils are anticipated to improve revegetation outcomes for the CGO final landforms (due to improved soil properties for plant growth) and may increase the number and diversity of revegetation species able to be used in the CGO rehabilitation programme (ie additional species could be used that are typically less tolerant to deficient soils) (McKenzie Soil Management, 2013). Soil conditioning (with gypsum) and the application of surface cover treatments improves the effectiveness of revegetation techniques including direct seeding and tubestock planting (DnA Environmental, 2013a).

- The results from vegetation growth trials undertaken to date indicate that seedlings of select salt tolerant tree species continued to grow when planted in a substrate including CGO oxide and sulphide tailings (Barrick, 2013b). As a result, it is considered salt tolerant tree species would likely establish and develop when planted on the top surfaces of the TSFs:

    - the results from tree root growth assessments of six-year-old trees planted in substrates including topsoil, subsoil and oxide waste rock indicate (DnA Environmental, 2017);

    - the root systems of the younger sapling plants preferred to grow laterally on top of dense clay oxide waste rock layers, but were capable of growing down into crumbly oxide waste rock layers;

    - as the tree and root system matures, the stronger and larger roots were able to penetrate the dense clay oxide waste rock; and

    - the chemical characteristics of the oxide waste rock has not been observed to be a constraint to plant growth.

Formal rehabilitation monitoring as described in Section 6.1 has been undertaken at CGO since 2010 (DnA Environmental, 2018) using a combination of:

- Landscape Function Analysis (LFA) indicators (which includes measurement of soil erosion type and severity);

- accredited soil analyses indicators; and

- an assessment of ecosystem characteristics using an adaptation of methodologies derived by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) *Methodology for the Grassy Box Woodlands Benchmarking Project in Southern NSW Murray-Darling Basin* (Gibbons, 2002) and the associated Biometric Model *Rapidly quantifying reference conditions in modified landscapes* (Gibbons *et al*., 2008).

LFA is one of three components of the EFA tool developed by the CSIRO that aims to measure the progression of revegetation/rehabilitation towards a self-sustaining ecosystem.

In accordance with the LFA methodology, the LFA monitoring results are to be used by CGO to assess whether rehabilitation areas are on a trajectory towards a self-sustaining landscape and to guide management intervention in accordance with the trigger, action and response plan in the CGO Rehabilitation Management Plan.

An annual rehabilitation report is prepared by DnA Environmental and the rehabilitation performance is reported to agencies and the public in the Annual Reviews.

4.2 Post-mining land use

Condition 3.8 of DA 14/98 required CGO to develop a long-term land use strategy for the CGO, which is described below. No changes to the planned post-mining land use strategy are proposed as a result of the underground operations or MOD 16.

The strategy is relevant to land within ML 1535, the Bland Creek Paleochannel water supply pipeline and borefield and Eastern Saline Borefield and Evolution-owned land outside ML 1535.

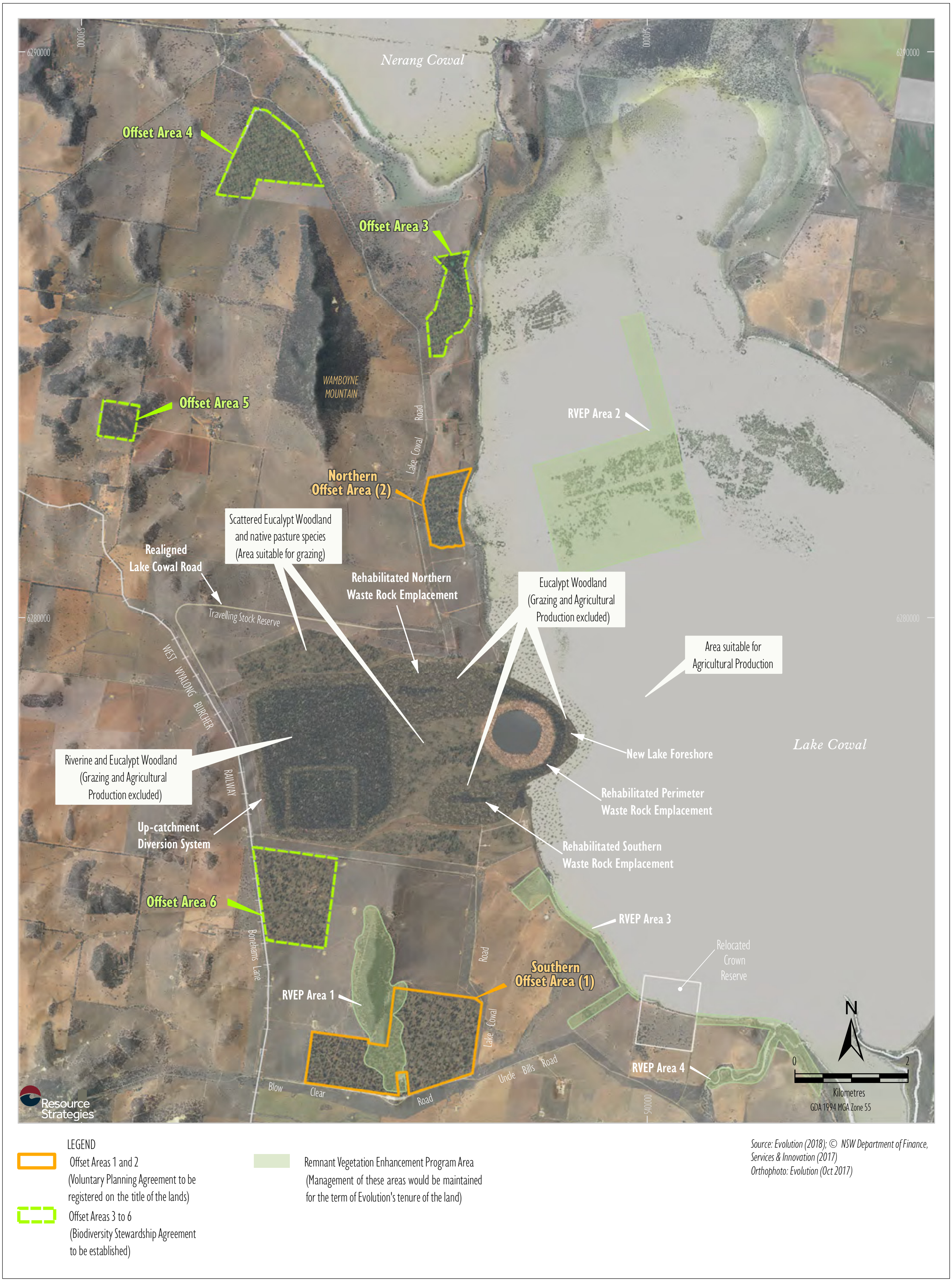
The land within ML 1535 is former cleared and semi-cleared farmland that was used for grazing of native and improved pastures by livestock. Prior to the development of the CGO, the original native tree cover within ML 1535 had largely been removed except for scattered individual trees or small stands, and the tree cover on the former Cowal West Hill which had been retained due to its shallow soils and poorer grazing potential. The landscape surrounding the CGO (including Evolution-owned lands outside ML 1535) is predominantly used for agriculture (eg broad-acre cropping) and grazing over relatively large landholdings. Current (and historical) uses of Lake Cowal include commercial and recreational fishing when inundated, and agricultural production including grazing by livestock when dry.

As described in the CGO's Flora and Fauna Management Plan (FFMP) and consistent with the CGO's rehabilitation objectives, rehabilitation of ML 1535 disturbance areas will aim to enhance and expand wildlife habitat values within ML 1535 and around Lake Cowal. CGO also recognises that the former land use within ML 1535 included grazing of cleared and semi-cleared areas of predominantly native pastures by livestock. Therefore it is proposed that at lease relinquishment, land use within ML 1535 would include fenced rehabilitation areas with grazing excluded and areas suitable for agricultural production including commercial and recreational fishing of lake areas or managed grazing by livestock (refer to Figure 4.1).

Evolution-owned land outside ML 1535 (with the exception of the Compensatory Wetland and Northern and Southern Offset Areas) would continue to be used for farming/agricultural production by Evolution and/or licensees that sign agreements to conduct agricultural activities on Evolution-owned land. It is anticipated that areas of lakebed country would be available for commercial and recreational fishing when inundated, and may be used for cropping and/or managed livestock grazing when dry, consistent with existing and historical uses of Lake Cowal.

Consistent with Condition 3.4(b) of DA14/98 and the CGO's Biodiversity Offset Management Plan (BOMP), long-term protection of the CGO Offset Areas will be provided by a Biodiversity stewardship agreement. Consistent with the CGO's Land Management Plan (LMP), the Remnant Vegetation Enhancement Programme (RVEP) Areas (Figure 4.1) would continue to be maintained for the term of Evolution's tenure of the land.

Some infrastructure may be retained and transferred to local landholders for use following lease relinquishment including electricity infrastructure, water storages, pipelines, bores and associated pump stations, if agreed with the Resources Regulator. If it is agreed with the Resources Regulator and the ultimate landholder that the CGO's Bland Creek Palaeochannel Borefield, Eastern Saline Borefield and the saline groundwater bores within ML 1535 be retained for local use, the pipelines would remain in place (Evolution, 2016).



EMM creating opportunities

Proposed final landforms and post mine land uses
Evolution Mining
Mine closure and rehabilitation strategy
Figure 4.1

Alternatively, if the infrastructure is not required for local use, the bores would be plugged, capped and decommissioned in accordance with relevant regulatory guidelines, the pump stations would be removed and the pipelines raised and dismantled for recycling (Evolution, 2016). Further detail of the proposed decommissioning procedures is provided in the CGO Rehabilitation Management Plan.

Long-term land uses would ultimately be subject to consultation with relevant regulatory authorities and key stakeholders including surrounding landholders.

4.2.1 Rehabilitation areas

Rehabilitated final landforms including the WRE, IWL, final void, Compensatory Wetland, former process plant area (including decommissioned and rehabilitated contained water storages) and the former ore stockpile areas will be fenced with grazing excluded, with some areas suitable for grazing surrounding the rehabilitated final landforms (refer to Figure 4.1).

Exclusion of grazing of these areas is proposed to protect revegetation and natural regeneration and to maintain the long-term stability of the final landforms. Permanent drainage features within ML 1535 including the Up-catchment Diversion System (UCDS) and drainage lines associated with the permanent catchment divide would remain to manage surface water runoff around the rehabilitated CGO area.

4.2.2 Areas suitable for grazing/agricultural production

The remaining areas of land within ML 1535 level with the natural ground surface disturbed by mining operations (eg former soil stockpile areas and former explosive storage areas) would be rehabilitated to include vegetation which expands on the areas of remnant endemic vegetation that currently exists in the region and include native pasture species. It is expected that once sufficiently mature vegetation communities have been established, these areas would be suitable for managed livestock grazing (refer to Figure 4.1).

A suitable stocking rate for these areas would be determined using the Dry Sheep Equivalent (DSE) method in conjunction with an assessment of soil fertility.

The relocated travelling stock reserve formed around the western boundary of ML 1535 (refer to Figure 4.1) would be retained.

Consistent with the CGO's LMP, at lease relinquishment, areas of Evolution-owned land (with the exception of Compensatory Wetland and Northern and Southern Offset Areas) (refer to Figure 4.1) will continue to be used for farming/agricultural production by Evolution and/or licensees that sign agreements to conduct agricultural activities on Evolution-owned land. It is anticipated that areas of lakebed country would be available for commercial and recreational fishing when inundated and may be used for managed livestock grazing when dry, consistent with existing and historical uses of Lake Cowal.

4.2.3 Other infrastructure

Surface infrastructure will mostly be decommissioned, dismantled and removed from site, and either transferred to another Evolution operation or sold. In accordance with Condition 4.4(b) of 14/98, a strategy for decommissioning of the CGO water management structures has been developed and is incorporated within the CGO Water Management Plan. Some infrastructure may however be retained and transferred to regional landholders for use following mine closure (eg electricity infrastructure, water storages, pipelines, bores and associated pump stations), if agreed with the Resources Regulator and the ultimate landholder.

4.3 Post-mining landform design

Key features of the final landform:

- a final void;
- backfilled and rehabilitated box cut;
- rehabilitated WRE surrounding the final void to the north, east and south;
- rehabilitated tailings storage facilities (IWL) located near the western extent of ML 1535;
- a woodland corridor between the rehabilitated Northern Waste Rock Emplacement and rehabilitated IWL;
- areas surrounding the rehabilitated WRE and tailings storage facilities associated with rehabilitated site infrastructure areas (ie the former process plant area and former soil stockpile areas);
- permanent water management features including the UCDS and low mounds associated with the ICDS; and
- permanent lake isolation embankments to hydrologically separate the open pit development area and Lake Cowal during mining and post-mining.

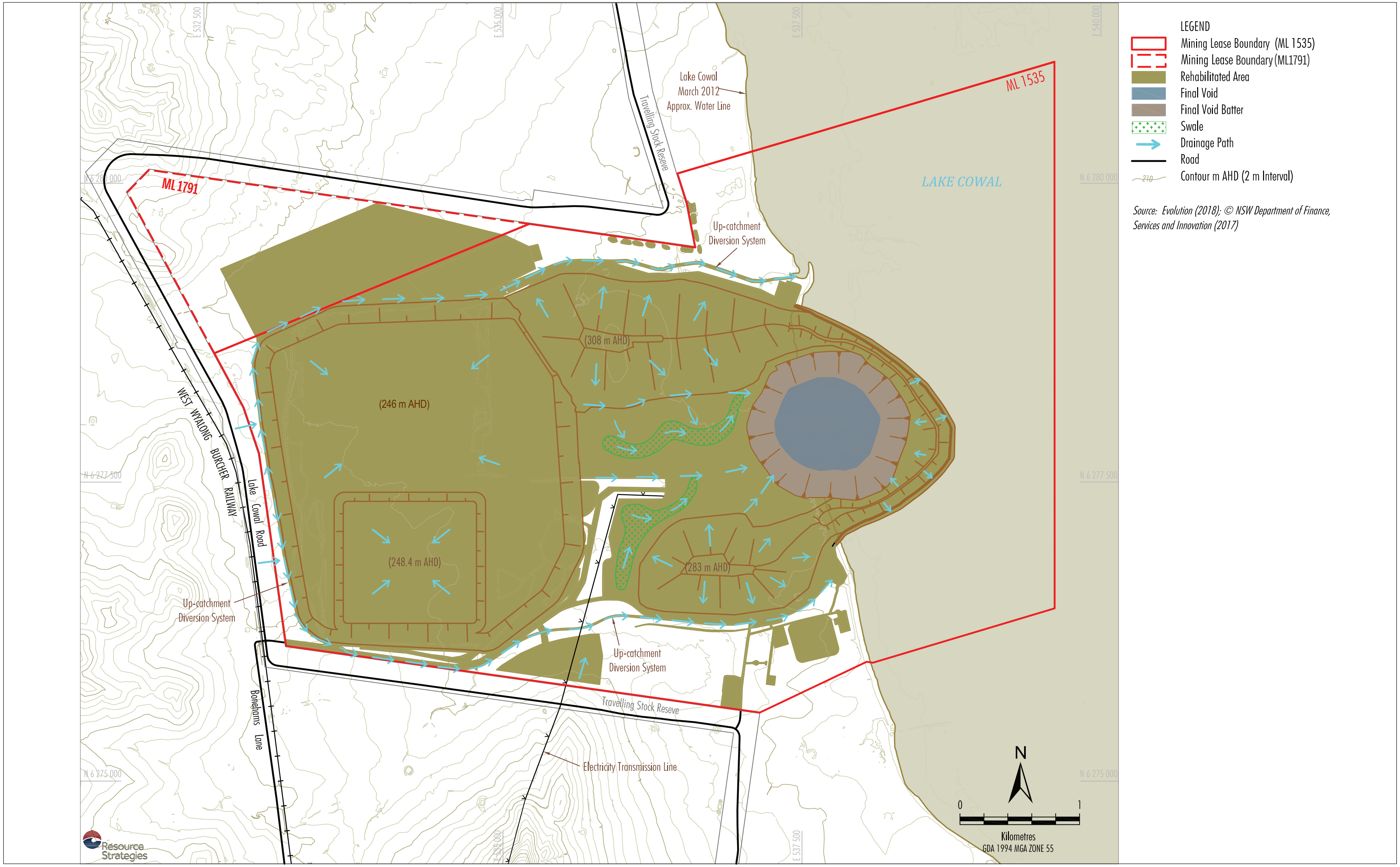
The CGO Mine Life Modification (Evolution, 2016) introduced the processing of mineralised material and therefore the mineralised material stockpile has been removed as a component of the northern waste rock emplacement landform. Figure 4.2 shows the conceptual general arrangement post-mining.

4.3.1 Final void

Open cut mining of the void will continue during development of mining of the underground operation. The pit will be progressively deepened and developed within its approved extent of approximately 131 ha.

At the end of open cut mining the void will be approximately -331m AHD (approximately 540 m below the natural surface level (CGO RMP).

The slope design criteria of the open pit have been developed in consideration of maintaining factors of safety appropriate for operating conditions and the long-term stability of the lake isolation system (Evolution, 2018a). The geotechnical modelling and analysis undertaken to determine suitable pit slope design criteria considered historical slope performance, and geotechnical data gained over previous and current studies for the existing open pit for both surficial (soil/highly weathered rock) and hard rock material. The design configuration for the open pit is described below.



Conceptual post mining landforms

Evolution Mining

Mine closure and rehabilitation strategy

Figure 4.2

The final void landform design criteria are shown in Table 4.1.

Table 4.1 Final void landform criteria (Table 5 CGO MOP)

Weathering Layer	Aspect	Criteria
Oxide	Batter angle	45°
	Batter height	9m
	Berm width (variable according to pit sector)	9m to 10m
	Inter-ramp angle (variable according to pit sector)	25°
Primary	Batter angle	65° to 90°
	Batter height	18 to 27m
	Berm width (variable according to pit sector)	9m to 13m
	Inter-ramp angle (variable according to pit sector)	46° to 61°

Single benches would be used for the oxide rock, with berms approximately 9 to 10 m in width, batter angles at 45° and with an inter-ramp angle of approximately 25° (variable according to open pit sector).

Primary rock would be mined in multiple benches, with berms up to 13 m in width, batter angles between 65° to 90° and with an inter-ramp angle of approximately 46° to 67° (variable according to open pit sector). Triple benching of primary rock and wall steepening was trialled during the previous MOP term, and is being implemented as part of standard operations where appropriate. The berm height and width and inter-ramp angle design criteria provided in Table 4.1 reflect the criteria that was trialled during triple benching.

The void has been designed with the steepest possible geotechnically stable sides to economically access the ore body and minimise the generation of waste rock. There is no opportunity to progressively backfill the void due to the single pit configuration, and any backfilling would prevent access to the orebody at depth. Reclaiming the waste rock to backfill the void after mining would render the project financially unviable.

Notwithstanding, the blasting and movement of rock results in swelling of the rock, meaning that even if the pit could be backfilled, only a portion of the waste rock material would fit back into the pit and WREs would always be required.

For these reasons, backfilling of the void is not considered financially viable nor reasonable and feasible and would exclude the full extent of the resource being mined.

Minimal modification to the final void landform is anticipated during the rehabilitation phase, other than reshaping upper batters of the void where soil and weathered rock is present and the construction of a safety bund and security fence.

DA 14/98 approves the CGO final void to remain and slowly fill with water. It is predicted that the void will fill to an equilibrium water level between 125 and 130 m AHD (approximately 80 m to 85 m below spill level) (Hydro Engineering and Consulting, 2020). The final void will be screened from public views on Lake Cowal Road by the IWL and WREs and will be fenced upon completion of mining. Signposted warnings to the public will also be placed along the fence.

The existing exploration underground portal is at 102 m AHD and the proposed southern and northern portals are at 77 m AHD and 127 m AHD respectively. It is expected that the two lowest portals will ultimately be flooded as the void fills the water to an equilibrium water level.

All portals will be sealed in accordance with the requirements of the Resources Regulator.

4.3.2 Waste rock emplacements

i Northern waste rock emplacement (NWRE)

The NWRE has been designed to contain most of the waste rock generated from the CGO. At its full extent, the NWRE final landform will have a roughly rectangular plan shape and will integrate with the IWL at its western extent. The outer batters are to be constructed with reverse graded berms installed.

The NWRE is designed and built to meet the long-term goal of containing potentially saline seepage generated from waste rock emplacement areas during operation and post-closure. Construction involved surface preparation works to facilitate the direction of any permeating waters towards the open pit. The existing topography of the footprint has been altered by placing compacted oxide waste rock within the footprint. The resulting basement for the emplacement slopes towards the open pit and provides drainage control. Any waters permeating through the emplacement are expected to be intercepted by this layer and preferentially flow towards the open pit.

A typical cross-section through the NWRE is shown in Figure 4.3. Consistent with the existing design, the outer batter of the emplacement is designed to have a final profile with an overall slope of 11°.

NWRE will have a maximum height of approximately 308 m AHD.

Compacted oxide waste rock would continue to be used to construct the low permeability basal layer for the emplacement expansion area, so that any waters permeating through the expanded emplacement are intercepted by this layer and preferentially flow towards the open pit.

ii Southern waste rock emplacement (SWRE)

The SWRE will not be used for further waste rock emplacement and will remain at a height of approximately 278 m AHD. No change to the footprint of the SWRE is anticipated.

The SWRE has a similar cross-section to the NWRE. Consistent with the existing design, the outer batter of the emplacement is designed to have a final profile with an overall slope of 11°.

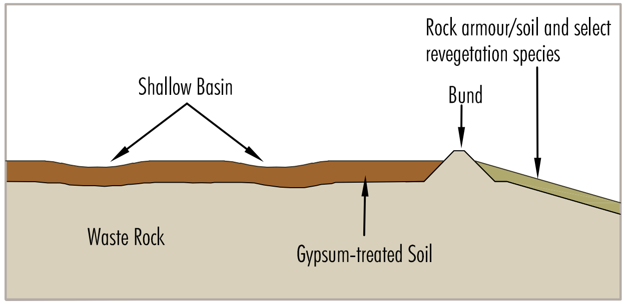
Rehabilitation of the SWRE outer batters would continue using the methods described in the CGO Rehabilitation Strategy and MOP.

iii Perimeter waste rock emplacement (PWRE)

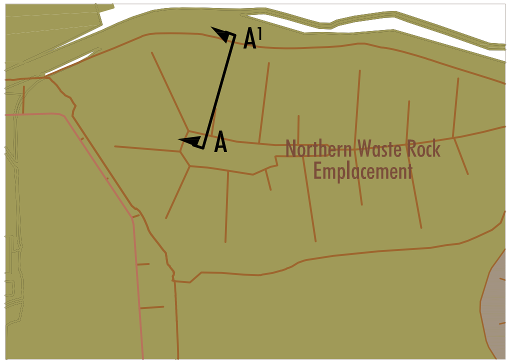
The PWRE has been constructed to its final height of approximately 223 m AHD and surrounds the pit to the north, east and south (refer to Figure 4.1).

The PWRE forms part of the series of embankments (ie Temporary Isolation Bund and Lake Protection Bund) between the open pit and Lake Cowal. The emplacement is located behind the Lake Protection Bund and has been constructed from oxide mine waste rock with the outer face constructed from low salinity soils.

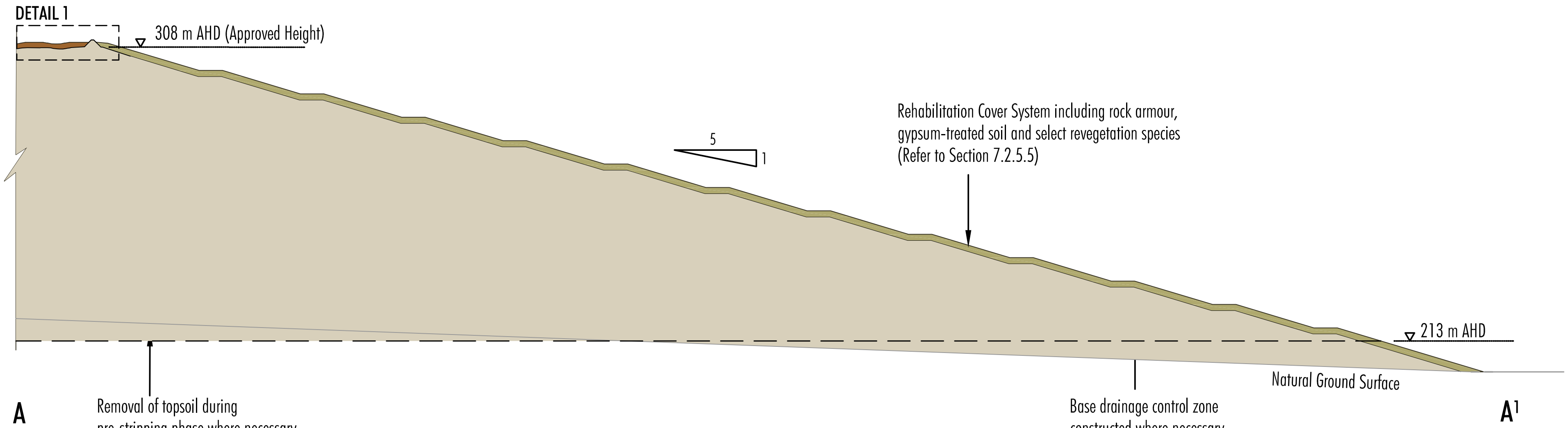
The outer batter slopes are 11° with reverse graded berms installed at vertical height intervals of approximately 5 m (refer to Figure 4.4). Surface preparation works to facilitate drainage of any infiltrating waters towards the open pit have been constructed at a gradient of 1(V):200(H).



DETAIL 1



INSET
(Refer Plan 4B)



SECTION A - A1

EMM
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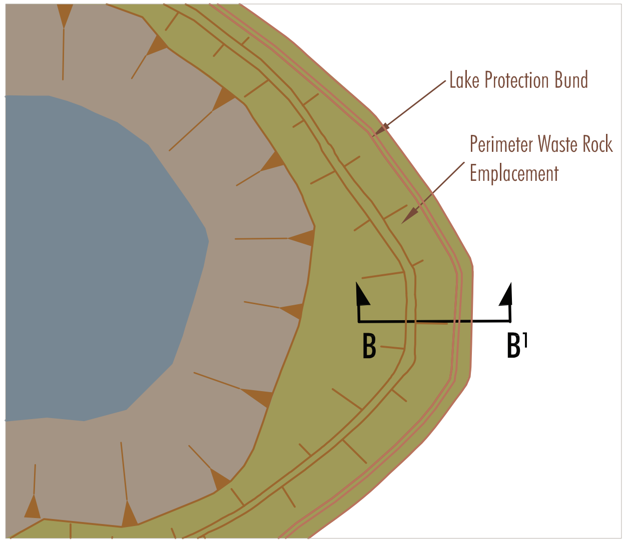
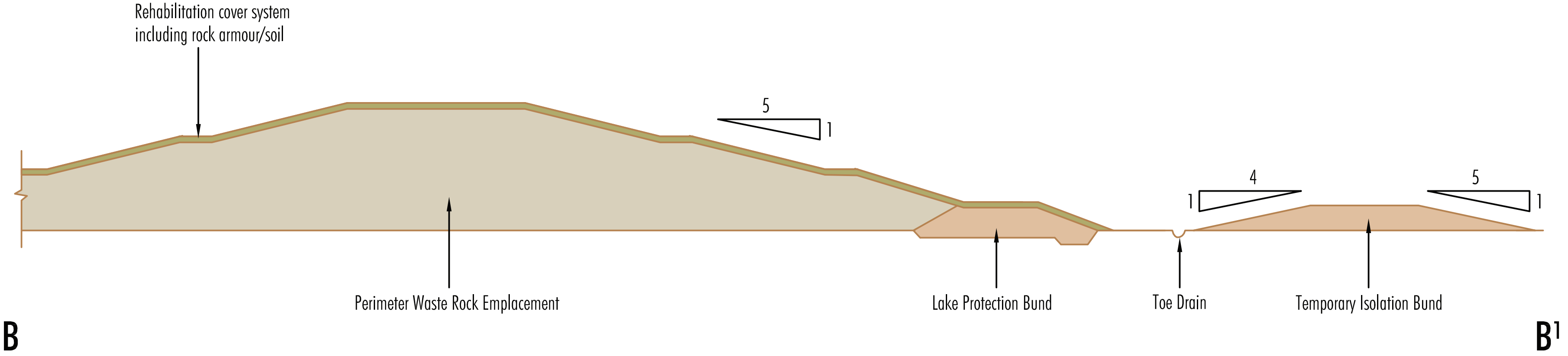
NWREA cross section

Evolution Mining
Mine closure and rehabilitation strategy
Figure 4.3



INSET
Refer Plan 4B



EMM creating opportunities

Lake isolation landform cross section

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Mine closure and rehabilitation strategy

Figure 4.4

4.3.3 Integrated waste landform

Construction of Stage 1 of the IWL commenced in late 2019 and involved the emplacement of mine waste rock at the IWL Stage 1 development area (to the south and east of the existing Southern TSF).

Generally, the IWL will be constructed in 2 m to 5 m lifts with (internal) batter slopes of 1(v):2(H) and with final outer batter slopes of 1(V):4(H) with 5 m berms.

The proposed underground operations will require an increase in height to the approved IWL of approximately 1 m via a downstream lift to a maximum height of 251 m AHD.

Prior to commissioning of the IWL for tailings storage, the existing NTSF and STSF will continue to be used to store tailings. These facilities would be raised to STSF Stage 7 (248.4 m AHD) and NTSF Stage 6 (240.5 m AHD). The IWL would be constructed to a maximum height of 245 m AHD.

The existing NTSF and STSF will be raised to STSF Stage 7 (248.4 m AHD) and NTSF Stage 6 (240.5 m AHD). Under MOD 16 the IWL would be constructed to a maximum height of 246 m AHD.

The outer batters of the IWL will be rehabilitated in a similar manner as the WRE's however the overall slope of the outer batter will be 14° (Figure 4.9 from Figure 5-3 Resource Strategies EA 2018).

4.3.4 Other landforms

Other landforms will be rehabilitated in accordance with Section 4.4 below.

4.4 Rehabilitation by domain

4.4.1 Domain 1A – Final void

The approved rehabilitation objectives for the final void are to (Evolution, 2018a):

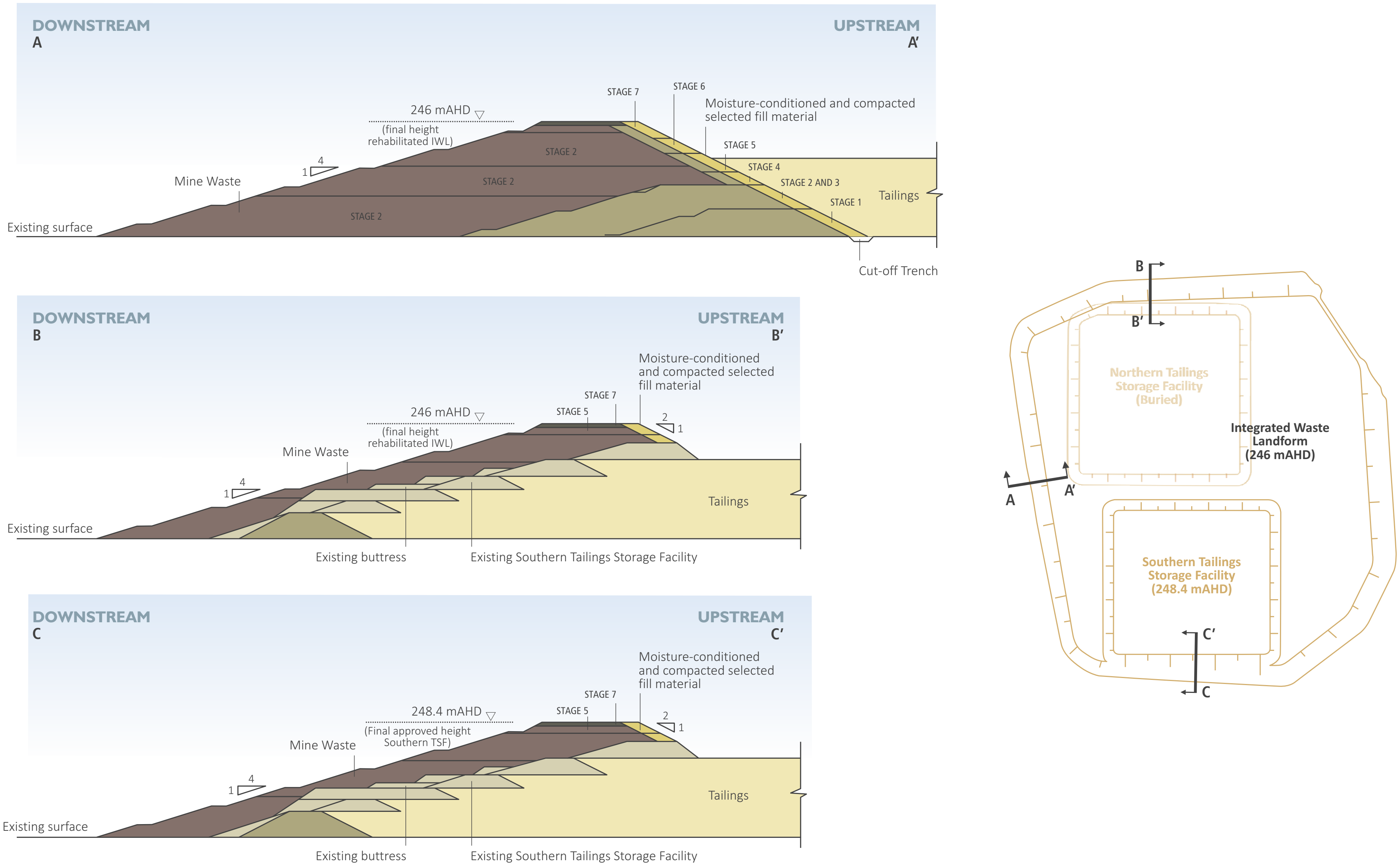
- create habitat opportunities for waterbirds at the approximate level at which void water will reach equilibrium, where feasible; and
- leave the void surrounds safe (for humans and stray stock).

At the completion of mining, the final void will be surrounded on three sides by the revegetated mine WRE.

The approved surface area of the final void will be approximately 131 ha, and at the end of mining, the void is approved to a maximum depth of approximately -331 m AHD (ie approximately 540 m below the natural surface level). The berm widths and slope angles will continue to be reviewed and monitored through ongoing geotechnical studies and data collection during mine development.

Modelling indicates that the approved final void will reach an equilibrium water level between approximately 125 m and 135 m AHD (approximately 80 m below spill level) over several hundred years (Hydro Engineering & Consulting Pty Ltd, 2018). Predictions of average void salinity confirm that salt concentrations in void waters would slowly increase towards hyper-salinity (Hydro Engineering & Consulting Pty Ltd, 2020).

The main underground portal and haulage portal is located at RL 1070. The fresh air intake adits will be located at RL's 930 m and 900 m respectively. All mining infrastructure will be removed from the void and the portal will be sealed in accordance with Resources Regulator requirements.



NOTE: this diagram is a conceptual representation only

EMM
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Proposed IWL cross section

Evolution Mining
Mine closure and rehabilitation strategy

Figure 4.5

A bund will be constructed around the perimeter of the final void which would be planted with an initial cover crop (to assist in stabilising the bund following construction) and native and/or endemic Eucalypt woodland species. The final void would be screened from public views on Lake Cowal Road by the IWL and WRE and will be fenced upon completion of mining. Signposted warnings to the public would also be placed along the fence (Evolution, 2018a).

4.4.2 Domain 2B – Permanent water management infrastructure

The rehabilitation objective for the permanent water management structures is to create stable systems (ie acceptably low risk of environmental harm to Lake Cowal).

The permanent water management structures for the CGO comprise:

- UCDS; and
- ICDS (including the existing low mounds associated with the permanent catchment divide).

The Lake Isolation System (including the Temporary Isolation Bund, Lake Protection Bund and Perimeter Waste Rock Emplacement) has also been constructed to hydrologically isolate the open pit and Lake Cowal during mining and post-mining.

Although some components of the Lake Isolation System are permanent water management features, these areas have their own rehabilitation domain (6E) as the rehabilitation objectives for the New Lake Foreshore are different from the rehabilitation objectives for the UCDS and ICDS. The remainder of the Perimeter Waste Rock Emplacement (ie excluding the first outer batter) is incorporated within rehabilitation domain 5D (Waste Rock Emplacements).

4.4.3 Domain 3C – Infrastructure areas

Post-operations, the rehabilitation objectives for the infrastructure areas are to:

- remove all infrastructure to ensure the site is safe and free of hazardous materials (unless an alternative arrangement is agreed between Evolution, the ultimate landholder and relevant regulatory authorities); and
- establish vegetative communities (including scattered Eucalypt Woodland species and native and/or endemic pasture species) that are suitable for managed grazing.

The rehabilitation objectives for the contained water storages (ie D1 to D10) are to either decommission the infrastructure or retain the infrastructure for local landholder use. Decommissioning of the contained water storages would be undertaken to the satisfaction of the DRG and EPA in consultation with DPIE – Water and NRAR. Alternatively, the contained water storages may be retained for local landholder use upon agreement by Evolution and in consultation with the regulatory authorities.

The rehabilitation objectives for the Bland Creek Palaeochannel Borefield, Eastern Saline Borefield and associated pump stations and pipelines are to either dismantle and decommission (i.e. plug and cap) the bores and associated pump stations, or agree to an alternative use with local water users.

In consultation with the CEMCC, the rehabilitation objectives for the infrastructure areas (including the Bland Creek Palaeochannel Borefield bores, Eastern Saline Borefield and associated pump stations and pipelines) will be discussed during the life of the CGO and will be specifically reviewed in consultation with the CEMCC at the commencement of the final year of mine operations.

4.4.4 Domain 4D – Integrated waste landform

The existing TSFs are currently being modified to form the IWL. The IWL will integrate with the existing NWRE and involve an extension to the existing approved TSF footprint.

The existing NTSF and STSF continue to be used to store tailings. The final heights of these facilities will be STSF Stage 7 (248.4 m AHD) and NTSF Stage 6 (240.5 m AHD). The IWL would be constructed to a maximum height of 246 m AHD.

The rehabilitation objectives for the existing TSFs and IWL are:

- to establish permanently stable landforms;
- during operations, stabilise batters so that they provide minimal habitat value for bird life (ie rock mulch or pasture cover);
- post-operations, to establish vegetation communities (including Eucalypt and Riverine Woodland species and understorey species such as Rush sp. and pasture species) which are suited to the hydrological features and substrate materials of the top surface of the landform;
- post-operations, to establish vegetation communities (including native and/or endemic Eucalypt Woodland, shrubland and grassland species) similar to those remnants in the surrounding landscape which are suited to the substrate materials and slope of the embankments; and
- to exclude grazing and agricultural production.

The rehabilitation strategy for the existing TSFs and IWL and will include:

- allowing decant areas to dry and then capping with fill and/or a concrete plug;
- grouting underdrains;
- dismantling tailings discharge pipes and monitoring systems for re-use or disposal with the bulk of CGO infrastructure; and
- fencing the IWL during operations to prevent access by terrestrial wildlife, and this fence would remain during rehabilitation and post-mining to exclude grazing and agricultural production.

i Embankment construction

The NTSF and STSF will continue to be constructed in stages with the height of the embankments raised in advance of the storage requirements. As the storages fill, the embankments will be raised in a series of upstream lifts, at a rate of approximately 5 m per year. Each lift will comprise an earth/rock fill embankment, with a clay basal zone, supported by the dry tailings beach.

Construction of each lift will continue to involve placement of an interim rock buttress cover on the outer slope of the embankment to enhance stability.

Rehabilitation materials (eg rock mulch and topsoil) on the existing TSF embankments will continue to be stripped prior to placement of the interim rock buttress. The stripped rehabilitation materials would be either transferred to a new rehabilitation area or stockpiled proximal to the IWL for use during ongoing or final rehabilitation activities.

The outer downstream embankment of the IWL will be constructed using mined waste rock to provide long-term stability. The overall final slope of the outer downstream embankment of the IWL will be 14°.

Figure 4.5 shows conceptual embankment cross-sections of the southern, western and northern embankments of the IWL.

ii Rehabilitation cover system

The top surface of the IWL will include an upper and lower catchment area. Each area will form a low, internally draining landform, with drainage effected by controlled placement of cover materials and a number of shallow swales. The contained catchments will minimise surface water runoff from the top surface down the embankments. The rehabilitation cover system materials for the top surface would include a capillary break layer of rock, and layers of gypsum-treated subsoil and topsoil.

The rehabilitation methods for the IWL embankments will include spreading gypsum-treated topsoil over the surface of the embankment, cross-ripping along the contour of the slope and then revegetating with native and/or endemic Eucalypt Woodland, shrubland and grassland species suited to slope and elevated positions similar to those remnants in the surrounding landscape.

iii Revegetation

Like the revegetation approach for the WREs, revegetation of the IWL will include selecting species suited to the hydrological features and substrate materials of the landform and would be based on results of rehabilitation investigations and trials in consultation with regulatory authorities.

Vegetation growth trials undertaken to date indicate that salt tolerant tree species including Belah (*Casuarina cristata*), Grey Box (*E. microcarpa*), Bimble Box (*E. populnea*), Mugga Ironbark (*E. sideroxylon*) and Buloke (*Allocasuarina leuhmannii*) and shrub species including Green Wattle (*Acacia deanei*), Western Golden Wattle (*A. decora*), Weeping Myall (*A. pendula*), Wedge-leaf Hop-bush (*Dodonaea viscose ssp. cuneata*) and Nitre Goosefoot (*Chenopodium nitrariaceum*) may be suitable for revegetation of the IWL top surface (Evolution, 2016a).

Based on the above, post-operation revegetation for the IWL includes:

- In the two central, occasionally wet areas, planting species such as River Red Gum and understorey species such as Rush sp.
- On the remainder of the covered storage surface, planting salt tolerant Eucalypt and Riverine Woodland species (which may include Belah, Grey Box, Bimble Box, Mugga Ironbark and Buloke and shrub species including Green Wattle, Western Golden Wattle, Weeping Myall, Wedge-leaf Hop-bush and Nitre Goosefoot).
- On the IWL embankments, planting native and/or endemic species suited to the slope and substrate materials of the embankment.

Revegetation will consider the results of hydrological modelling predictions for the IWL (ie plant species will be selected that are suited to the hydrological conditions of the storages such as inundated areas, dry areas and swales).

Rehabilitation trials will continue to be undertaken to determine the most suitable revegetation species for the top surface and embankments of the IWL. A description of the rehabilitation trials that will be undertaken for the is provided in Section 6.2.

4.4.5 Domain 5D – Waste rock emplacements

The currently approved rehabilitation objectives for the WRE are to (Evolution, 2018a):

- stabilise batter slopes with rock armour (primary waste rock mulch) to control surface water runoff downslope and reduce erosion potential in the long-term;
- provide a stable plant growth medium able to support long-term vegetation growth including native and/or endemic Eucalypt woodland, shrubland and grassland species suited to slope and elevated positions similar to those remnants in the surrounding landscape; and
- exclude grazing and agricultural production.

The approved final heights of the Northern, Southern and Perimeter Waste Rock Emplacements are 308 m AHD, 283 m AHD and 233 m AHD, respectively.

A cross-section of the NWRE is shown in Figure 4.3 and is representative for the SWRE.

As described in the approved CGO Rehabilitation Strategy, drainage on the top surfaces of the WRE will be managed via a series of small shallow basins (depressions), a rehabilitation cover system (including gypsum-treated subsoil and topsoil) that absorbs rainfall and comprises woodland vegetation (Evolution, 2018a). The use of depressions is aimed at maximising internal drainage without creating permanent ponding during normal and heavy rainfall events (Evolution, 2018a).

A layer of gypsum and then primary waste rock may be placed over oxide waste rock areas on the top surface (and batters) of the SWRE (which has largely been constructed of oxide waste rock material) to assist with stabilising the sodic and dispersive characteristics of the oxide waste rock (Evolution, 2018a). Given the NWRE is mainly constructed of primary waste rock material, this practice is not required for this emplacement (Evolution, 2018a). This method may be subject to further investigations and/or trials.

A bund around the perimeter of the top surfaces of the waste rock emplacement will be constructed to provide a contained catchment and minimise surface water runoff from the top surface down the batters.

i Rehabilitation cover system – Batters

The rehabilitation cover system for the waste rock emplacement batters remains unchanged for the underground operations and includes:

- benign (primary) rock mulch; and
- low salinity and gypsum-treated topsoil.

The rock mulch and topsoil layers are cross-ripped with approximately 10 tonnes per hectare (t/ha) gypsum to reduce dispersion and form a binary rock/soil matrix, followed by seeding with native and/or endemic Eucalypt Woodland and shrub species during suitable seasonal conditions.

To stabilise areas where an adequate vegetation cover has yet not established, a layer of locally harvested seed-bearing native pasture hay (or clean wheaten hay) is spread to provide soil protection and soil stability for vegetation establishment. Cross-ripping along the contour is undertaken to encourage infiltration and enhance vegetation establishment.

The benign (primary) rock mulch used in the cover system is sourced from development of the open pit and includes suitable non-saline material.

Results of rehabilitation investigations and trials will continue to inform and refine CGO rehabilitation methods including rehabilitation materials and revegetation species. It is expected that the NWRE rehabilitation trial will continue to inform the most suitable applications of rock mulch and topsoil and plant species suited to the substrate materials.

ii Revegetation

The underground operations do not change the currently approved revegetation approached for the WRE. Revegetation aims to re-establish native and/or endemic Eucalypt Woodland, shrub and grassland communities similar to those remnants which persist on similar landforms in the regional landscape (eg Wamboyne Mountain, Fellmans Hill and Billy's Lookout). Suitability of revegetation species include consideration of the physiographic and hydrological features of the landform and performance relative to both stability and surface rehabilitation materials (subject to availability).

Figure 4.6 shows the vegetation communities that occur within ML 1535 and in the immediate landscape surrounding the CGO. A detailed description of the vegetation communities within ML 1535 and in the wider landscape is provided in the SSD EIS and Modification 16 Assessment Report(EMM 2020).

Results of ongoing rehabilitation monitoring will continue to be used to refine the revegetation species suited to the cover system materials for the waste rock emplacement batters.

Revegetation species considered suitable for revegetation of the CGO WRE have been developed by DnA Environmental (2016) with assistance from Diversity Native Seeds (a local native seed supplier). These species are associated with woodlands on low ridges and hills in the local landscape. A selection of these species has been used in the NWRE rehabilitation trial and would also be used in the large-scale substrate profile trials (Section 6.2).

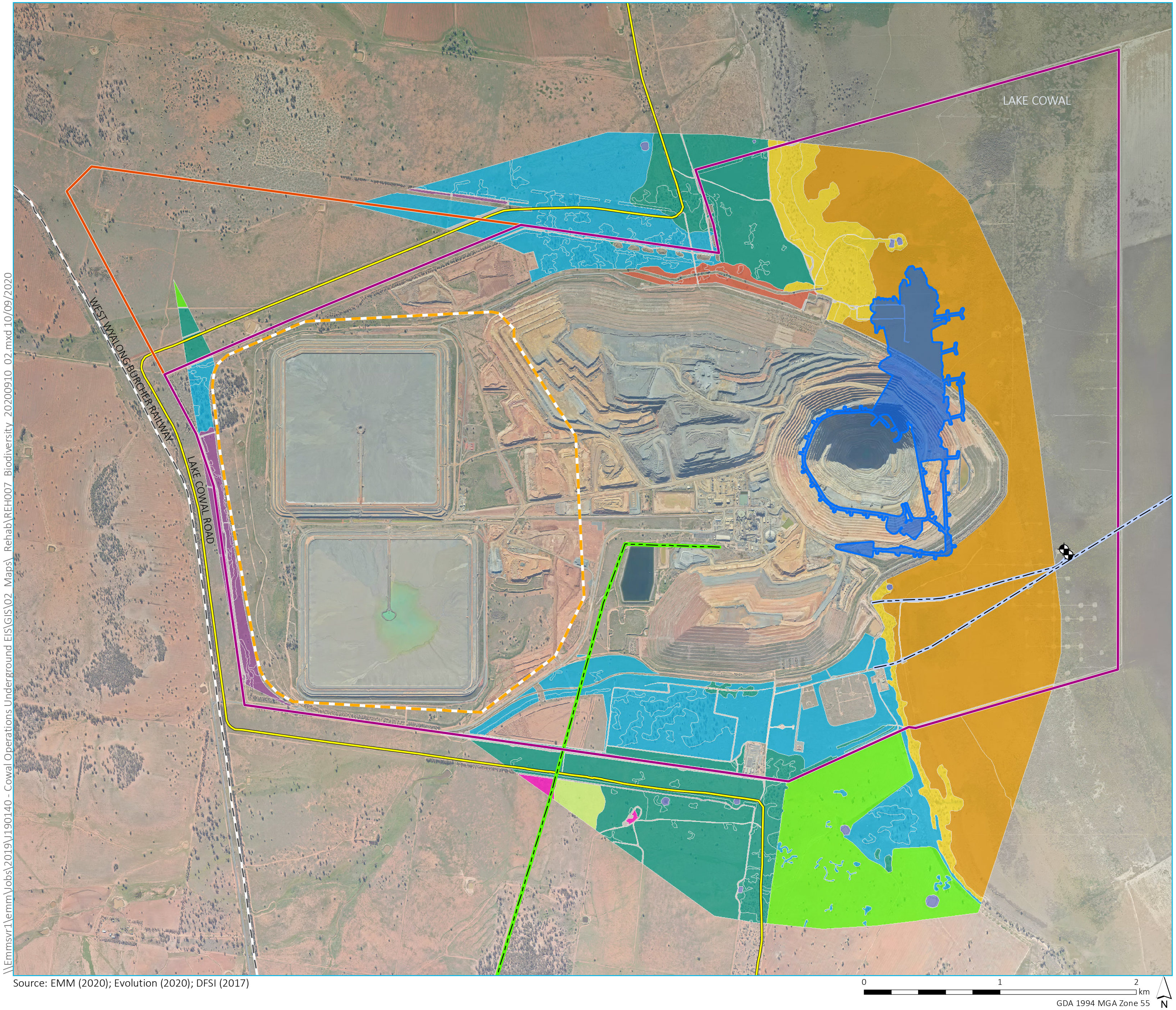
Consistent with the approved CGO Rehabilitation Strategy, revegetation species lists developed for the WRE may be refined based on results of rehabilitation investigations and trials (Evolution, 2018a).

4.4.6 Domain 6E – New Lake Foreshore

The New Lake Foreshore comprises the Temporary Isolation Bund, Lake Protection Bund and the first batter of the Perimeter Waste Rock Emplacement (PWRE).

Construction of the lake isolation embankments has been completed and the Temporary Isolation Bund and the Lake Protection Bund have been topsoiled and revegetated with native and exotic grass species and scattered aquatic species such as Lignum, Rush sp., River Cooba and River Red Gums. The outer batter slopes of the Lake Protection Bund have been rock armoured to further protect against wave action from lake level rises.

As described in the approved CGO Rehabilitation Strategy and MOP, the Temporary Isolation Bund is a short-term feature and at the completion of operations is proposed to be reworked (breached) by light machinery (ie small excavator and bob cat) when the level of the lake is lower than the bund, to create a series of low mounds (Evolution, 2018a). The mounds will comprise a mixture of inert bund rock and lakebed sediments (Evolution, 2018a).



Source: EMM (2020); Evolution (2020); DFSI (2017)

KEY

- Proposed underground development
- Mining lease (ML1535)
- Mining lease (ML1791)
- Indicative integrated waste landform perimeter
- Electricity transmission line
- Water supply pipeline
- Saline groundwater supply bore
- Rail line
- Main road

Vegetation mapping

- PCT26 - Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- PCT53 - Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluivial plains and floodplains
- PCT55 - Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.
- PCT82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
- PCT185 - Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion
- PCT244 - Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).
- PCT249 - River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW
- Cropped
- Exotic grassland
- Dam
- Cleared

CGO vegetation communities

Evolution Mining
Cowal Gold Operations
Mine closure and rehabilitation strategy
Figure 4.6

EMM
creating opportunities

Once the Temporary Isolation Bund has been reworked during the post-closure phase, the New Lake Foreshore will then comprise the Lake Protection Bund and the first batter of the PWRE.

Rehabilitation of the New Lake Foreshore is an iterative process and revegetation species will continue to be selected in consideration of:

- Lake Cowal's hydrological regime (wetting and drying cycles);
- species occurring in relevant reference sites (including lake and slope woodland communities);
- species performance during revegetation trials; and
- suitability to substrate conditions.

Subject to these parameters, species may be selected from the following vegetative suites:

- fringing lake vegetation on foreshore batters (i.e. Eucalypt dominated woodland including River Red Gum, River Cooba [*Acacia stenophylla*], Wilga [*Geijera parviflora*], Kurrajong [*Brachychiton populneus*], Green Wattle [*Acacia deanei*] and Grey Box [*Eucalyptus microcarpa*]); and
- freshwater habitats (ie Foxtail [*Austrostipa densiflora*], Rush, Cane Grass [*Eragrostis australasica*] and Lignum).

5 Rehabilitation methods for closure

5.1 Soil management

5.1.1 Soil stripping procedures and soil stockpile management

The currently approved strategies/objectives for management of the soil resources as described in the CGO Soil Stripping Management Plan require no change for the underground operation and include:

- characterisation of the suitability of material for rehabilitation works is conducted prior to stripping;
- stripping and stockpiling soil resources selectively and managed according to their suitability for rehabilitation purposes;
- stripping sufficient volumes of subsoil and stable topsoil for rehabilitation purposes;
- progressive rehabilitation of final landforms as soon as practical after completion of landforms or when areas are no longer required; and
- stripping and storing soil resources in such a manner that their long-term viability is maintained.

The general protocol for management of stockpiled soil includes soil handling measures that optimise the retention of soil characteristics (in terms of nutrients and micro-organisms) favourable to plant growth. The protocol includes:

- locating soil stockpiles outside the Lake Cowal floodplain;
- leaving the surface of the completed soil stockpiles in a roughened condition to help promote water infiltration and minimise erosion prior to vegetation establishment;
- deep ripping soil stockpiles with gypsum (or other relevant ameliorants) and seeding to maintain soil organic matter levels, soil structure and microbial activity;
- installing signposts for all soil stockpiles with the date of construction and type of soil; and
- recording details of all soil stockpiles on a site database which includes the location and volume of each stockpile and the stockpile maintenance records (eg ameliorative treatment, weed control, seeding).

Long-term topsoil stockpiles will continue to be constructed up to 3 m in height with slopes at a maximum acceptable angle to resist erosion. Subsoil stockpiles vary in height as determined by storage volumes and available space within the footprint of approved disturbance areas.

A detailed soil stockpile inventory is maintained to track soil resource accounting. McKenzie Soil Management's recommendations (including the treatment requirements for each soil stockpile and the soil characteristics) is incorporated into the inventory. The inventory is regularly updated to reflect soil treatment measures and soil usage.

5.1.2 Topsoil

The majority of stockpiled topsoil resources at the CGO reflect the hard-pedal red duplex soils associated with the majority of the ML area. The soils have a fine sandy clay loam to medium heavy clay loam texture and are hard setting (McKenzie Soil Management, 2013). These soils are dispersive (where non-saline), have variable pH, are partially phosphorus deficient, range from non-saline to strongly saline and are sodic (McKenzie Soil Management, 2013).

Where indicated by soil testing, topsoil is ameliorated with gypsum to improve its structure and reduce its potential to disperse.

5.1.3 Subsoil

The majority of stockpiled subsoil resources also reflect the hard-pedal red duplex soils associated with the majority of the mining lease area. The soils have a light medium clay texture and are extremely hard when dry (McKenzie Soil Management, 2013). The subsoil stocks are dispersive, strongly saline, strongly sodic, phosphorus deficient and have variable pH ranging from neutral to alkaline (McKenzie Soil Management, 2013).

To enhance the suitability of subsoil stocks for plant growth and to reduce tunnel erosion potential, gypsum application rates ranging between approximately 91 and 153 t/ha/m have been recommended by McKenzie Soil Management (2013).

5.1.4 Soil amelioration and management

Soil amelioration methods adopted at CGO are based on recommendations provided by McKenzie Soil Management (2013). These methods include (McKenzie Soil Management, 2013):

- spreading gypsum on the insitu soil surface prior to soil stripping;
- deep-ripping and applying gypsum (or other relevant treatment) to stockpiled soil; and
- applying gypsum to soil during re-application on rehabilitation areas.

A summary of the proposed soil amelioration methods is provided below. These are listed in order of preference.

i Application to soil prior to stripping

Gypsum has low solubility and requires mixing in the soil to be effective, so application to the soil surface prior to stripping is desirable as it ensures that the gypsum and soil is well mixed during the stripping process. It is also more cost effective as it easy to spread the gypsum over flat undisturbed soil compared with a soil stockpile or 11° WRE slope.

Gypsum will be applied to the surface of the Northern Waste Rock Emplacement expansion area, IWL footprint area and other approved infrastructure disturbance areas prior to stripping.

ii Treatment of soil stockpiles

If required by soil testing, soil stockpiles will be ripped to incorporate gypsum (or lime, or a gypsum-lime blend). The ameliorated soil is then excavated for rehabilitation purposes and the process repeated until all soil within the stockpile has been treated.

iii Treatment of soil on rehabilitation areas

Consistent with current rehabilitation procedures at the CGO, gypsum will continue to be applied to soil used for rehabilitation at rates based on soil testing results.

Based on McKenzie Soil Management's recommendations, soil re-application activities include:

- deep-ripping the soil surface to minimise compaction;
- applying coarse grade gypsum at approximately 10 t/ha to rehabilitation areas to provide a prolonged source of electrolyte to minimise dispersion of soils to assist with the revegetation establishment; and
- applying native pasture hay where possible to protect the surface soil and provide slow-release nutrients to encourage native plant growth.

5.2 Vegetation establishment

5.2.1 Species selection

Revegetation of the final landforms will include endemic vegetation communities, selected specifically for their suitability to the created elevation, substrate conditions and the overriding objective of re-establishing a greater extent of endemic vegetation within ML 1535.

Lists of species potentially considered suitable for use as tubestock and in a native seed mix for the CGO's rehabilitation programme have been developed by DnA Environmental in conjunction with Diversity Native Seeds and are provided in Appendix A. These lists consider the common local endemic vegetation species present in the landscape surrounding the CGO (DnA Environmental, 2016a).

The revegetation approaches for disturbed areas will continue to be informed by the results of the rehabilitation investigations, trials (Section 6.2) and rehabilitation monitoring results. Based on these results, the CGO rehabilitation programme (including revegetation species lists for each rehabilitation domain) will be refined in consultation with relevant regulatory agencies.

5.2.2 Seed collection

As a component of the Vegetation Clearance Protocol, during the preliminary habitat assessment phase, trees may be examined for their provision of seed to be used in the rehabilitation programme.

Where available, seed would be collected at the time of vegetation clearance activities and habitat features (ie hollows and logs) would be salvaged for use in rehabilitation or habitat enhancement programmes within ML 1535 and/or within the CGO's offset areas and RVEP areas.

CGO also proposes to engage an external consultant to prepare a seed supply and planting implementation strategy for the CGO's rehabilitation programme within ML 1535 and for implementation of CGO's offset strategy. The strategy will include implementation plans/programmes for:

- seed collection/harvesting and seed processing and storage;
- seed propagation;
- site preparation and planting; and
- maintenance (including supplementary plantings and weed and pest control).

The strategy will include an assessment of the potential risks associated with the seed supply and planting implementation programme.

5.2.3 Revegetation methods

Revegetation at the CGO uses a combination of direct seeding and tubestock planting.

5.3 Fauna and habitat enhancement measures

As detailed in CGO's Rehabilitation Management Plan, where practicable, vegetation clearance operations will be managed to maximise the re-use of cleared vegetative material and habitat resources/features. Habitat resources/features such as logs and hollows will be clearly marked (with flagging tape or similar) for salvage/relocation in the CGO's rehabilitation programme (or for use within the CGO's offset enhancement areas or remnant vegetation enhancement programme areas).

Vegetative material unsuitable for the rehabilitation programme or for habitat enhancement may be mulched and stockpiled.

5.4 Erosion and sediment control

An assessment of soil erosion hazard was undertaken for the project in accordance with the requirements of Landcom 2004. This is described in section 3.2.2 and ranges from very low to very high. The key erosion risks for the project are:

- highly erodible dispersible subsoils and topsoils;
- low annual average rainfall to establish and sustain vegetation cover; and
- long and steep slopes.

Erosion and sediment control management and mitigation measures are described in the approved CGO Erosion and Sediment Control Plan.

The majority of the disturbed areas within the project will report to Type D/F sediment basins such that any eroded sediments will be contained (up to and including the design storm event). Contained turbid water is re-used on site.

The sediment basins will be maintained on site until 70% soil surface cover has been achieved on the rehabilitated surfaces and/or runoff meets the nominated water quality criteria.

Dispersive soils are managed in accordance with the methodologies described in sections 4.4 and 5.1.4 that including gypsum treatment to reduce exchangeable sodium and exchangeable magnesium levels and the use of rock/soil matrices on slopes.

Progressive rehabilitation of disturbed areas is undertaken to reduce the area and duration of exposure.

Interim rehabilitation measures that are implemented to minimise the area exposed for dust generation include the topsoiling and establishment of a cover crop on landforms/areas and on long-term soil stockpiles to minimise area exposed for dust generation.

Rock mulch is applied as soon as practicable following the completion of landform shaping to minimise the potential for windblown dust from the surface waste rock and to reduce the potential for soil erosion from rainfall.

Following re-profiling works and rock mulch and topsoil application, native pasture hay (or clean wheaten hay) applied on areas where the initial cover crop has not yet established to assist with stabilising and minimising the loss of topsoil resources.

5.5 Post-closure maintenance

5.5.1 Rehabilitation monitoring

Rehabilitation monitoring will continue to be undertaken using analogue sites and LFA to assess rehabilitation progress and success as detailed in the RMP and MOP. Annual rehabilitation reports are prepared, and a summary of these reports are included in the Annual Reviews.

Data obtained from the analogue sites provides a range of values from replicated examples of similar vegetation communities. Rehabilitation areas are compared to reference sites that best represent the final land use, vegetation community and management conditions they will be subjected to.

This approach allows the recognition of the dynamic nature of ecosystems therefore rehabilitation sites are monitored simultaneously to the reference sites over time to account for changes in:

- seasonal variations;
- climatic conditions;
- management practices; and
- unexpected disturbance events such bushfire.

In order to demonstrate rehabilitate success or succession toward rehabilitation success, specific indicators have been developed to equal values obtained from the reference site under the same set of conditions or demonstrate a positive trend towards target values.

Rehabilitation monitoring informs areas requiring maintenance and identify and address deviations from the expected outcomes. Rehabilitated areas are assessed against performance indicators (refer Section 6) and regularly inspected (at least on an annual basis) for the following aspects:

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

Where rehabilitation criteria have not been met, maintenance works will be undertaken in accordance with the Trigger, Action, Response Plan (TARP) provided as Table 5 in the RMP.

5.5.2 Weed management

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

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

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

5.5.3 Access

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

5.5.4 Public safety

Controls will be implemented to minimise the potential for impacts on public safety, and may include maintenance of fencing and warning signs around areas that have the potential to cause harm and are that are accessible to the public including bunding and fencing of the void as described in section 4.4.1.

5.5.5 Rehabilitation resources

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

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

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

A rehabilitation management plan has been developed to provide a structured and documented process for managing and improving rehabilitation activities at the mine. The plan serves as a process map for interdepartmental administration of rehabilitation activities within the mine planning and implementation process.

6 Performance indicators and completion criteria

6.1 Rehabilitation criteria and reporting

Rehabilitation completion criteria are used as the basis for assessing when rehabilitation of the project is complete. Indicators are measured against the criteria, and are set for the six phases of rehabilitation, consistent with ESG3 as follows:

- Phase 1 – Decommissioning (ie removal of equipment and infrastructure);
- Phase 2 – Landform Establishment (ie land shaping);
- Phase 3 – Growth Medium Development (ie soil physical and chemical properties);
- Phase 4 – Ecosystem and Land Use Establishment (ie vegetation establishment);
- Phase 5 – Ecosystem and Land Use Sustainability (ie established vegetation is supporting post-mining land use); and
- Phase 6 – Land Relinquishment.

Rehabilitation criteria for the project have been developed with the current knowledge of rehabilitation practices and success in similar project environments. They consist of a set of objectives; rehabilitation criteria and evidence that criteria have been met using LFA and agricultural productivity measures or the like.

Whether rehabilitation criteria have been met depends on the trending of measurements over time compared to pre-mining or analogue site conditions.

The rehabilitation criteria need to demonstrate that the rehabilitation objective has been achieved. Qualitative and quantitative rehabilitation performance indicators and completion criteria have been developed by DnA Environmental (2016; 2017) to assess rehabilitation performance at the CGO. These are provided in Table 6.1.

DnA Environmental has identified an upper and lower range of criteria values based on monitoring data collected across selected analogue sites. It is important to note that these upper and lower criteria values are dynamic and change each year based on the monitoring results from the analogue sites. This is undertaken to reflect the seasonal and climatic conditions at the time of monitoring.

Domains rehabilitation criteria and post-mining land use objectives are provided in Table 6.2 to Table 6.7. Some of these include alternative options that are still subject to consultation and agreement (eg decommissioning water management infrastructure or retaining for future use post-mining), the performance indicator will be to undertake the relevant consultation to determine the final rehabilitation and post-mining land use objective. The relevant completion criteria will then be updated in future MOPs once the post-mining land use is agreed for these domains.

Table 6.1 Rehabilitation performance indicators and completion criteria

Rehabilitation Phase	Aspect or Ecosystem Component	Completion Criteria	Performance Indicators	Unit of Measurement	Lake Foreshore Ecosystem Range		Grassland Ecosystem Range		Hill Ecosystem Range 2017		Slopes Ecosystem Range	
Performance indicators are quantified by the range of values obtained from replicated reference sites					Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Landform establishment and stability	Landform slope, gradient	Landform suitable for final land use and generally compatible with surrounding topography	Slope	Degrees	1	5	4	6	2	7	1	4
	Active erosion	Areas of active erosion are limited	Number of rills/gullies	Number	0	0	0	0	0	0	0	0
			Cross-sectional area of rills/gullies	Square metre (m^2)	0	0	0	0	0	0	0	0
Growth medium development	Soil chemical, physical properties and amelioration	Soil properties are suitable for the establishment and maintenance of selected vegetation species	pH	pH	6.73	6.77	5.90	6.10	4.50	5.80	7.75	8.32
			EC	<deciSiemens per metre (dS/m)	0.065	0.091	0.066	0.082	0.045	0.151	0.297	0.503
			Organic Matter	%	1.4	1.8	3.2	3.4	4.6	21.0	3.0	3.4
			Phosphorous	Parts per million (ppm)	14.4	20.3	13.1	28.2	9.8	42.3	14.8	25.6
			Nitrate	ppm	4.4	11.0	3.4	9.0	1.5	8.1	5.5	6.9
			Cation Exchange Capacity	Centimoles of positive charge per kilogram (Cmol+/kg)	10.1	21.0	8.6	10.1	7.1	10.2	33.5	51.3
			Exchangeable Sodium Percentage	%	3.1	3.5	2.5	6.0	1.6	3.3	2.3	8.9
Ecosystem and Land Use Establishment	LFA Landform Stability and Landscape Organisation indices	Landform is stable and performing as designed	LFA Stability	%	42.7	70.0	67.5	70.5	60.9	73.5	54.7	76.0
			LFA Landscape Organisation	%	51	88	100	100	77	100	56	100

Table 6.1 Rehabilitation performance indicators and completion criteria

Rehabilitation Phase	Aspect or Ecosystem Component	Completion Criteria	Performance Indicators	Unit of Measurement	Lake Foreshore Ecosystem Range		Grassland Ecosystem Range		Hill Ecosystem Range 2017		Slopes Ecosystem Range	
	Vegetation diversity	Vegetation contains a diversity of species comparable to that of the local remnant vegetation	Diversity of shrubs and juvenile trees	Species/area	3	4	1	1	1	4	3	4
				% population	100	100	100	100	98	100	97	100
			Total species richness	Number/area	35	37	31	38	9	42	22	41
			Native species richness	> Number/area	20	29	24	26	9	38	21	35
			Exotic species richness	< Number/area	8	15	7	12	0	5	1	6
	Vegetation density	Vegetation contains a density of species comparable to that of the local remnant vegetation	Density of shrubs and juvenile trees	Number/area	41	274	1	1	32	379	31	59
Ecosystem and Land Use Establishment (Cont.)	Ecosystem composition	The vegetation is comprised by a range of growth forms comparable to that of the local remnant vegetation	Trees	Number/area	1	1	0	1	1	4	1	3
			Shrubs	Number/area	2	3	0	1	2	3	1	2
			Sub-shrubs	Number/area	2	3	2	6	0	9	8	9
			Herbs	Number/area	18	23	18	20	3	15	7	17
			Grasses	Number/area	7	11	8	10	2	12	3	11
			Reeds	Number/area	0	1	0	1	0	1	0	0
			Ferns	Number/area	0	0	1	1	0	1	0	0
			Aquatic	Number/area	0	0	0	0	0	0	0	0
			Parasite	Number/area	0	0	0	0	0	0	0	1
Ecosystem and Land Use Development	LFA Landform Function and Ecological Performance indices	Landform is ecologically functional and indicative of a landscape on a trajectory towards a	LFA Infiltration	%	40.4	44.9	31.7	34.4	40.1	58.8	30.3	37.3
			LFA Nutrient Cycling	%	22.5	34.6	33.2	34.4	43.7	56.4	29.1	44.4

Table 6.1 Rehabilitation performance indicators and completion criteria

Rehabilitation Phase	Aspect or Ecosystem Component	Completion Criteria	Performance Indicators	Unit of Measurement	Lake Foreshore Ecosystem Range		Grassland Ecosystem Range		Hill Ecosystem Range 2017		Slopes Ecosystem Range	
		self-sustaining ecosystem										
	Protective ground cover	Ground layer contains protective ground cover and habitat structure comparable with the local remnant vegetation	Litter cover	%	30	61	63	83	67	88	58	75
			Annual plants	< %	1	14	7	9	0	0	0	0
			Cryptogam cover	%	0	0	1	2	0	6	4	6
			Rock	%	0	0	0	1	0	2	0	0
			Log	%	0	1	0	0	0	10	0	3
			Bare ground	< %	32	32	1	18	5	14	4	27
			Perennial plant cover (<0.5 m)	%	6	25	6	12	1	21	9	15
			Total Ground Cover	%	68	69	82	100	86	96	74	96
	Ground cover diversity	Vegetation contains a diversity of species per square meter comparable to that of the local remnant vegetation	Native understorey abundance	>Species/m2	2.6	5.8	4.0	6.0	1.8	5.0	4.0	5.0
			Exotic understorey abundance	<Species/m2	0.8	1.6	1.0	3.0	0.0	0.2	0.0	0.8
	Native ground cover abundance	Native ground cover abundance is comparable to that of the local remnant vegetation	Percent ground cover provided by native vegetation <0.5 m tall	%	72.2	85.0	53.2	82.7	96.0	100	86.4	100
Ecosystem and Land Use Development (Cont.)	Ecosystem growth and natural recruitment	The vegetation is maturing and/or natural recruitment is occurring at rates similar to those of the local remnant vegetation	Shrubs and juvenile trees 0–0.5 m in height	Number/area	15	236	1	1	1	364	7	12
			Shrubs and juvenile trees 0.5–1 m in height	Number/area	4	7	0	0	1	17	5	9

Table 6.1 Rehabilitation performance indicators and completion criteria

Rehabilitation Phase	Aspect or Ecosystem Component	Completion Criteria	Performance Indicators	Unit of Measurement	Lake Foreshore Ecosystem Range		Grassland Ecosystem Range		Hill Ecosystem Range 2017		Slopes Ecosystem Range	
			Shrubs and juvenile trees 1−1.5 m in height	Number/area	2	2	0	0	0	5	7	7
			Shrubs and juvenile trees 1.5 – 2 m in height	Number/area	2	4	0	0	0	3	4	8
			Shrubs and juvenile trees >2 m in height	Number/area	13	30	0	0	0	53	8	23
	Ecosystem structure	The vegetation is developing in structure and complexity comparable to that of the local remnant vegetation	Foliage cover 0.5–2 m	% cover	6	13	0	0	0	6	0	17
			Foliage cover 2–4 m	% cover	0	3	0	0	0	11	8	10
			Foliage cover 4–6 m	% cover	4	4	0	0	0	16	3	7
			Foliage cover >6 m	% cover	0	7	0	0	5	29	0	20
	Tree diversity	Vegetation contains a diversity of maturing tree and shrubs species comparable to that of the local remnant vegetation	Tree diversity	Species/area	1	2	0	0	2	5	1	2
				%	100	100	0	0	100	100	100	100
	Tree density	Vegetation contains a density of maturing tree and shrubs species comparable to that of the local remnant vegetation	Tree density	Number/area	2	12	0	0	6	59	11	26
			Average diameter at breast height (dbh)	centimetre	23	50	0	0	11	50	11	12
	Ecosystem health	The vegetation is in a condition comparable to that of the local remnant vegetation	Live trees	% population	100	100	0	0	57	100	88	91
			Healthy trees	% population	0	92	0	0	16	100	64	85
			Medium health	% population	8	100	0	0	0	39	4	27

Table 6.1 Rehabilitation performance indicators and completion criteria

Rehabilitation Phase	Aspect or Ecosystem Component	Completion Criteria	Performance Indicators	Unit of Measurement	Lake Foreshore Ecosystem Range		Grassland Ecosystem Range		Hill Ecosystem Range 2017		Slopes Ecosystem Range	
			Advanced dieback	% population	0	0	0	0	0	26	0	0
			Dead Trees	% population	0	0	0	0	0	36	9	12
			Mistletoe	% population	0	0	0	0	0	0	0	4
			Flowers/fruit: Trees	% population	33	100	0	0	12	50	0	8
			Hollows: Trees	% population	0	50	0	0	0	33	0	0

Table 6.2 Rehabilitation objectives, performance indicators and completion criteria for Domain 1A

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
Decommissioning	Leave the void surrounds safe (for humans and stray stock).	Safety measures implemented in area surrounding final void.	Perimeter bund constructed, is stable and vegetated with long-term cover crop.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
			Void fenced and warning signs posted along the fence.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
			Portals sealed and underground infrastructure removed	Resource Regulator requirements

Table 6.3 Rehabilitation objectives, performance indicators and completion criteria for Domain 2B

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
Ecosystem and Land Use Sustainability	Permanent drainage of adjacent areas upslope of the CGO to Lake Cowal will be facilitated by the UCDS.	UCDS constructed.	UCDS facilitates permanent drainage of adjacent areas upslope of the CGO to Lake Cowal.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
	The UCDS will include constructed features that simulate endemic drainage features including low flow and overbank zones, meanders, pool/riffle sequences and riparian vegetation to stabilise the channel.	Low flow and overbank zones, meanders, pool/riffle sequences constructed and riparian vegetation established.	The UCDS constructed features simulate endemic drainage features and riparian vegetation is present and stabilises the upper banks of the channel.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
	Runoff generated within the site will be contained by low mounds associated with the ICDS.	Low mounds constructed.	Runoff generated within the site is contained.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)

Table 6.4 Rehabilitation objectives, performance indicators and completion criteria for Domain 3C

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
Decommissioning	All infrastructure (unless alternative use agreed) will be dismantled, decommissioned and removed to ensure the site is safe and free of hazardous materials.	Workshop, storage, process plant and administration buildings removed.	Complete removal of buildings.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
		All exploration facilities dismantled and exploration areas including drill holes decommissioned and exploration equipment removed from site.	All open drill holes plugged, capped and decommissioned in accordance with the regulatory guidelines.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)

Table 6.4 Rehabilitation objectives, performance indicators and completion criteria for Domain 3C

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
		Hazardous materials removed.	Hazardous materials (including process chemicals) removed to appropriate standards.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a) *Decontamination and Decommissioning Plan, Cowal Gold Mine Processing Facilities* (ATC Williams, 2014)
		Cyanide areas decontaminated and decommissioned.	Cyanide areas decontaminated and decommissioned to appropriate standards.	*Decontamination and Decommissioning Plan, Cowal Gold Mine Processing Facilities* (ATC Williams, 2014)
		Undertake consultation to confirm any alternative use for non-permanent water management infrastructure (i.e. contained water storages) post-mining.	Consultation complete. Decision made regarding whether water management infrastructure is retained for alternative use or if infrastructure is to be decommissioned.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
	A reference site(s) will be established in an area of scattered Eucalypt Woodland/Grassland in the surrounding landscape which is representative of the proposed post-mining land use for the Infrastructure Area.	Undertake assessment of landscape surrounding the CGO to determine an appropriate reference site.	Reference site(s) selected.	Explanatory Note 2 (Section L) of *ESG3: Mining Operations Plan (MOP) Guidelines* (September 2013)
Growth Medium Establishment	All areas where infrastructure has been removed will be ripped, contoured (if necessary) and topsoiled.	Infrastructure removed. Topsoil stocks available. Gypsum applied to topsoil (if necessary).	Growth medium established for all former infrastructure areas where infrastructure is not retained.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
Ecosystem and Land Use Establishment	Establish vegetative communities (including scattered Eucalypt woodland species and native pasture species) which are endemic to the region and/or suited to the substrate materials.	Refer to Ecosystem and Land Use Establishment performance indicators in Table 13 Evolution, 2018a	Refer to Ecosystem and Land Use Establishment completion criteria in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)

Table 6.4 Rehabilitation objectives, performance indicators and completion criteria for Domain 3C

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
	Vegetative communities (including scattered Eucalypt woodland species and native pasture species) are self-sustaining and suited to agreed post-mining land use.	Refer to Ecosystem and Land Use Development performance indicators in Table 13 Evolution, 2018a.	Refer to Ecosystem and Land Use Development completion criteria in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)

Table 6.5 Rehabilitation objectives, performance indicators and completion criteria for Domain 4D

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
Decommissioning	IWL infrastructure to be removed.	A plan for decommissioning the IWL has been developed.	Pipelines, pumps and related tailings infrastructure removed.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
Landform Establishment	Establish permanently stable landforms.	TSF/IWL outer batter slopes constructed in accordance with design criteria.	TSF/IWL outer batters constructed as designed.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
		Assessment of the integrity of the TSF/IWL walls.	Agreement/sign-off from the DSC.	DSC requirement.
Growth Medium Establishment	During operations, stabilise embankments so that they provide minimal habitat value for bird life (i.e. pasture cover).	Erosion monitoring undertaken.	No active erosion on outer batter slopes.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
		Benign primary waste rock mulch (rock mulch) sized approximately < 300 mm available for use.	Rock mulch size and depth is effective in stabilising outer batters of the TSFs/IWL.	
		Complete soil resource materials balance.	Sufficient soil available to meet cover system depth requirements.	
		Soil analysis undertaken to confirm appropriate gypsum application rate.	Soil analysis complete and gypsum applied at appropriate application rate.	

Table 6.5 Rehabilitation objectives, performance indicators and completion criteria for Domain 4D

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
Ecosystem and Land Use Establishment	During operations, stabilise embankments so that they provide minimal habitat value for bird life (i.e. pasture cover).	Refer to Ecosystem and Land Use Establishment performance indicators for 'Grassland Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Ecosystem and Land Use Establishment completion criteria for 'Grassland Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
Ecosystem and Land Use Sustainability	**Top Surface of IWL** Post-operations, establish vegetative communities (including Eucalypt and Riverine woodland species and understorey species such as Rush sp. and pasture species) on the top surface of the IWL which are suited to the hydrological features and substrate materials of the top surface of the landform.	Rehabilitation trials have identified vegetation species suited to the IWL top surface.	Rehabilitation monitoring demonstrates vegetation established on top surface of the IWL is suited to the landform and is on a trajectory towards a self-sustaining ecosystem.	RMP
	Outer Embankments of IWL Post-operations, establish vegetative communities (including native and/or endemic Eucalypt Woodland, shrubland and grassland species) similar to those remnants in the surrounding landscape which are suited to the substrate materials and the slope of the embankments.	Refer to Ecosystem and Land Use Development performance indicators for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Ecosystem and Land Use Development completion criteria for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
	Exclude grazing and agricultural production.	Fence IWL.	IWL fenced, and grazing and agricultural production excluded.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)

Table 6.6 Rehabilitation objectives, performance indicators and completion criteria for Domain 5D

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
Landform Establishment	Stabilise batter slopes with rock armour (benign primary waste rock mulch) to control surface water runoff downslope and reduce erosion potential in the long-term.	Refer to Landform Establishment and Stability performance indicators for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Landform Establishment and Stability completion criteria for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
	Top surfaces of WRE constructed to include a series of small shallow basins (depressions) to maximise internal drainage.	Shallow basins constructed on waste rock emplacement top surfaces.	Drainage of top surfaces of WRE is managed by shallow basins.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
	A bund around the perimeter of top surface of WRE will be constructed to minimise surface water runoff from the top surface down the batters.	Perimeter bund constructed.	The top surface of WRE forms a contained catchment and the perimeter bund minimises surface water runoff from the top surface down the batters.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
Growth Medium Development	Provide a stable plant growth medium on the outer batters and top surfaces of the WRE able to support long-term vegetation growth.	Refer to Growth Medium Development performance indicators for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Growth Medium Development completion criteria for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
Ecosystem and Land Use Establishment	**Top Surfaces of Waste Rock Emplacements** Post-operations, establish vegetative communities (including Eucalypt woodland species) on the top surfaces of the WRE which are suited to the substrate materials and is comparable to local remnant ecological communities located on hill top areas in the surrounding landscape.	Refer to Ecosystem and Land Use Establishment performance indicators for 'Hill Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Ecosystem and Land Use Establishment completion criteria for 'Hill Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)

Table 6.6 Rehabilitation objectives, performance indicators and completion criteria for Domain 5D

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
	Outer Batters of Waste Rock Emplacements Post-operations, establish vegetative communities (including Eucalypt woodland species) on the outer batters of the WRE which are suited to the substrate materials and is comparable to local remnant ecological communities on rocky slopes in the surrounding landscape.	Refer to Ecosystem and Land Use Establishment performance indicators for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Ecosystem and Land Use Establishment completion criteria for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
Ecosystem and Land Use Sustainability	**Top Surfaces of Waste Rock Emplacements** Ecosystem is on a trajectory towards self-sustaining and is comparable to local remnant ecological communities on hill top areas in the surrounding landscape.	Refer to Ecosystem and Land Use Development performance indicators for 'Hill Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Ecosystem and Land Use Development completion criteria for 'Hill Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
Ecosystem and Land Use Sustainability (continued)	**Outer Batters of Waste Rock Emplacements** Ecosystem is on a trajectory towards self-sustaining and is comparable to local remnant ecological communities on rocky slopes in the surrounding landscape.	Refer to Ecosystem and Land Use Development performance indicators for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Ecosystem and Land Use Development completion criteria for 'Slopes Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
	Exclude grazing and agricultural production from WRE.	Fence WRE.	Waste rock emplacements fenced, and grazing and agricultural production excluded.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)

Table 6.7 Rehabilitation objectives, performance indicators and completion criteria for Domain 6E

Rehabilitation Phase	Objective	Performance Indicator	Completion Criteria	Justification/Source
Landform Establishment	Raise Temporary Isolation Bund height by 0.5 m to provide for future lake water level rises and stabilise outer batters using rock mulch to minimise erosion from wave action.	Lake water level suitable for works to commence.	Stabilisation works complete.	*Cowal Gold Mine Mining Operations Plan 1 September 2016 – 31 August 2018* (including approved Amendments)
Growth Medium Development	Provide a plant growth medium on newly constructed components of the Temporary Isolation Bund able to support long-term vegetation growth.	Refer to Growth Medium Development performance indicators for 'Lake Foreshore Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Growth Medium Development completion criteria for 'Lake Foreshore Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
Ecosystem and Land Use Establishment	Select and establish species for revegetation of the New Lake Foreshore from vegetative suites as described in Section 5.3.6 and based on rehabilitation monitoring and trial results.	Refer to Ecosystem and Land Use Establishment performance indicators for 'Lake Foreshore Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Ecosystem and Land Use Establishment completion criteria for 'Lake Foreshore Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)
Ecosystem and Land Use Sustainability	Ecosystem is on a trajectory towards self-sustaining.	Refer to Ecosystem and Land Use Development performance indicators for 'Lake Foreshore Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Refer to Ecosystem and Land Use Development completion criteria for 'Lake Foreshore Ecosystem Range 2017' in Table 13 Evolution, 2018a.	Cowal Gold Operations Processing Rate Modification Environmental Assessment (Evolution, 2018a)

6.2 Rehabilitation monitoring and research

6.2.1 Rehabilitation monitoring

The rehabilitation monitoring methodology used CGO has been independently developed to assess the performance of the CGO's rehabilitation areas (and to assess regeneration [and revegetation] performance within the CGO's Offset and RVEP Areas).

The rehabilitation monitoring methodology was developed by DnA Environmental in 2011 that includes a combination of:

- Landscape Function Analysis (LFA) indicators (which includes measurement of soil erosion type and severity);
- accredited soil analyses indicators; and
- an assessment of ecosystem characteristics using an adaptation of methodologies derived by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Methodology for the Grassy Box Woodlands Benchmarking Project in Southern NSW Murray-Darling Basin (Gibbons, 2002) and the associated Biometric Model Rapidly quantifying reference conditions in modified landscapes (Gibbons et al., 2008).

The methodology includes qualitative performance indicators and completion criteria and quantitative performance indicators and completion criteria developed from relevant analogue sites representative of the CGO final landforms and long-term land use strategy.

A summary of the monitoring methodology components currently used on site, and will continue to be used, is provided below.

i Landscape function analysis

LFA is one of three components of the EFA tool developed by the CSIRO that aims to measure the progression of revegetation/rehabilitation towards a self-sustaining ecosystem.

LFA indices can be used to demonstrate that an area is on a trajectory towards a self-sustaining landscape, that is, the landscape contains processes operating to maintain the biogeochemical 'engine-room' of a landscape (Tongway and Hindley, 2004). The EFA methodology is described in detail in *Assessing Rehabilitation Success Version 1.1* (Tongway, 2001), *Landscape Function Analysis: Procedures for Monitoring and Assessing Landscapes with Special Reference to Minesites and Rangelands Version 3.1* (Tongway and Hindley, 2004), *and Landscape Function Analysis Field Procedures* (Tongway, 2008).

In accordance with the LFA methodology, the LFA monitoring results will be used to assess whether rehabilitation areas are on a trajectory towards a self-sustaining landscape. Relevant LFA performance indicators and completion criteria are detailed in Section 6.1.

ii Soil analyses

Soil samples are taken using a core sampler within a monitoring quadrat at each rehabilitation monitoring site. At least 12 cores are taken at each site and soil samples sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis.

Soil samples are analysed for the following parameters: pH, electrical conductivity, available calcium, magnesium, potassium, ammonia, sulphur, organic matter, exchangeable sodium, calcium, magnesium, potassium, hydrogen, aluminium, cation exchange capacity, available and extractable phosphorus, micronutrients (zinc, manganese, iron, copper, boron) and total carbon and nitrogen. Exchangeable sodium percentages are also calculated as a measure of sodicity or dispersion.

iii Ecological assessment

In addition to LFA, various biodiversity components are assessed to monitor the successional phases/changes of plant development and to identify the requirements for ameliorative measures and guide adaptive management. The rapid ecological assessment provides quantitative data that measures changes in:

- floristic diversity including species area curves and growth forms (using full floristic sampling);
- ground cover diversity and abundance;
- vegetation structure and habitat characteristics (including ground cover, cryptogams, logs, rocks, litter, projected foliage cover at various height increments);
- understorey density and growth (including established shrubs, direct seeding and tubestock plantings and tree regeneration);
- overstorey characteristics including tree density, health and survival; and
- other habitat attributes such as the presence of hollows, mistletoe and the production of buds, flowers and fruit.

Permanent transects and photo-points have been established to record changes in these attributes over time.

These ecological assessment components will be described in detail in the annual rehabilitation monitoring report.

The monitoring methodology described above may be revised (in consultation with relevant regulatory authorities) should an alternative method be required to adequately assess rehabilitation performance.

iv Monitoring quadrats

The monitoring methodology components described above are undertaken within 20 m x 50 m monitoring quadrats established at each rehabilitation monitoring site and reference site. An LFA transect is established along the 20 m downslope boundary of the quadrat. Vegetation monitoring is undertaken within 1 m x 1 m sub-quadrats at 5 m intervals along the 50 m transect which runs perpendicular to the LFA transect.

The transect and quadrat boundary points are marked with pegs (and flagging tape) and global positioning system details recorded at each peg to ensure the location of the quadrat and transects is consistent over time.

Permanent photopoints have been established at the monitoring quadrats to monitor the changes that occur over time. The methodology for photographic monitoring is consistent with the NSW National Parks and Wildlife Service (2003) *Conservation Management Note 9 – Photographic Monitoring*. Photos are taken annually during spring and during a similar time of day (for consistence of light conditions).

After each photographic monitoring event, the photographs are compared to the photographs from the previous monitoring periods. The following elements will be noted:

- plant establishment;
- the status of weeds;
- natural regeneration of species; and
- presence of habitat features (eg logs, litter, rocks).

A review of aerial photography may also be used to show enhancement of vegetation connectivity.

v Analogue sites

In 2011 DnA Environmental identified four broad vegetation community types as representative of the CGO final landforms:

- lake – woodlands occurring within the lake and lake foreshores (relevant to the New Lake Foreshore [Domain 7]);
- slopes – woodlands occurring on flat to gently undulating slopes (relevant to lower slopes of the WRE [Domain 5]);
- hills – woodlands occurring on low ridges, hills and elevated land (relevant to upper slopes and top surfaces of the WRE [Domain 5]); and
- grasslands – cleared native grasslands, predominantly occurring on flat to gently undulating slopes (relevant to infrastructure areas [Domain 3] and slopes of the tailings storage facilities [during operations] [Domain 4]).

Analogue sites relevant to each of the four broad vegetation communities listed above were established in the landscape surrounding the CGO in 2010 and include the following:

- RLake 01 and RLake 02 – woodlands occurring within the lake and lake foreshores;
- RSlope 01 and RSlope 02 – woodlands occurring on flat to gently undulating slopes;
- RHill 02, RHill 03 and RHill 06 – woodlands occurring on low ridges, hills and elevated land; and
- RGrass 01 and RGrass 03 – cleared native grasslands, predominantly occurring on flat to gently undulating slopes.

These are shown in Figure 12 in the CGO Rehabilitation Management Plan.

6.2.2 Rehabilitation trials and research

Rehabilitation will continue to be an iterative process, whereby the results of the revegetation trials and monitoring will be used to provide feedback into the most appropriate species, revegetation and propagation methods, and substrate suitability for the rehabilitation of the CGO components.

Many of the rehabilitation practices currently used on site are a function of previous research and rehabilitation trials. Key examples include:

- the use of topsoil and rock matrices to provide erosion protection, reduce runoff and maximise native plant establishment; and
- the use of native pasture hay for erosion protection and moisture retention.

Ongoing rehabilitation trials and research will be an extension of the trials undertaken to date and will include:

- Material Amelioration – Continued investigation into the chemical and physical properties of soil resources and the optimum rates of gypsum application to improve suitability for plant growth and use on rehabilitation areas.
- Rehabilitation Media – Northern Waste Rock Emplacement trial – continued monitoring of the effectiveness of various applications associated with the rock mulch, topsoil and hay cover materials stabilising landform slopes (ie controlling erosion) and providing a suitable medium for revegetation.

- Revegetation – Ongoing trials and research to determine the most appropriate revegetation species suited to substrate materials of the CGO's final landforms including:
  - implementation of new vegetation growth trials to investigate revegetation species suited to the top surface rehabilitation materials of CGO final landforms, including the TSFs and WRE, to refine revegetation objectives;
  - investigations and implementation of a trial to determine the most effective methods for direct seeding rehabilitation areas following the establishment of the initial Wimmera Ryegrass cover crop; and
  - implementation of research and a revegetation trial to investigate revegetation methods and species suited to the final slopes and rehabilitation media of the TSF/IWL embankments.
- Water Management and Erosion Control on Landform Slopes – Continued investigation into water management and erosion control concepts including hydrological and hydraulic modelling of different CGO landform slope designs (ie single slope compared with tiered slope) and different surface treatments (ie rock mulch or without rock mulch surface treatments) under various rainfall events.

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Appendix A

Revegetation species




Table A1 Tubestock species

Scientific name	Common name	Form
Callitris endlicheri	Black Cypress Pine	Tree
Allocasuarina leuhmannii	Buloke	Tree
Eucalyptus dwyeri	Dwyer's Red Gum	Tree
Eucalyptus microcarpa	Grey Box	Tree
Eucalyptus populnea	Bimble Box	Tree
Eucalyptus sideroxylon	Mugga Ironbark	Tree
Geijera parviflora	Wilga	Tree
Alectryon oleifolius	Western Rosewood	Tree
Brachychiton populneus	Kurrajong	Tree
Apophyllum anomalum	Warrior Bush	Shrub/sub-shrub
Allocasuarina verticillata	Drooping Sheoak	Shrub/sub-shrub
Chenopodium nitrariaceum	Nitre Goosefoot	Shrub/sub-shrub
Senna artemisioides subsp.	Silver Cassia	Shrub/sub-shrub
Indigofera australis	Australian Indigo	Shrub/sub-shrub
Acacia deanei	Green Wattle	Shrub/sub-shrub
Acacia doratoxylon	Spearwood	Shrub/sub-shrub
Acacia hakeoides	Hakea Wattle	Shrub/sub-shrub
Acacia oswaldii	Miljee	Shrub/sub-shrub
Acacia parviflora	Wattle	Shrub/sub-shrub
Eremophila longifolia	Emubush	Shrub/sub-shrub
Eremophila mitchellii	Budda	Shrub/sub-shrub
Myoporum montanum	Western Boobialla	Shrub/sub-shrub
Pittosporum angustifolium	Butterbush	Shrub/sub-shrub
Hakea tephrosperma	Hooked Needlewood	Shrub/sub-shrub
Santalum acuminatum	Sweet Quandong	Shrub/sub-shrub
Dodonaea viscosa subsp. cuneata	Wedge-leaf Hop-bush	Shrub/sub-shrub

Table A2 Native seed mix upper slopes

Landform Slope	Scientific Name	Common Name	Form
Upper Slopes	*Eucalyptus dwyeri*	Dwyer's Red Gum	Dominant Tree
	Eucalyptus dealbata	Tumbledown Red Gum	Dominant Tree
	Eucalyptus sideroxylon	Mugga Ironbark	Dominant Tree
	Brachychiton populneus	Kurrajong	Sub-dominant Tree

Table A2 Native seed mix upper slopes

Landform Slope	Scientific Name	Common Name	Form
	Callitris endlicheri	Black Cypress Pine	Sub-dominant Tree
	Geijera parviflora	Wilga	Sub-dominant Tree
	Pittosporum angustifolium	Butterbush	Sub-dominant Tree
	Acacia doratoxylon	Spearwood	Sub-dominant Tree
	Allocasuarina verticillata	Drooping Sheoak	Sub-dominant Tree
	Acacia deanei	Green Wattle	Shrub
	Acacia hakeoides	Hakea Wattle	Shrub
	Indigofera australis	Australian Indigo	Shrub
	Acacia decora	Western Silver Wattle	Shrub
	Acacia parviflora	Wattle	Shrub
	Hardenbergia violacea	False Sarsparilla	Shrub
	Cassinia laevis	Cough Bush	Shrub
	Dodonaea truncatiales	Angular Hopbush	Shrub
	Senna artemesioides subsp. zygophylla	-	Shrub
	Ajuga australis	Austral Bugle	Forb/Sub-shrub
	Arthropodium minus	Small Vanilla Lily	Forb/Sub-shrub
	Atriplex semibaccata	Creeping Saltbush	Forb/Sub-shrub
	Atriplex spinebractea	Spiny-fruited Saltbush	Forb/Sub-shrub
	Calotis cuneifolia	Purple Burr-daisy	Forb/Sub-shrub
	Calotis lappulacea	Yellow Burr-daisy	Forb/Sub-shrub
	Chenopodium desertorum	Desert Goosefoot	Forb/Sub-shrub
	Chrysocephalum semipapposum	Clustered Everlasting	Forb/Sub-shrub
	Einadia hastata	Berry Saltbush	Forb/Sub-shrub
	Einadia nutans	Climbing Saltbush	Forb/Sub-shrub
	Enchylaena tomentosa	Ruby Saltbush	Forb/Sub-shrub
	Gonocarpus tetragynus	Common Raspwort	Forb/Sub-shrub
	Podolepis neglecta	Copper Wire Daisy	Forb/Sub-shrub
	Pomax umbellata	Pomax	Forb/Sub-shrub
	Rhodanthe corymbiflora	Small White Sunray	Forb/Sub-shrub
	Swainsona galegifolia	Smooth Darling-pea	Forb/Sub-shrub
	Vittadinia sp.	Fuzzweed	Forb/Sub-shrub
	Wahlenbergia sp.	Bluebell	Forb/Sub-shrub
	Xerochrysum bracteatum	Golden Everlasting	Forb/Sub-shrub
	Xerochrysum viscosum	Sticky Everlasting	Forb/Sub-shrub
	Austrostipa densiflora	Foxtail Speargrass	Grass

Table A2 Native seed mix upper slopes

Landform Slope	Scientific Name	Common Name	Form
	Austrostipa scabra	Speargrass	Grass
	Austrostipa spp.	-	Grass
	Bothriochloa macra	Red-leg Grass	Grass
	Chloris truncata	Windmill Grass	Grass
	Panicum effusum	Hairy Panic	Grass
	Austrodanthonia sp.	Wallaby Grass	Grass
	Elymus scaber	Common Wheatgrass	Grass
	Microlaena stipoides	Weeping Grass	Grass
	Themeda australis	Kangaroo Grass	Grass
	Walwhalleya proluta	Rigid Panic	Grass

Table A3 Native seed mix lower slopes

Landform Slope	Scientific Name	Common Name	Form
Lower Slopes	*Eucalyptus dwyeri*	Dwyer's Red Gum	Dominant Tree
	Eucalyptus microcarpa	Grey Box	Dominant Tree
	Eucalyptus populnea	Bimble Box	Dominant Tree
	Eucalyptus sideroxylon	Mugga Ironbark	Dominant Tree
	Brachychiton populneus	Kurrajong	Sub-dominant Tree
	Callitris glaucophylla	White Cypress Pine	Sub-dominant Tree
	Geijera parviflora	Wilga	Sub-dominant Tree
	Pittosporum angustifolium	Butterbush	Sub-dominant Tree
	Acacia doratoxylon	Spearwood	Sub-dominant Tree
	Acacia pendula	Weeping Myall	Sub-dominant Tree
	Allocasuarina leuhmannii	Buloke	Sub-dominant Tree
	Acacia cardiophylla	Wyalong Wattle	Shrub
	Acacia deanei	Green Wattle	Shrub
	Acacia hakeoides	Hakea Wattle	Shrub
	Acacia rigens	Needle Wattle	Shrub
	Indigofera australis	Australian Indigo	Shrub
	Acacia decora	Western Silver Wattle	Shrub
	Acacia lineata	Streaked Wattle	Shrub
	Acacia oswaldii	Miljee	Shrub
	Acacia parviflora	Wattle	Shrub

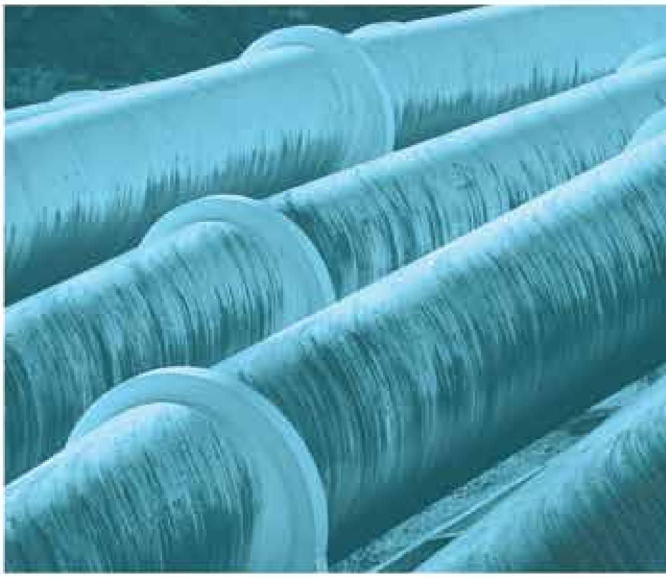
Table A3 Native seed mix lower slopes

Landform Slope	Scientific Name	Common Name	Form
	Hardenbergia violacea	False Sarsparilla	Shrub
	Cassinia laevis	Cough Bush	Shrub
	Dodonaea truncatiales	Angular Hopbush	Shrub
	Dodonaea viscosa subsp. cuneata	Wedge-leaf Hop-bush	Shrub
	Myoporum montanum	Western Boobialla	Shrub
	Senna artemesioides subsp. zygophylla	-	Shrub
	Ajuga australis	Austral Bugle	Forb/Sub-shrub
	Arthropodium minus	Small Vanilla Lily	Forb/Sub-shrub
	Atriplex semibaccata	Creeping Saltbush	Forb/Sub-shrub
	Atriplex spinebractea	Spiny-fruited Saltbush	Forb/Sub-shrub
	Calotis cuneifolia	Purple Burr-daisy	Forb/Sub-shrub
	Calotis lappulacea	Yellow Burr-daisy	Forb/Sub-shrub
	Chenopodium desertorum	Desert Goosefoot	Forb/Sub-shrub
	Chenopodium nitrariaceum	Nitre Goosefoot	Forb/Sub-shrub
	Chrysocephalum semipapposum	Clustered Everlasting	Forb/Sub-shrub
	Einadia hastata	Berry Saltbush	Forb/Sub-shrub
	Einadia nutans	Climbing Saltbush	Forb/Sub-shrub
	Enchylaena tomentosa	Ruby Saltbush	Forb/Sub-shrub
	Podolepis neglecta	Copper Wire Daisy	Forb/Sub-shrub
	Pomax umbellata	Pomax	Forb/Sub-shrub
	Rhodanthe corymbiflora	Small White Sunray	Forb/Sub-shrub
	Swainsona galegifolia	Smooth Darling-pea	Forb/Sub-shrub
	Vittadinia spp.	Fuzzweed	Forb/Sub-shrub
	Wahlenbergia spp.	Bluebell	Forb/Sub-shrub
	Xerochrysum bracteatum	Golden Everlasting	Forb/Sub-shrub
	Xerochrysum viscosum	Sticky Everlasting	Forb/Sub-shrub
	Austrostipa densiflora	Foxtail Speargrass	Grass
	Austrostipa scabra	Speargrass	Grass
	Austrostipa spp.	-	Grass
	Bothriochloa macra	Red-leg Grass	Grass
	Chloris truncata	Windmill Grass	Grass
	Digitaria brownii	Cotton Panic Grass	Grass
	Digitaria coenicola	Finger Panic Grass	Grass
	Digitaria divaricatissima	Umbrella Grass	Grass
	Eragrostis spp.	Lovegrasses	Grass

Table A3 Native seed mix lower slopes

Landform Slope	Scientific Name	Common Name	Form
	Panicum effusum	Hairy Panic	Grass
	Paspalidium constrictum	Knottybutt Grass	Grass
	Austrodanthonia sp.	Wallaby Grass	Grass
	Dichanthium sericeum	Queensland Bluegrass	Grass
	Elymus scaber	Common Wheatgrass	Grass
	Enteropogon acicularis	Curly Windmill Grass	Grass
	Eriochloa crebra	Cup Grass	Grass
	Eulalia aurea	Silky Browntop	Grass
	Microlaena stipoides	Weeping Grass	Grass
	Sporobolus carolii	Fairy Grass	Grass
	Sporobolus creber	Western Rat-tail Grass	Grass
	Themeda australis	Kangaroo Grass	Grass
	Walwhalleya proluta	Rigid Panic	Grass



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