



ENVIRONMENTAL MANAGEMENT PLAN (EMP) FOR THE ARGYLE UNDERGROUND PROJECT

REHABILITATION MANAGEMENT PLAN



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1 INTRODUCTION

1.1 PURPOSE

The primary aims of this Management Plan are aligned with Ministerial Condition 365:M3 (Appendix A) and Closure Management Plan, which are to outline actions to rehabilitate the disturbed areas on the Argyle mining lease and miscellaneous licences so that they are:

- Geotechnically safe and stable;
- Non-polluting;
- Blend visually with surrounding undisturbed areas;
- Are capable of sustaining chosen closure land uses (pastoral); and
- Revegetated using local provenance species that form the basis of a self-sustaining ecosystem.

Management actions, which will ensure that these objectives are met, are outlined in Table B15-2 Rehabilitation Management.

1.2 SCOPE

The scope of this Management Plan is to provide an overview of rehabilitation that has been completed to date, outline any significant findings from previous research trials and allocate actions to responsible people. This will ensure that systematic and progressive rehabilitation, which is also cost effective, will be completed during the operational and closure phases of the mine. Some areas may be excluded from rehabilitation if the Traditional Owners and Government require them for purposes other than grazing.

1.3 AREA

Argyle mining lease and miscellaneous licences.



2 DEFINITIONS

Rehabilitation

The process of returning disturbed land to a stable, self-sustaining landform that is compatible with the surrounding environment.

3 DETAILS

3.1 AREA OF DISTURBANCE

Alluvial mining was carried out in the upper reaches of Smoke and Limestone Creek between 1982 and 1985, and then 1989 to 2002. The AK1 open cut operation commenced in 1985 following the development of processing, waste, transport and accommodation facilities. To date 3700 hectares has been cleared for mining operations. Rehabilitation was undertaken in 97% of the alluvial mining areas; however a very small area has been completed on the AK1 waste dumps, TSF or alluvial tailings areas. Operational changes have resulted in several rehabilitation trial areas being covered or otherwise destroyed. Existing areas of disturbance and the areas, which have been rehabilitated, are shown in Table 15 -1.

Table 15-1 Areas of Disturbance and Rehabilitation

Lease and Miscellaneous Licences	FACILITY TYPE	AREA (ha)	
		Disturbed	Rehabilitated
M259A	Infrastructure, AK1 WD, TSFs, Villages, roads	1270	28
M80/42, M80/43, M80/44	Alluvial mining/exploration	1424	1393
M80/45	Alluvial Infrastructure	580	67
L80/1	Road to Lake Argyle	431	86
L80/11	Lake Argyle to AK1 water pipeline		
L80/24			
L80/26	Pipeline and power		
Total Area		3705	1574

The proposed underground development will require the clearing and disturbance of a further 126 ha for the new TSF2, and 133ha for the proposed RCP3.

3.2 LANDFORMS

Tailings and WRD landforms, if unstable may be prone to significant erosion and rehabilitation failure. Stability is dependent on a number of factors including slope length and angle, drainage design, soil cover structure and vegetative cover. Management of surface drainage and incipient rainfall is critical to ensure landform stability. It has been found that vegetative cover may take 10 years or more to fully establish, therefore all final landforms will incorporate geotechnical design to withstand higher than average rainfall occurrences.

The rehabilitated alluvial areas at the site, although morphologically dynamic because they are generally creek beds, are relatively low lying and stable. Rehabilitation of WRD landforms has not been undertaken, with the exception of some in-situ and laboratory trials. Waste rock from underground operations represents a very small proportion of the total waste for the open cut operation and as such its management is integrated into rehabilitation plans for the WRD. Rehabilitation and decommissioning of the TSF1 and TSF2 is subject to further research. Outslope angles, surface material and revegetation

trials are scheduled for 2005.

3.2.1 Tailings Storage Facilities

No adverse leachates, other than some $MgSO_4$ have been recorded seeping from the AK1 TSF1. The AK1 TSF1 is a water harvesting design, that is, it retains water to maximise infiltration and recycling. After completion, the AK1 TSF1 will be rock armoured with quartzite to ensure stability. If adverse leachates are detected and are likely to continue, an erosion resistant cover and rock drains may be constructed to shed water from the facility. (Fawcett Mine Rehabilitation Services, 2004).

No rehabilitation trials have been conducted on the AK1 TSF1, however data from Hyde (2003) indicates that the tailings material may provide a reasonable growth medium for direct rehabilitation. Blending with a layer of selected competent, rocky material and ripping may also be beneficial to create micro-catchments and reduce wind erosion. Rehabilitation trials are scheduled for the LIA embankment of the AK1 TSF1 in 2005.

The new TSF2 will also be water retaining and an upstream design, which is considered the most stable. A central decant and starter, then later further embankment drainage systems will optimise water recovery. Rehabilitation on this structure is unlikely to commence for some time as the structure develops in an outward progression to final design out slopes as the dam reaches capacity.

In addition the following rehabilitation measures will be incorporated for the rehabilitation of the new TSF:

- Outer batters to be a vegetated rock mulch wall at a grade of 1:3.
- Reshaping of the dry tailings surface to produce low gradient batters.
- Revegetation using the local seed mixes as discussed in Section 9.3.1.
- Construction of rock mulched drains to carry excess rainfall from berms.
- Semi permanent wetlands areas will be established to enhance vegetation growth.
- Final geometry of the embankment will be 15 m wide benches at 15 m vertical intervals.

The seed species selected for revegetation of the wetter areas of the TSF will need to tolerate wet conditions. The establishment of trees may be beneficial to draw down the water table, assuming that the tailings are inert and that there is no encapsulating layer that tree roots may interfere with. It may not be feasible to establish a community on the TSF that mirrors the original habitat before the construction of the TSF. The revegetation goals may be for reduced species diversity if the growing conditions are unique.

3.2.2 Waste Rock Dumps

Waste rock from the underground operations will be characterized as barren or PAF and placed accordingly, although none is expected to be PAF at this stage. The AK1 WRD Operating Manual outlines procedures to ensure PAF materials are not exposed or placed in close proximity to final landform surfaces. This is to optimize rehabilitation success by minimizing development of adverse soil chemistry. Several rehabilitation trials are scheduled for Q4 2005 including store and release, variable slope and surface treatment trials. Earthworks on 4 ha of flat ground and 12 ha of slopes will take 2 – 4 months to complete.

The principles to be followed for waste rock dump rehabilitation include the following:

- Consider the final landform design concept in the placement of waste rock;
- Design dump faces to minimize erosion and slumping of rock faces;

- Final batter angle of slopes to be a maximum of 20°;
- Lower Southern Waste Rock Dump outer slopes to be designed for a 500 year erosion profile;
- Construct lined drainage channels to minimize the flow of stormwater down the batters and outer dump slopes;
- Divert all stormwater runoff from the natural catchment off the waste rock dumps;
- Avoid contact of internal drainage and stormflow with acid forming material to minimize generation of ARD;
- Final dump design to incorporate aspects of “store and release” systems, sub-surface drainage sumps, and surface water shedding;
- Stabilize and revegetate benches and access roads;
- Construct a large bund around the base of the waste rock dumps to contain sediment; and
- Revegetate the waste rock dumps, where practicable.

3.3 GROWTH MEDIUM PLACEMENT AND GROUND PREPARATION

Hyde (2003) conducted in-situ and laboratory rehabilitation trials on NW WRD 320 and waste rock. It was found that germination and growth was enhanced by the addition of tailings and ripping. Where mudstone substrate was applied or no ripping took place, plant growth was inhibited.

The final layer of material placed prior to spreading growth medium material will be barren, competent overburden. Where topsoil is available, it will be spread in a 100 - 200 mm layer; tailings may provide a reasonable substitute or add bulk where little or no topsoil is available. The area will be ripped on the contour to a depth of 0.5 to 1.0 metres by a D9 or D10 dozer/crawler tractor with a triple tine and seed will be distributed with a machine seeder if available. Spacing between rip lines will be no greater than 1.5 metres apart. If timber mulch is available it will be spread across the batters and mixed into the growth material prior to ripping. Manual seeding was the primary method used for alluvial rehabilitation, however machine seeding has proven to be very effective at other large mine sites.

3.4 REVEGETATION

3.4.1 Species Selection

Kimberley local provenance species will be used for rehabilitation. The seeds will be weed free with a proportion of annual to perennial species analogous to the vegetation on the rocky slopes on the site. Eucalyptus trees and Spinifex (*Triodia bitextura*) comprise almost 65% of the natural cover on undisturbed hill slopes around the mine (Salt, 1990) and were considered key elements to rehabilitation on site by Hyde (2003).

3.4.2 Seed

Trials are underway to determine the species mix and rates of application for rehabilitation, however the rate is likely to be around 8 kg/ha. Seed may be mixed with vermiculate or other material to assist in dispersal if deemed necessary. Seed will be stored in a dry environment, out of reach of rodents and other vermin. It will also be treated with Dyracide or a similar product to prevent insect damage if stored for any length of time. Preferably seed will not be mixed until just prior to sowing.

3.4.3 Timing

Unreliable monsoon rainfall and high temperatures make it necessary to carefully evaluate seasonal trends and the probability of consistent following rains. A heavy rainfall event may promote germination only to be followed by lengthy dry periods and plant death. The most difficult aspect is ensuring that the seedbed is prepared and that machinery and resources are available at relatively short notice. Most germination occurs in the early wet and thus December is generally the optimum time to seed, but would be dependent on seasonal conditions.

3.5 MONITORING

The rehabilitation trial and rehabilitated alluvial areas are monitored annually. In addition, permanent transects may be established for Ecological Function Analysis (EFA) to assist in determining closure criteria for the site.

3.6 REMEDIATION

3.6.1 Weed Control

Hyde (2003) found that natural recruitment has occurred on waste dump areas that have remained undisturbed for an extended period of time and that weeds were the dominant recruiting species.

Weeds will be monitored, but only controlled in rehabilitation areas if they are out competing the native species or if identified for control in the annual Weed Control Action Programme. In the interim they may help stabilise the soil and reduce erosion.

3.6.2 Erosion

Surface stabilisation is a primary objective of rehabilitation because all mining activities are conducted in the catchment of Lake Argyle and successful rehabilitation requires a stable surface. Rehabilitated landforms will be inspected to detect instability and erosion indicated by major rills, gulying, piping and ponding. EFA assessments will also provide a measure of erosion if undertaken. Earthworks will be carried out as required to rectify these problems.

3.6.3 Vegetation Cover and Species Diversity

The complexity of plant communities in terms of species diversity and vegetation cover (trees, shrubs, perennials, annuals) will be assessed within the rehabilitation areas following surveys and analyses by external contractors. If necessary, remedial works will be carried out to achieve closure criteria objectives.

3.7 CLOSURE CRITERIA

Detailed closure criteria are being formulated for the whole of site. The mining lease covers land originally used for grazing by Lissadell Station. Grazing continues on non-active areas of the lease. The final land use for the area in which the mine is located will rest with the Traditional Owners of the land, regulators and be an established and agreed process incorporated into the Indigenous Land-Use Agreement. It is currently envisaged that the land will be transferred to the Traditional Owners prior to, or at, relinquishment. An anticipated final land use is likely to be cattle grazing but this does not preclude other opportunities such as eco-tourism. The completion criteria for the site will reflect these potential land-uses.

4 RESPONSIBLE PEOPLE

The following people are responsible for actions to manage Rehabilitation at Argyle:

4.1 SUPERINTENDENT ENVIRONMENT

The Superintendent Environment is responsible for quantifying all disturbed and rehabilitated areas, formulating a Rehabilitation Schedule, reviewing the Procedure for Rehabilitation and other relevant procedures. The Superintendent Environment will also ensure that Rehabilitation trials and operations are undertaken in accordance with the Rehabilitation Schedule and reported to Government. The Superintendent Environment will ensure that regular liaison with Traditional Owners and other stakeholder's takes place.

4.2 ENVIRONMENTAL ADVISOR/OFFICER

The Environmental Advisor/Officer will ensure that a register of topsoil stockpiles and volumes is maintained and the areas, which have been disturbed and rehabilitated, are surveyed and described.

4.3 MANAGER PRODUCTION MINING

The Manager Production Mining will ensure that no clearing, stripping or dumping is undertaken prior to obtaining clearance from the Environment Section and in accordance with the Clearing and Topsoil Stripping Procedure.

4.4 MINE SURVEYOR

Ensures that the Environmental Advisor is notified of topsoil volumes and placement locations.



5 RELATED DOCUMENTS

5.1 MANAGEMENT AND OPERATIONAL PLANS

- 16 Closure Management Plan
- Argyle (2005b) Closure Plan

5.2 PROCEDURES AND WORK INSTRUCTIONS

- Argyle (2001c) Work Instruction for Topsoil Handling and Management
- Argyle (2003m) Land Clearance Guidelines
- Argyle (2003ac) Procedure for Rehabilitation Assessment
- Argyle (2004p) Work Instruction for Seed Ordering/Preparation for Rehabilitation
- Argyle (2004q) Work Instruction for Seeding of Rehabilitation Areas
- Argyle (2005d) Environmental Procedure Clearing and Topsoil Stripping
- Argyle (2005e) Environmental Procedure Topsoil Management and Handling – Mining

Rehabilitation research references and other background documents are listed in Part C References of the Environmental Protection Statement (EPS).

6 RECORDS MANAGEMENT

As subsequent revisions of this document are carried out, previous versions are retained within DM5 for records management purposes in accordance with the **Management of Controlled Documents Procedure #AD-226750**.

7 APPENDICES

Table B 15-2: Rehabilitation Management

Action	Key Issue	Objective	Management Action	Timing	Responsibility	Target	Work Procedure	Instruction
B.15.1	Planning for rehabilitation	To include systematic methodology for describing disturbed and rehabilitation areas in the Procedure.	<p>Review the Procedure for Rehabilitation Assessment to describe all disturbed and rehabilitated areas including:</p> <ul style="list-style-type: none"> ▪ A unique reference number; ▪ Surveyed location; ▪ Risk assessment – including Aboriginal heritage; ▪ Facility type; ▪ Original and current vegetation cover etc. 	2005	Superintendent Environment	Complete review of Procedure	Procedure for Rehabilitation Assessment (Argyle, 2003ac)	for (Argyle, 2003ac)
B.15.2		Ensure all disturbed and rehabilitated areas are mapped.	Map all disturbed and rehabilitated areas by year of disturbance and rehabilitation into the Geographic Information System.	Ongoing	Superintendent Environment	Complete GIS maps	Nil	Nil
B.15.3		To maximise areas rehabilitated each year.	<p>Determine which areas will be available for rehabilitation and schedule for the Life of Mine.</p> <p>Include Schedule in Annual Operating Plan.</p>	2005	<ul style="list-style-type: none"> ▪ Long Term Mine Planner ▪ Superintendent Environment 	Complete a Schedule of Rehabilitation for the Life of Mine.	Nil	Nil
B.15.4			Describe disturbed and rehabilitated areas using the Procedure for Rehabilitation Assessment and Procedure for Rehabilitation and add them to the Disturbed Land Register (Excel Spreadsheet) – involve Traditional Owners	Ongoing	Environmental Officers, Advisors Safety People	Disturbed Land Register completed (ongoing)	Procedure for Rehabilitation Assessment (2003ac) Disturbed Land Register.	for Argyle Land

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Action	Key Issue	Objective	Management Action	Timing	Responsibility	Target	Work Procedure	Instruction
B.15.5	Planning for rehabilitation	To ensure Closure Criteria and a Rehabilitation Schedule are met.	Complete Argyle Site Closure Plan and include a Schedule for Rehabilitation for the Life of Mine to Government. Submit final Closure Plan to Government.	5 years prior to decommissioning	Mine Planning Superintendent Environment	Closure Plan endorsed by management. Final Closure Plan submitted to Government.	Procedure 2.3 (Metago, 2004).	
B.15.6	Rehabilitation of disturbed areas.	Successful rehabilitation.	Review and update the Work Instruction for Seeding of Rehabilitation Areas (2004p) and the Work Instruction for Seed Ordering/Preparation for Rehabilitation (Argyle, 2004o)	2005	Superintendent Environment	Review the Work Instructions for Seeding and Seed Ordering	Work Instruction for Seeding of Rehabilitation Areas (Argyle, 2004q)	
B.15.7			Develop a Work Instruction or Procedure for Rehabilitation and include sections on: <ul style="list-style-type: none"> ▪ Earthworks & Landform Profile ▪ Topsoil – placement, depth ▪ Seeding ▪ Ripping – depth, width, machinery specifications ▪ Timing – seasonal variations and revegetation success 	2005	Superintendent Environment	Complete new Rehabilitation Work Instruction or Procedure.	Work Instruction for Seed Ordering / Preparation for Rehabilitation (Argyle, 2004o)	
B.15.8			Undertake rehabilitation trials on WRD, TSF's and other areas. Investigate alternative methods of: <ul style="list-style-type: none"> ▪ ground preparation (ripping depths and widths, growth medium depth); ▪ growth mediums (eg tailings); ▪ seed mixes & dispersal; and ▪ Fertilisers. 	Commence Q1 2005 Ongoing	Superintendent Environment	Identify methods and strategies to successfully rehabilitate the TSF's, WRDs and other disturbed landforms on the site.	Nil	



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Action	Key Issue	Objective	Management Action	Timing	Responsibility	Target	Work Procedure	Instruction
B.15.9	Rehabilitation of disturbed areas.	Successful rehabilitation.	Commence Progressive Rehabilitation Schedule and report progress in AER.	Annual	Relevant Managers Production	100% of scheduled annual rehabilitation is completed.	Nil	
B.15.10	Rehabilitation in accordance with Traditional Owner's and to original country.	Rehabilitate areas in a manner consistent with expectations of Traditional Owners.	<ul style="list-style-type: none"> ▪ Consult Traditional Owners about rehabilitation activities through the Relationship Committee. ▪ Present Closure Plan and 3D waste dump model to Traditional Owners through the Relationship Committee. ▪ Record their preferences and opinions. ▪ Incorporate feedback into Closure Plan where feasible. 	Quarterly	Cultural Heritage Management Officer	Minutes validate meetings and are circulated to Traditional Owners. Traditional Owners endorse Closure Plans.	Participation Agreement Clause 4 and Management Plans 1, 5 & 8 (Freehills, 2004)	
B.15.11	Growth medium management.	Ensure optimal collection and management of topsoil resource.	<p>Review Procedures for Clearing and Topsoil Stripping and include:</p> <ul style="list-style-type: none"> ▪ Survey peg areas that are to be stripped of topsoil. ▪ Quantify (estimate) volume of topsoil to be stripped to enable calculation of area required for stockpile ▪ Locate topsoil in area approved and pegged for stockpiles, include on mine plan maps. ▪ Review the Land Clearance Guidelines (2003) to include "whole of site" activities. 	Ongoing	Superintendent Environment	Topsoil resource is quantified prior to clearing. Optimal topsoil is recovered. Topsoil stockpiles are signposted, surveyed and mapped.	<p>Procedure for Topsoil Management and Handling (Argyle, 2005e)</p> <p>Procedure: Clearing and Topsoil Stripping (Argyle, 2005d)</p> <p>Land Clearance Guidelines (Argyle, 2003m)</p>	



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Action	Key Issue	Objective	Management Action	Timing	Responsibility	Target	Work Procedure	Instruction
B.15.12	Genetic integrity of plant species on site.	Maintain genetic diversity.	Preferentially seek local provenance native seed suitable for areas to be rehabilitated – from suppliers including Traditional Owners.	2005	Superintendent Environment	Find short term and longterm suppliers of local provenance seed.	Nil	
B.15.13	Completion criteria are being met as per Closure Plan.	Rehabilitation is trending towards completion criteria.	Establish and implement a vegetation and erosion monitoring programme for all rehabilitation areas.	Annually, Q1	Superintendent Environment	Vegetation and erosion monitoring programme is in place.	Nil	
B.15.14			Review rehabilitation monitoring reports in conjunction with sediment transport data (15.16) and determine whether remedial works are required.	Annually, Q2	Superintendent Environment External consultants	Include remedial works in annual rehabilitation programme.	Nil	

To ensure that rehabilitation is undertaken on disturbed areas as soon as practicable and that it achieves a stable and functioning landform.

