

CHAPTER 11- Closure and rehabilitation

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11.1 Introduction

This chapter outlines the approach to rehabilitation and eventual closure of the Twin Bonanza project. The current proposal for the project will result in the disturbance and eventual rehabilitation of potentially 200.8ha additional to the existing clearing which is 32.5ha (This figure does not include the mining void area of 22.5 hectares). The major features of the project include a processing plant, mining pits, tailings dams, concentrate residual dam, waste rock dumps, accommodation village and supporting infrastructure. The entire project is underlain by Aboriginal land (Mount Fredrick Land Trust No. 2) and is held as freehold title under the Aboriginal Land Rights Act 1976 (Cth). The land is currently used for the benefit and activities of the Traditional Owner communities located in the area; conceptual closure strategies have been designed to align the end land use to current land practices.

Planning for rehabilitation and closure for the whole of site has been initiated at a conceptual stage with future refinement as the project progresses. This section should be read in conjunction with Appendix O: Conceptual Mine Closure Plan (CMCP) which details conceptual closure information, management strategies and mitigation. In addition, the Conceptual Care and Maintenance Plan (CC&MP) (Appendix P) provides clear guidance on the care and maintenance of the Twin Bonanza mine site if mining operations are forced to close temporarily or prematurely. The development of a CC&MP is designed to take into consideration the legal obligations and environmental risks associated with the Twin Bonanza project.

11.2 Environmental values

The following environmental values have been considered during preliminary closure and decommissioning planning:

- maintenance of ecological processes to conserve biodiversity
- preservation of soil resources and nutrient cycling
- maintenance of water quality
- creation of self-sustaining landforms and landscapes.

11.3 Rehabilitation objectives

The main objectives of the rehabilitation of the Twin Bonanza project are to:

1. ensure the characterisation, handling and placement of mine wastes is in a manner as to produce safe, stable and non-polluting landforms consistent with surrounding environs and environmental values

2. conduct trials and studies to refine rehabilitation strategies to improve rehabilitation outcomes
3. minimise risk while optimising rehabilitation success.
4. ensure that rehabilitation achieves an acceptable standard, compatible with the agreed post mining land use and management practices
5. create the integrity, ecological functions and environmental values of landscapes and landforms.

Rehabilitation strategies will evolve as a better understanding of the environment is gained and rehabilitation techniques develop. This process will be reflected in further updates and refinements of the closure plan during the life of the mine to reduce uncertainty and enhance site rehabilitation strategies. Where practicable, disturbed areas no longer required for operational purposes will be progressively rehabilitated

11.4 Rehabilitation Strategy

ABM is committed to ensure appropriate planning, scheduling and resourcing of rehabilitation to ensure success of eventual mine closure and relinquishment. The cost of closure will be reviewed annually to ensure financial provisioning reflects the liability of closure. ABM proposes undertaking rehabilitation trials and where practicable will carry out rehabilitation on areas no longer in use thereby reducing environmental risks and liabilities.

The following measures have been adopted to achieve the rehabilitation objectives:

- ensuring closure is considered during life of mine planning and scheduling.
- annually reviewing rehabilitation planning including the CC&MP and CMCP
- ongoing engagement of stakeholders to refine rehabilitation and post mining land use objectives
- allocating responsibilities for rehabilitation during the life of the mine.

11.5 Rehabilitation and decommissioning success factors

Potential risks associated with the success of rehabilitation and decommissioning of the disturbed area are detailed as follows:

- poor management and scheduling of rehabilitation resources including topsoil management and clearing beyond approvals
- poor life of mine planning
- failure to undertake progressive rehabilitation

- inappropriate resourcing for rehabilitation
- poor closure implementation
- ineffective rehabilitation
- premature mine closure.

These risks have been further discussed in Chapter 5: Risk assessment. The management of closure risks both known and yet to be identified will be an ongoing process during project construction, operation and closure. To ensure success, closure planning will be an adaptive process as closure strategies are improved based on the emergence of new site information and changing levels of uncertainty. To minimise the potential for negative impacts and unacceptable environmental legacies at closure, ongoing studies of groundwater, surface water, tailings, waste rock, fauna and flora will be undertaken to ensure closure outcomes are attained.

11.6 Rehabilitation guidelines and closure objectives

ABM in the course of preparing a CMCP and CC&MP has followed the principles and objectives identified in the Strategic Framework for Mine Closure (ANZMEC, 2000). In addition, the following documents have been consulted to assist and guide in closure planning:

1. Leading Practice Sustainable Development in Mining Handbooks
 - a. A Guide to Leading Practice Sustainable Development in Mining
 - b. Evaluating Performance: Monitoring and Auditing
 - c. Mine Closure and Completion
 - d. Mine Rehabilitation
 - e. Risk Management
 - f. Tailings Management
2. Planning for Integrated Mine Closure: Toolkit (ICMM 2008)
3. Guidelines for Preparing Mine Closure Plans (Department of Mines and Petroleum Western Australia/EPA, 2011).
4. Mine Close out Objectives, Life of Mine Planning Objectives, Advisory Note (Department of Mines and Energy 2008)

A framework of closure objectives was developed based on the “Mine Close Out Objectives, Advisory Note” (Department of Mines and Energy 2008). The six objectives that were identified are:

- compliance

- infrastructure and rubbish clean up
- physical safety
- stability of landforms and landscape (including visual amenity)
- revegetated or otherwise Improved
- low risk to biota.

Meeting the requirements of relevant authorities for the condition of heritage and archaeological sites is also a closure objective. It has not been specifically included in this chapter as the risk will be mitigated across the anticipated life of mine during operations as well as closure planning. ABM will maintain their continuing dialogue, on country meetings and surveys with the Central Land Council and the Traditional Owners they represent. Relevant authorities will also be consulted during this process. Further detail of these management measures are presented in Chapter 13: Social and Economic Risks and Appendix U: Cultural and Heritage Management Plan.

To ensure closure objectives are attainable a number of completion criteria have been formulated with associated measurement tools and performance indicators. Further detail is provided in Appendix O: Conceptual Mine Closure Plan.

11.7 Land disturbance areas

Over the life of the project the total land disturbance will be 223.3 ha.

Clearing will involve the removal of native vegetation and the recovery of topsoil prior to the establishment of mining features and landforms. Clearing will be carried out progressively as the project develops to provide an opportunity for fauna to relocate from disturbed areas. Prior to disturbance the area is surveyed to ensure that no cultural heritage sites are disturbed.

11.8 Mine rehabilitation processes

11.8.1 Design criteria

In designing the project consideration has been given to rehabilitation of the disturbed landscape and constructed landforms. This has resulted in the following design decisions:

- The outer tailings dam and concentrate residual dam embankments designed with 14 degree (1(V):4(V)) walls to limit erosion.
- Formation of a low permeability layer in the tailings dam to limit seepage.
- Operation of the decant pond in the centre of tailings dam to limit seepage through the embankments.

- Separation of tails into two dams:
 1. Residual cyanide leached material for the lined evaporative dam (referred to as the concentrate residual dam (CRD)). Cyanide removed prior to deposition.
 2. Standard tailings (no cyanide) standard treatment as discussed above with standard lining.
- Separate stockpiling of siltstone, sandstone and the pisolite/gravel horizon overlying the pits for the capping of the tailings dam and CRD.
- Capping the tailings dam with a 1.6 m store and release cover to limit water egress into the tailings.
- Encapsulating physical and geochemically adverse material within the waste dump to limit erosion and potential for chemical reactions.
- Design of the outer waste rock dump batters at 15° (1(V):3.7(H)) based on modelling of the competent and inert material to be used.
- Perimeter storm water diversions left at closure will be designed and constructed to 1:1000yr peak flow event.
- Designing the top of the waste dump to be water harvesting to prevent water cascading from the top surface down the outer slopes.
- Locating the tailings dam, CRD and waste rock dumps on mineralised soil with a similar geochemical signature (i.e. elevated in arsenic) to the most enriched waste rock units and tailings to minimise the geochemical contrast.

11.8.2 Rehabilitation

Disturbance areas/domains across the site will be rehabilitated to stable landforms with self-sustaining vegetation covers for integration into the larger land use area. All historical exploration (including costeans, sumps, access tracks, drill pads etc.) will be filled to the natural surface (where necessary) and ripped.

Prior to decommissioning unused chemicals, hydrocarbons and explosives are to be removed from site. At closure the project area will be surveyed by an accredited auditor to ascertain the presence and extend of any contamination. If any areas are identified a plan will be put in place to remove this material and if, possible treat, on site or dispose of appropriately in accordance with the current legislative requirements and in agreement with the relevant regulators.

Closure planning is an evolving process, the management and rehabilitation treatments for each area will be updated due to further stakeholder consultation and as more information becomes available. Successful rehabilitation will be accomplished when compilation criteria have been met enabling a functioning ecosystem that fits the surrounding area.

11.8.3 Shaping and contouring

During rehabilitation areas at grade or above grade will be contoured where practicable to restore surface water flow and/or shaped to the desired landform as approved and agreed upon by stakeholders.

11.8.4 Topsoil management

Clearing will be undertaken progressively to reduce the effects of soil degradation and erosion. Progressive rehabilitation will be undertaken during the life of the mine, to optimise topsoil properties. Topsoil stockpiles that are retained for longer periods will be paddock dumped to increase the surface to volume ratio to encourage natural re-vegetation. The vegetation material, where practicable, is to be retained for fauna habitat and later rehabilitation. Depending on its constituents, topsoil can serve a number of important functions (DITR 2006), such as the:

- supply of seed and other propagules
- contribution of beneficial micro-organisms
- supply of natural nutrients
- rapid development of groundcover.
- amelioration of adverse constituents in the underlying mine waste.

Where practicable, the timing of topsoil removal would be coordinated with rehabilitation operations to ensure minimal handling and storage. In general, this method helps ensure that the reserve of indigenous plant seeds and soil microflora are maintained and assists with the preservation of local genetic material and the re-establishment of a similar range and mix of species to that of the original vegetation in rehabilitation areas.

ABM is committed to retaining the topsoil as a viable resource to use for rehabilitation purposes at a later date. Top soil stripping will involve the top 100mm of material. The topsoil will be stored in stockpiles no greater than 2m high proximal to disturbance areas for future use in rehabilitation and decommissioning. Designated topsoil stockpiling areas will be prepared to minimise topsoil losses. Topsoil stockpile areas will be signposted to prevent inadvertent use. A 100mm layer of topsoil will be placed on flat lying rehabilitation areas. In areas of above grade (for example a waste rock dump) topsoil will be combined with competent inert waste to form a rock mulch for integration into the slope to allow armouring overtime.

A topsoil balance has been calculated for the site based on the recovered volumes, there is sufficient topsoil to cover all the landforms and landscape. Details of the calculations are provided in Appendix O: Conceptual Mine Closure Plan.

11.8.5 Seeding and revegetation

Successful revegetation invariably requires a combination of techniques to reintroduce biodiversity. Initially the landscape or landform requires stabilisation and the establishment of a profile that is conducive to biological activity and water retention. These considerations have been incorporated in the landform designs. The re-introduction of plant species and soil biota will be by the careful handling of and application of topsoil to disturbed areas, as has been detailed in Section 11.8.4. After topsoil application the areas will be monitored for species recruitment. If low levels of recruitment are observed, areas will be seeded with locally collected seed with the aid of Traditional Owners as required. ABM proposes to undertake small rehabilitation trials to further refine the rehabilitation method to improve the understanding of vegetation establishment on the specific landforms. Once rehabilitated, areas will have signage and access will be restricted with bunds to prevent disturbance to the rehabilitation.

11.8.6 Sediment control and erosion

During rehabilitation disturbed areas are to be managed to minimise length of time soils are exposed and to capture liberated sediment. A primary focus of erosion and sediment control measures are related to the constructed landforms which will remain in place after mine closure. The general strategy for these landforms is to ensure that their design and construction results in a land surface that is stable enough in the short term to allow for the establishment of revegetation species, which will further stabilise the landforms in the long-term.

The overall approach to sediment and erosion control is detailed in Appendix E: Erosion and Sediment Control Plan.

11.8.7 Flood mitigation

The majority of the main infrastructure areas are located on topographic highs or diverging slope areas, where the potential for converging surface water flows is minimal. The shape of the landscape indicates that sheet flow will be the dominant surface water flow process, with some accumulation of flows possible in lower-lying areas after large storm events. As such, large flow volumes from extensive catchment areas will not need to be managed.

At closure the main site diversion drains will remain in place after closure to protect the landforms from erosion during extreme rainfall-runoff events. These main diversion structures are to be constructed based on the modelled 1:1000 year peak flow event.

11.8.8 Geotechnical stability

During operations the geotechnical performance of tailings dam cells 2A and 2B, CRD, open pit and the northern and southern waste rock dumps will be regularly monitored. Prior to decommissioning, a competent geotechnical engineer will conduct a review and prepare an assessment on the current status of each facility and landform to demonstrate long term stability. If required, the report will include recommendations on further investigations and work needed to decommission the facilities and landforms. All geotechnical investigation will be scheduled and integrated into closure implementation.

11.8.9 Fire management

Fire is a common occurrence in the semi-arid landscape. Management of fire directly associated with the site will focus primarily on the prevention and control of fires accidentally generated by site activities (Appendix Z: Fire Management Plan). Management of fire for rehabilitation may include:

- excluding fire from recently rehabilitated areas to protect young rehabilitation thus allowing time for it to become fire resilient
- introducing fire (via confined and controlled burns) to well established rehabilitation to encourage resprouting of native grasses, manage fire loads to prevent hot burns and to test vegetation resilience; this will only occur in consultation with Traditional Owners.

11.8.10 Weed management

Baseline surveys identified that no declared weed species are present at the site. However, buffel grass (*Cenchrus ciliaris*) has been recorded at the existing camp. This introduced grass is not defined as a weed but has the potential to significantly change the ecological functioning of the landscape by altering fire regimes displacing native fauna and changing fauna habitat (CRC 2008). Weed management will focus on:

- ensuring declared weeds are excluded from the site by machinery hygiene, monitoring and eradication
- controlling the known occurrence of buffel grass and preventing its spread across the site.

By preventing the establishment of weeds during operations the ability of native vegetation to establish will not be reliant on its ability to outcompete introduced plant species.

11.8.11 Recognition of uncertainty

The project is located in a semi-arid environment that has highly variable weather conditions on a yearly basis. Climate extremes, for example drought, can directly affect

rehabilitation performance and success. To address this issue the following steps will be taken:

- Monitoring results will be used to refine rehabilitation methods and strategies.
- Remediation provisions will be incorporated as part of the rehabilitation practice.

11.9 Care and maintenance

The CC&MP has been designed to take into consideration the legal obligations and environmental risks associated with the Twin Bonanza project in the unlikely event that operations were to be temporarily suspended.

The main objectives of the CC&MP are to ensure management measures are in place for:

1. the plant and equipment
2. all the environmental aspects identified in the CMCP
3. all statutory obligations and documented commitments
4. resource scheduling
5. environmental monitoring
6. the mine site to ensure public safety.

The CC&MP applies to existing environmental and management commitments, as outlined in the EIS, CMCP and Mining Management Plans for Twin Bonanza, with regards to temporary mine closure of the Twin Bonanza project. The CC&MP will be subject to ongoing review and change to ensure that it remains relevant and effective throughout the life of the operation.

During a period of suspended operations the environmental risks that have been identified are:

1. waste dumps
2. tailings dams and water dam
3. processing plant
4. chemical/hydrocarbon storage
5. open pits
6. surface drainage
7. emergency response
8. waste water facilities.

The proposed care and maintenance planning will ensure these risks are mitigated with suitable monitoring and management as outlined in Appendix P: Conceptual Care and Maintenance Plan.

11.10 Decommissioning – mine closure

For the purposes of rehabilitation and decommissioning, the Twin Bonanza site has been divided into a number of rehabilitation domains that represent separate mining features requiring differing rehabilitation treatments. A list of the closure domains is as follows and illustrated in Figure 10-1:

- waste rock dumps
- tailings dam
- CRD
- water storage dam
- pits
- processing plant
- ROM areas and low grade stockpile
- borrow pit
- haul and access roads
- accommodation village
- workshop areas and hydrocarbon areas (including explosive magazine)
- bores and pipelines
- airstrip

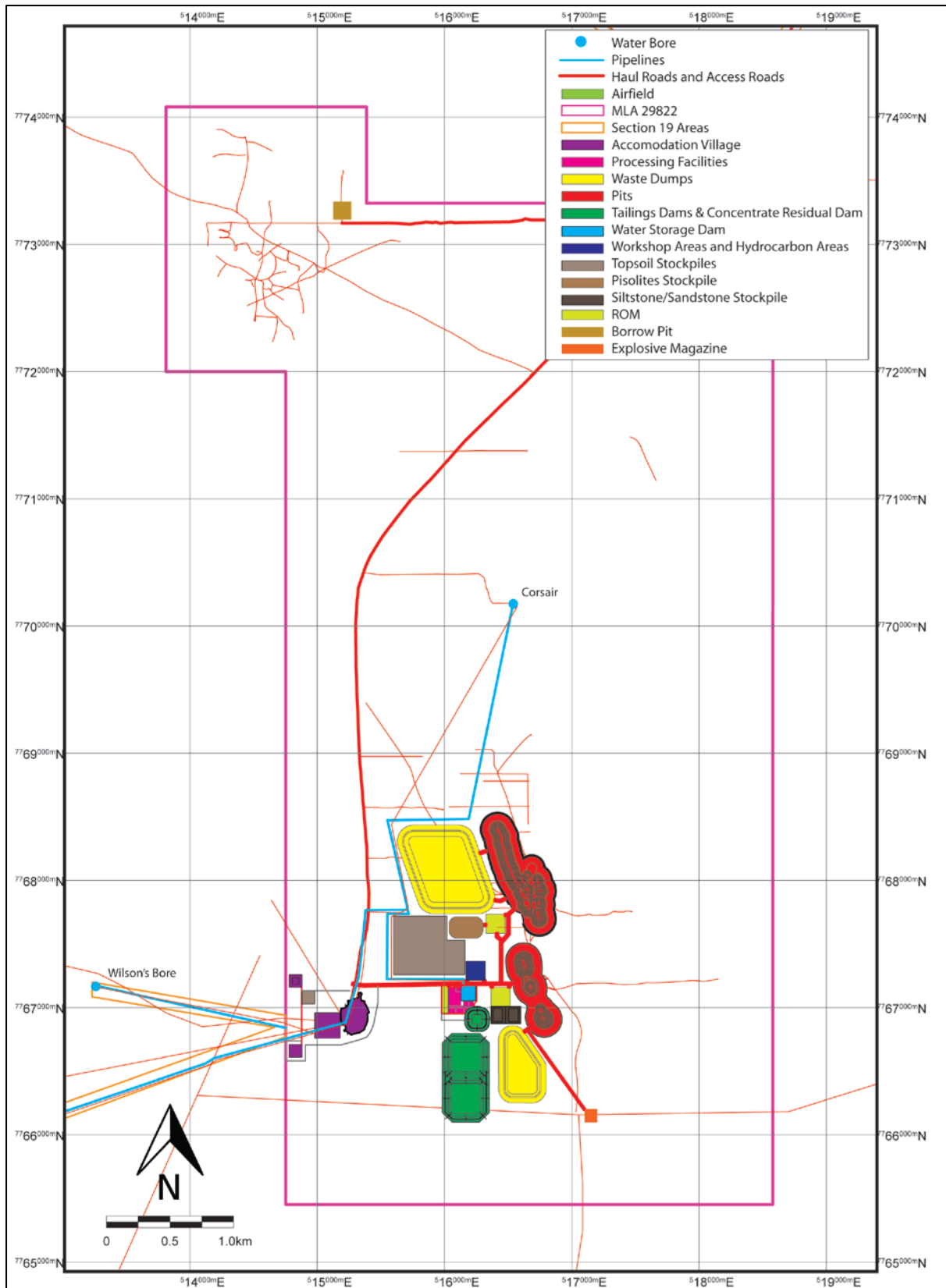


Figure 10-1. Proposed rehabilitation domains at the Twin Bonanza project.

Specialised contractors will be employed to implement decommissioning of each domain where required. ABM proposes to complete the decommissioning, which will involve the removal of infrastructure and rehabilitation of any outstanding disturbed areas as soon as practicable, after the cessation of mining. Initially the area and landforms will be made safe, with the subsequent focus on completion of batter angles and construction of soil profiles. These activities will enable a self-sustaining ecosystem that can achieve the proposed post mining land use and integrate into the surrounding environment.

Further details on the rehabilitation of each domain are provided in Appendix O: Conceptual Mine Closure Plan.

11.11 Mine closure requirements

11.11.1 Decommissioning personnel

To decommission the site appropriately qualified and skilled personnel and companies are to be employed in all aspects of the management, technical assessments, demolition, bulk earthworks, ecosystem establishment and monitoring.

11.11.2 Monitoring and caretaking

Post-closure monitoring of all the rehabilitated landforms is proposed to be completed using EFA monitoring, erosion monitoring, a rehabilitation/compliance audit and the continuation of the onsite surface and groundwater monitoring.

The results of all these monitoring programs will be reported annually within the MMP until the completion criteria have been satisfied. If results of the monitoring programs reveal that the rehabilitation is not meeting the completion criteria set in the CMCP (i.e. not meeting target vegetation growth, stability etc.), remedial work will be completed to rectify any issues identified with the rehabilitation. Once completion criteria have been met, annual monitoring will cease and a report of the results will be submitted to the DME along with all relevant documentation for a certificate of closure to enable relinquishment.

11.11.3 Final site relinquishment and infrastructure handover

Once agreed upon, the closure completion criteria and associated measurement tools will be used to demonstrate the closure objectives for the site have been obtained. When the closure objectives have been met the Mineral Lease will be relinquished and the transfer of any infrastructure to be used in conjunction with the post mining land use completed.