

8. MINE CLOSURE AND REHABILITATION

This chapter summarises the findings of the Mine Closure and Rehabilitation Plan prepared for the project (Appendix 5). This plan presents a conceptual mine closure and rehabilitation plan for Stage 1 of the project only to demonstrate that Stage 1 of the project can be successfully closed and rehabilitated. It assumes that Stage 2 of the project does not proceed.

8.1 Introduction

The intent of mine closure and rehabilitation is to return the land to as close as is reasonably possibly to its pre-disturbance condition, suitable for use by Traditional Owners and as habitat for flora and fauna. Infrastructure not requested to remain in place by Traditional Owners will be removed for sale and used elsewhere or disposed of.

It is intended that as much rehabilitation as possible will be undertaken progressively during the life of the mine. This will allow rehabilitation methods to be tested and refined to determine the most suitable, and successful, method for final rehabilitation. Careful management of topsoil during the life of the project will provide for revegetation from the seed bank in the soil, minimising the need for direct revegetation.

While rehabilitation and mine closure will continue to be refined during the life of the mine, generally disturbed areas will be rehabilitated as follows:

- **Open pits**—where pit design is amenable, strip mining or a variation on the process will be used, allowing open pits to be progressively backfilled with waste rock during mining. These areas will be contoured, topsoil will be spread and direct seeded to encourage revegetation with native species of local provenance. In pits too small for strip mining backfilling will be undertaken where possible; however, in the majority of pits some final void will remain.

It is not economically viable to backfill all open pits. It has been estimated that were all remaining voids backfilled, upon cessation of mining, the cost would be in excess of \$250 M. Where final voids will remain, rehabilitation will focus on ensuring geotechnical and geochemical stability and bunds will be established to ensure public safety.

- **Waste rock storages**—waste rock storages will remain at the completion of mining and these will be contoured, and spread with topsoil and direct seeded to encourage revegetation with native species of local provenance. There will be no requirement for onerous engineering measures (e.g., covers, underdrainage or seepage collection) due to the benign geochemical nature of the waste rock. Where possible, the landform of these storages will mimic that of the regional landscape.

The waste rock storages are designed to a maximum height of 20 m above the natural ground level. Lower elevations for these waste rock storages were considered; however, reducing the elevation significantly increases the disturbance area. As such, a 20 m elevation was considered an appropriate compromise between disturbance area and visual/landscape impact.

- **Infrastructure areas**—mine infrastructure will be preferentially provided to Traditional Owners to improve the infrastructure in the Wunara community. Infrastructure not required by Traditional Owners will be removed from site. Once infrastructure has been removed, any areas of contamination will be remediated and the areas will then be revegetated with native species.

Closure requirements for the project follow legislative requirements, relevant policies, codes and frameworks, conditions of land use permits, Minemakers company requirements and performance standards. Each has implications for the development of this and the final mine closure and rehabilitation plan. These requirements are discussed in detail in Appendix 5.

8.2 Objectives

The objectives of the closure and rehabilitation process are to ensure the:

- Protection of human health and safety.
- Progressive rehabilitation of the site during operations.
- Vegetation is resilient, self-sustaining and comparable to the surrounding areas.
- Project does not compromise the quality and quantity of surface water or groundwater to existing users and water dependent ecosystems.
- Need for long term monitoring and maintenance is reduced through design and construction of mine waste landforms that are physically and chemically stable.
- Altered landforms (waste rock storages) are contoured and, recognising that the regional landscape is gently undulating and relatively flat with little to no significant elevation, as inconspicuous as possible.
- Residual risks and liabilities are identified and can be readily controlled.
- Mine closure process and lease relinquishment occurs in a cost-effective and efficient manner.
- Full cost of decommissioning and rehabilitation is understood and that a mechanism for funding exists.
- Development of an environmental monitoring and reporting program which is focused towards demonstrating the achievement of closure outcomes.

8.3 Stakeholder Involvement

8.3.1 Consultation to Date

Mine closure planning has been conducted in consultation with stakeholders to meet the following final rehabilitation and mine closure objectives:

1. Meet their perceptions of a suitable end land use for the project area.
2. Incorporate their requirements (e.g., retention of certain infrastructure for use by local land users).
3. Keep them informed of the achievement of mine closure criteria.

Detailed results of all consultation for the project are provided in Chapter 10.

8.3.2 Ongoing Consultation

The ongoing closure consultation process through the life of the project will aim to keep stakeholders informed by developing and agreeing on final closure objectives and criteria with them, and on a process for the relinquishment of the lease following closure.

The specific objectives of this consultation will be to ensure that:

- Stakeholders are included in the closure process, have their interests considered and have the resources to participate meaningfully in the process.
- All outcomes agreed to are achievable and sustainable, and ensure that the long-term integrity of the site is maintained.
- Requirements of the government and community are met.

Minemakers' stakeholder consultation process, of which closure consultation will be a part, is detailed in Chapter 10.

8.4 Description of Closure Domains

The project has been broadly divided into categories, generally known as domains, for closure. For consistency, these domains match those suggested by the Northern Territory Government (DRDPIFR, 2007a; DRDPIFR, 2009). The domains and their components are:

- **Site infrastructure**, including:
 - Accommodation village.
 - Administration offices.
 - Aerodrome.
 - Borefields.
 - Crushing and screening plants.
 - Main workshop and stores area.
 - Power station.
 - Sewage and water treatment plants.
- **Extractive workings**, including sand, gravel or clay borrow pits.
- **Hard rock pits**.
- **Water dams and ponds**, there are no water dams or ponds on site; this domain refers to surface water management structures.
- **Waste rock storages**, including non-DSO ore stockpiles.
- **Exploration**, including:
 - Drillholes, pads, sumps and costeans.
 - Tracks and gridlines.
- **Access and haul roads**.

These areas are shown in Figures 8.1, 8.2 and 8.3 for Arruwurra and Main Zone, respectively. The proposed end land uses for each domain are outlined in Table 8.1. Some of the domains do not appear on the figure, this is due to the scale of the figure being too great to show small detailed domains such as sediment ponds, not that they do not exist or have been missed. Exploration is also not included on this figure.

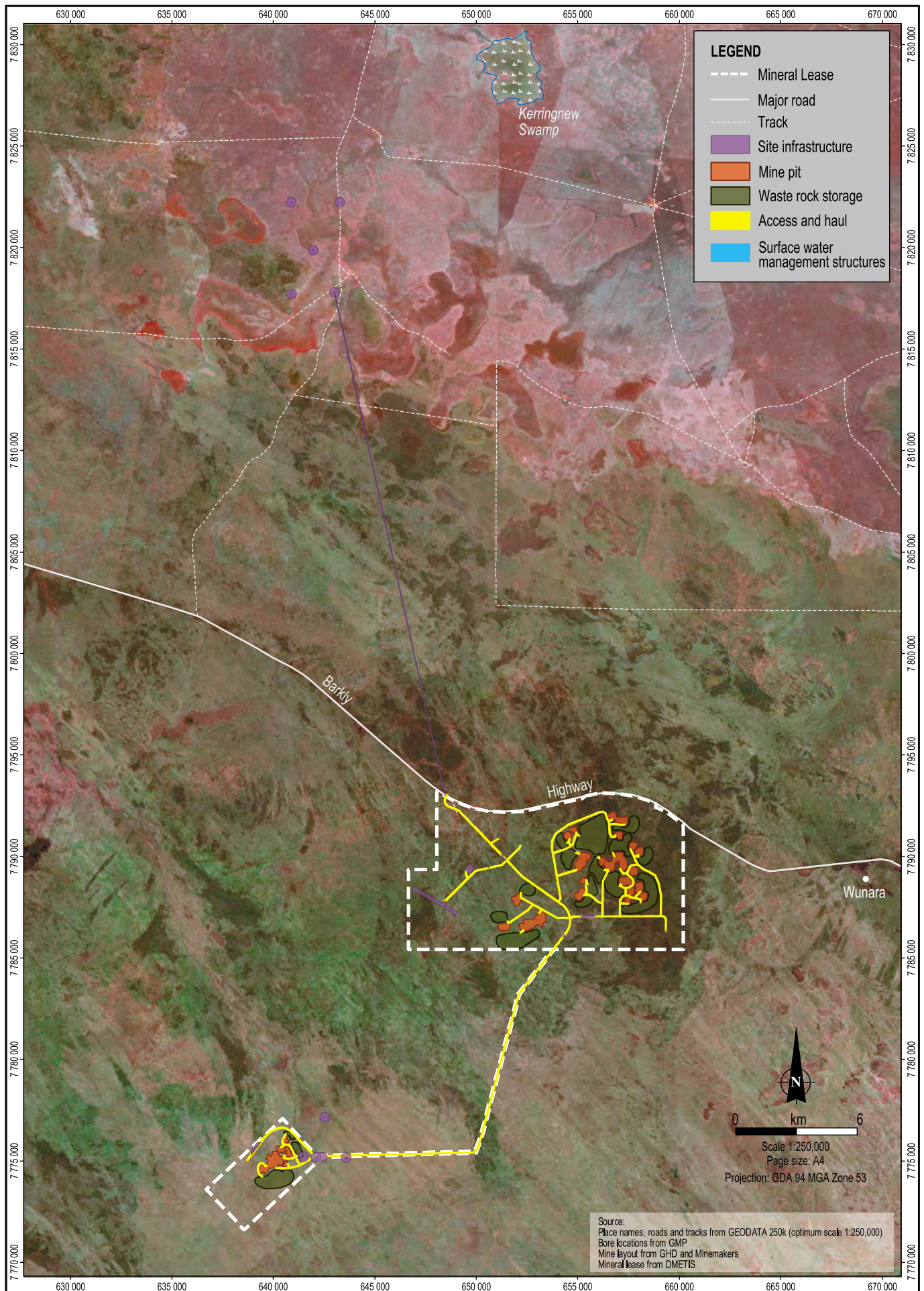
Future consultation with the Traditional Owners may result in some infrastructure being left behind by Minemakers to be utilised by the Wunara community. However, this will be determined after significant consultation with the Traditional Owners and a definitive decision will be made closer to the time closure. At this stage the base case is that Minemakers will remove all infrastructure from the Wonarah mine site.

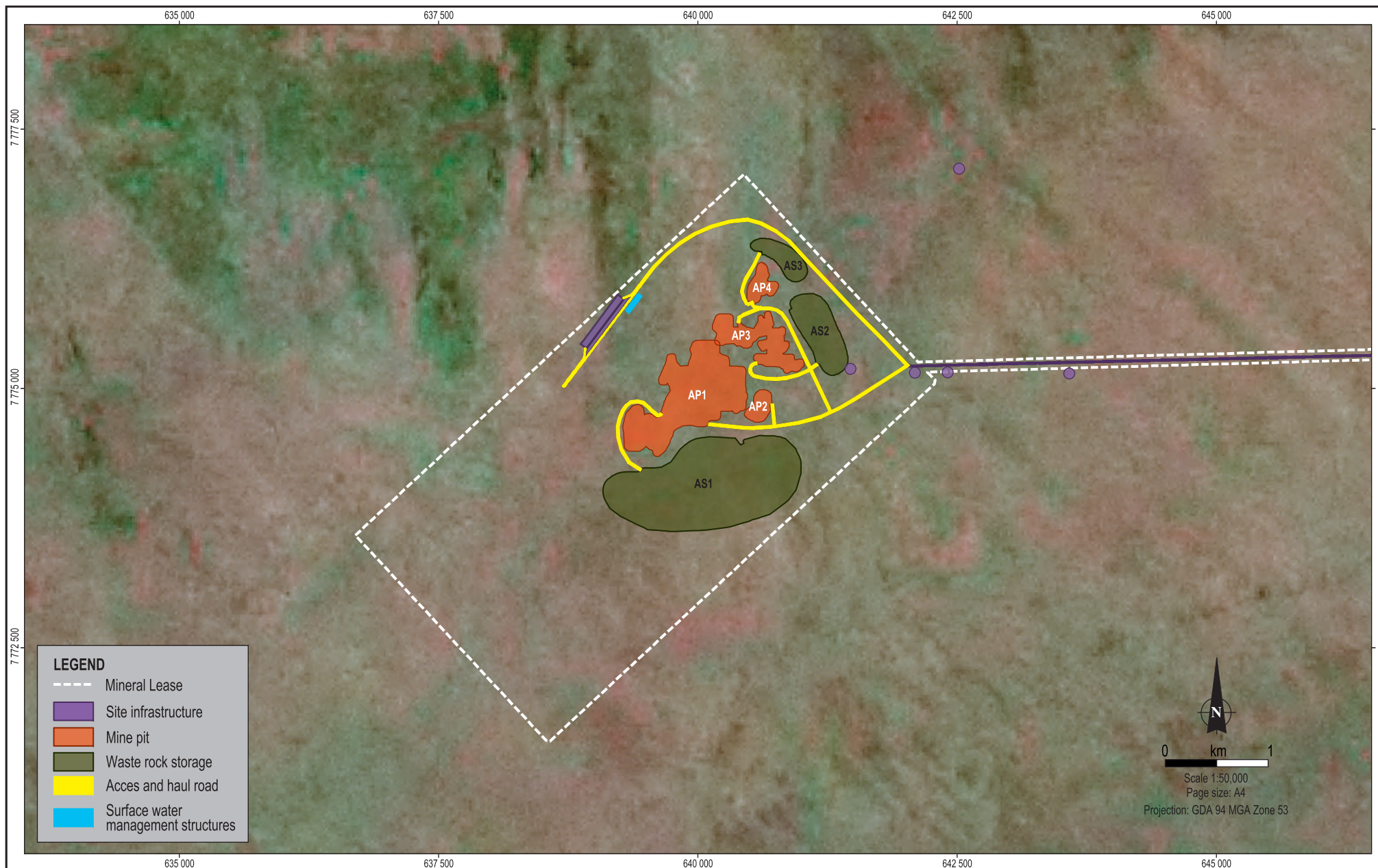
8.5 Closure Criteria

Closure outcomes have been developed for each domain (Table 8.2); these outcomes represent Minemakers' public commitments for the closure of the project. The outcomes and criteria:

- Have been written to be as clear and measurable as practical.
- Will form the basis for conditions of lease relinquishment.

During the closure planning process the outcomes and criteria will be reviewed and revised to take into consideration the results of trials and investigations, changes in mine planning and feedback from stakeholders on final land uses.





Source:
Mine layout from GHD and Minemakers
Mineral lease from DMETIS
Bore locations from GMP

coffey
natural systems

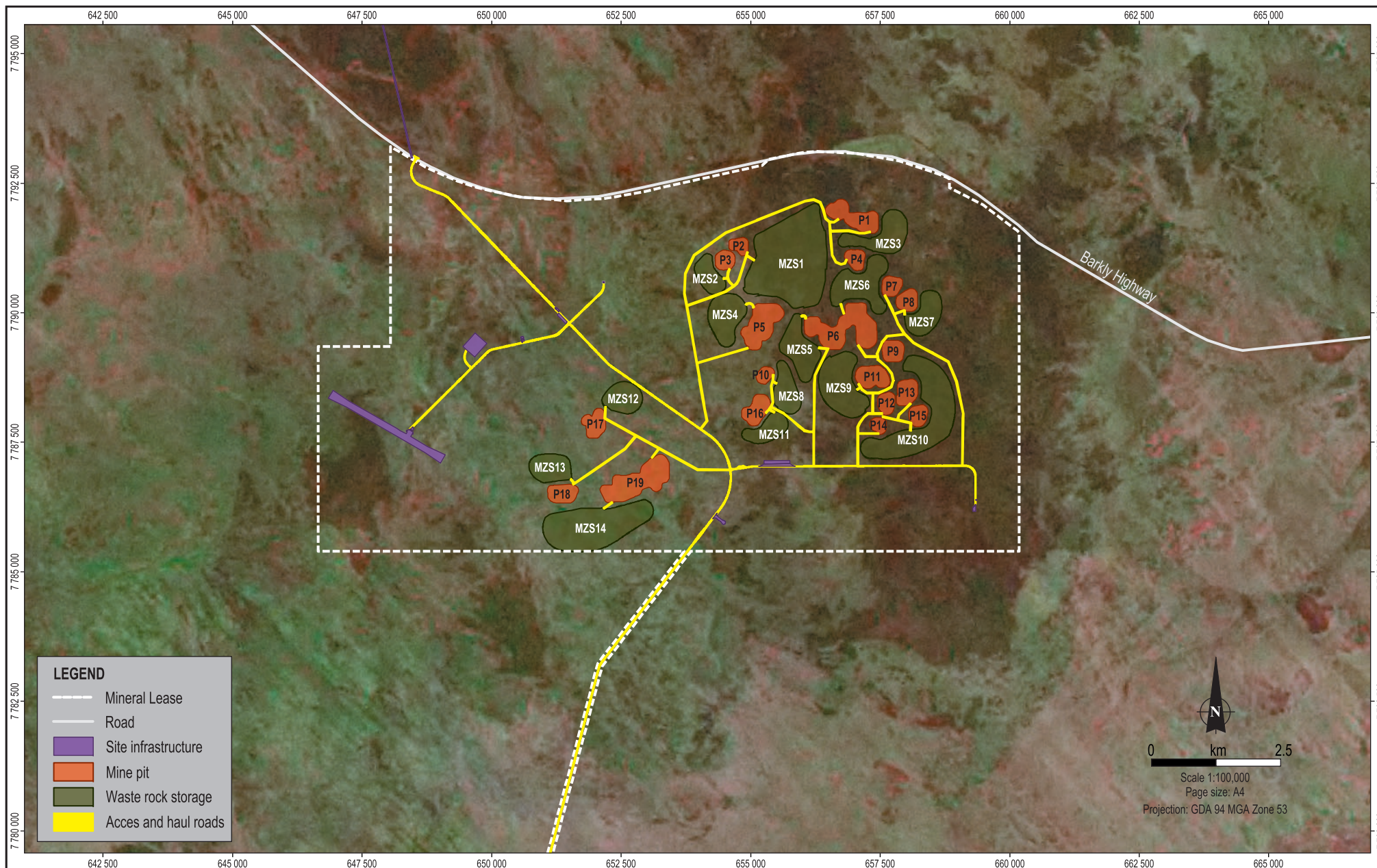
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9014_10_F08.02_GIS_HB

Minemakers Australia Pty Ltd
Wonarah Phosphate Project

MINEMAKERS
AUSTRALIA PTY LTD

Arruwurra closure domains

Figure No:
8.2



Source:
Road from GEODATA 250k (optimum scale 1:250,000)
Mine layout from GHD and Minemakers
Mineral lease from DMETIS
Bore locations from GMP

coffey
natural systems

Date:
11.11.2009
MXD:
Minemakers_Wonarah_GIS.mxd
File Name:
9014_10_F08.03_GIS_HB

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Wonarah Phosphate Project

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Main Zone closure domains

Figure No:

8.3

Table 8.1 Proposed land uses for each domain after closure

Domain	Component	Proposed land use
Site Infrastructure	Accommodation village	Traditional land use and resilient, self-sustaining native vegetation of local provenance providing suitable habitat for fauna.
	Administration offices	
	Aerodrome	Downgraded to airstrip and left for use by landowners.
	Borefield	Surrounding areas to be available for return to pastoral use.
	Crushing and screening plant	Traditional land use and resilient, self-sustaining native vegetation of local provenance providing suitable habitat for fauna.
	Main workshop and stores area	
	Power station	
	Sewerage, water treatment plant	
Extractive workings	Borrow pits	Stabilised modified landform providing traditional land use and resilient, self-sustaining native vegetation of local provenance.
Hard rock pits	Backfilled pits	Stabilised modified landform providing traditional land use and resilient, self-sustaining native vegetation of local provenance.
	Open pits	Pits: open voids. Abandonment bund: resilient, self-sustaining native vegetation of local provenance.
Water dams and ponds	Surface water management structures	Ephemeral drainage.
Waste rock storages	Waste rock storages	Stabilised modified landform with resilient, self-sustaining native vegetation of local provenance.
Exploration	Drillholes, pads, sumps and costeans	Traditional land use and resilient, self-sustaining native vegetation of local provenance.
	Access tracks and gridlines	
Access and haul roads	Access road	Traditional land use and resilient, self-sustaining native vegetation of local provenance, some access tracks may be left to facilitate Traditional Owner's access to sacred sites.
	Haul roads	Traditional land use and resilient, self-sustaining native vegetation of local provenance. May be left to facilitate Traditional Owner's access to sacred sites.

Table 8.2 Closure outcomes and completion criteria

Domain and Component	Outcome	Completion Criteria
General		
All site components	The community and future generations are left with no residual liability for site rehabilitation or maintenance.	Government acceptance of mine completion report which demonstrates achievement of all completion criteria.
	Public health and safety is not endangered.	Audit shows any remaining mining infrastructure is left in a safe and secure manner, and discourages public access.
	Landscape function and vegetation is resilient, self-sustaining and comparable to the surrounding areas.	Landscape and vegetation assessment undertaken and reported to show function is resilient, self-sustaining and comparable to the surrounding areas.
	No increase in contamination levels above baseline conditions.	Site contamination survey (conducted to Australian Standards) demonstrates no elevated levels of selected contaminants.
	Full awareness in community regarding mine closure concept and timing.	Stakeholder engagement records show ongoing consultation and engagement in closure planning process.
Site Infrastructure		
Accommodation village	All infrastructure removed.	Audit of domain against final closure plan to confirm the accommodation or related infrastructure does not remain on site.
Administration offices	All infrastructure removed.	Audit of domain against final closure plan to confirm the Administration offices or related infrastructure does not remain on site.
Aerodrome	All infrastructure removed except that required for function as airstrip.	Audit of domain against final closure plan to confirm only required airstrip infrastructure remains on site.
Borefields	No adverse change in ecological condition.	Field surveys show no increase in numbers of grazing animals above baseline conditions and consequent impacts from this.
	Borefields decommissioned.	Audit of domain against final closure plan shows only borefields required remain in use, and those not required are capped in accordance Northern Territory Government guidelines (e.g., DRDPIFR, 2007b)
	All infrastructure removed unless required for end land use or requested and agreed between Minemakers and Traditional Owners.	Audit of domain against final closure plan to confirm only required borefield infrastructure remains on site.

Table 8.2 Closure outcomes and completion criteria

Domain and Component	Outcome	Completion Criteria
Site Infrastructure (Cont'd)		
Crushing and screening plants	All infrastructure removed.	Audit of domain against final closure plan to confirm no crushing and screening plant infrastructure remains on site.
Main workshop and stores area	All infrastructure removed.	Audit of domain against final closure plan to confirm no workshop or stores area infrastructure remains on site.
Power station	All infrastructure removed.	Audit of domain against final closure plan to confirm no power station infrastructure remains on site.
Sewage, water treatment plant	All infrastructure removed.	Audit of domain against final closure plan to confirm no sewage and water treatment plant infrastructure remains on site.
Extractive workings		
Borrow pits	Landscape function and vegetation is resilient and self-sustaining and comparable to surrounding area. Left with no risk of becoming a trap for people or fauna.	Landscape and vegetation assessment undertaken and reported to show function is resilient, self-sustaining and comparable to the surrounding areas.
Hard rock pits		
Backfilled pits	Landscape function and vegetation is resilient, self-sustaining and comparable to surrounding area.	Landscape and vegetation assessment undertaken and reported to show function is resilient, self-sustaining and comparable to the surrounding areas.
Open pits	Water quality in open pit voids is suitable and does not lower surrounding water quality or impact fauna that may use them, e.g., birds and amphibians.	Monitoring post closure demonstrates that pit water is of suitable quality. No creation of long-term mosquito breeding habitat.
	No impact on water quantity or quality available to existing groundwater users due to pit inflow.	Monitoring post closure of site bores demonstrates there is no change from baseline in terms of quality or quantity and audit shows that recharge is as per predictions.
	No injuries or deaths resulting from pit stability or ease of access to pit.	Abandonment bund constructed around the pit perimeter to restrict inadvertent access to the pit void, with the location of the bund to be determined by a geotechnical specialist.
		Pit ramps blocked to prevent inadvertent access.
		Geotechnical assessment of pit at closure demonstrates stability is acceptable.

Table 8.2 Closure outcomes and completion criteria

Domain and Component	Outcome	Completion Criteria
Water dams and ponds		
Surface water management structures	Surface water storage areas rehabilitated to provide habitat for wetland bird species.	Vegetation and fauna assessment undertaken and report to show areas function as habitat for wetland bird species.
		No creation of long-term mosquito breeding habitat.
		Audit shows that where possible and necessary water structures are rehabilitated to provide polishing wetlands.
	All surface water structures remaining in place are physically stable and safe to fauna and humans.	Audit of structures to confirm stability and safety acceptable.
Waste rock storages		
Waste rock storages	Waste rock storages are physically and chemically stable.	Geotechnical assessment shows that waste rock storages are physically stable.
		Monitoring to demonstrate no adverse impact to the quality and quantity of surface or groundwater caused by waste rock storages to water-dependent ecosystems.
Exploration		
Drillholes, pads, sumps and costeans	Ecosystem and landscape function is resilient and self-sustaining and comparable to surrounding area.	Audit shows all exploration drill holes capped and drill pads rehabilitated in accordance with Northern Territory Government guidelines (DRDPIFR, 2007b; DRDPIFR, 2007c; respectively).
		Audit shows all costeans and sumps backfilled or battered and rehabilitated in accordance with Northern Territory Government guidelines (DRDPIFR, 2007d).
Access tracks and gridlines	Ecosystem and landscape function is resilient and self-sustaining and comparable to surrounding area.	Audit shows all access tracks, grid lines and drill pads rehabilitated as per Northern Territory Government guidelines (DRDPIFR, 2007e).
Access and haul roads		
Access road	Access road rehabilitated unless required for end land use by Traditional Owners.	Audit shows all access road infrastructure no longer required is decommissioned.
Haul roads	All haul roads and other site roads rehabilitated unless required for end land use by Traditional Owners.	Audit shows all haul road and other site road infrastructure rehabilitated.

8.6 Potential Impacts and Risk Analysis

8.6.1 Potential Impacts

A number of potential impacts may occur across most or all of the closure domains; to avoid repetition they are not mentioned for each individual domain. These are:

- Air quality:
 - Decrease in air quality due to dust emissions from disturbed and poorly rehabilitated land.
- Cultural heritage:
 - Reduced amenity of sacred sites near the project area.
- Fauna:
 - Increased abundance of introduced species.
 - Reduced species abundance and/or diversity compared to baseline.
- Flora:
 - Reduced species abundance and/or diversity compared to baseline.
 - Introduction of new weed species and increased weed density and distribution.
 - Increased potential for fire, or changed fire characteristics.
- Groundwater:
 - Contamination of groundwater resources due to seepage from land contaminated by mining operations.
- Landscape and visual amenity:
 - Altered landscape and reduced visual amenity compared to baseline, particularly as a result of waste rock storages.
- Socio-economic – positive:
 - Reduced project-related traffic on the Barkly Highway.
 - Provision of access tracks to sacred sites.
 - Lasting socio-economic benefits to Traditional Owners.
- Socio-economic – negative:
 - Reduced employment opportunities.
 - Reduced spending in the local community.
 - Increased human health (i.e., safety) risks.
 - Changed population in local communities.
 - Potential burden on government should Minemakers not be able to provide post-closure monitoring and maintenance costs.
- Surface water:
 - Adverse effects on aquatic fauna and habitats due to increased sediment loads in watercourses resulting from ineffective rehabilitation of disturbed land.
 - Contamination of watercourses due to runoff from land contaminated by mining operations.

8.6.2 Residual Risk Analysis

A summary of the assessment of the residual risks of all impacts associated with the closure and rehabilitation of the project is provided in Table 8.3.

Table 8.3 Residual risks for each domain

Domain	Impact	Likelihood	Consequence	Residual Risk
General				
All site components	The community and future generations are left with residual liability for site rehabilitation or maintenance.	Unlikely	Moderate	Moderate
	Public health and safety is not ensured.	Rare	Major	High
	Landscape function and vegetation is not resilient, self sustaining and comparable to the surrounding areas.	Unlikely	Moderate	Moderate
	Long term contamination of land.	Unlikely	Minor	Low
	The community is unaware of mine closure concept and timing.	Rare	Major	High
	Infrastructure is not removed.	Rare	Minor	Low
Site infrastructure				
Borefield	Uncontrolled release of groundwater and adverse change in ecological conditions as a result of bores not being appropriately decommissioned.	Rare	Insignificant	Low
Extractive workings and hard rock pits (Arruwurra and Main Zone)				
Backfilled pits	Landscape function and vegetation is not resilient, self sustaining and not comparable to the surrounding areas.	Unlikely	Major	High
Open pits	Injuries or deaths resulting from pit stability or ease of access to pit.	Rare	Catastrophic	High
Water dams and ponds				
Surface water management structures	Surface water management structures remaining in place are not physically stable and safe to fauna and humans.	Unlikely	Moderate	Moderate
Storages and waste rock storages				
Waste rock storages	Waste rock storages not physically or chemically stable.	Unlikely	Major	High
	Self-sustaining vegetation is not established over waste rock storage areas.	Unlikely	Major	High
	Decrease in visual amenity of landform compared to baseline.	Likely	Insignificant	Moderate
Exploration				
Drillholes, pads,	Injury due to inadequate rehabilitation.	Rare	Moderate	Moderate

Table 8.3 Residual risks for each domain

Domain	Impact	Likelihood	Consequence	Residual Risk
sumps and costeans	Landscape function and vegetation is not resilient, self sustaining and comparable to the surrounding areas.	Rare	Minor	Low
Tracks and gridlines	Landscape function and vegetation is not resilient, self sustaining and comparable to the surrounding areas.	Rare	Minor	Low
<i>Access and haul roads</i>				
Access roads	Landscape function and vegetation is not resilient, self sustaining and comparable to the surrounding areas.	Rare	Minor	Low
Haul roads				

8.7 Post-closure Monitoring and Maintenance

8.7.1 Monitoring

An environmental and social monitoring program after the closure of the project is detailed in Appendix 5. The objectives of this monitoring will be to determine whether (or not) the objectives of closure, and the closure criteria for the project, are being met. Aspects to be monitored include:

- Air quality.
- Cultural heritage and archaeology.
- Flora and fauna: species composition, condition and abundance.
- Flora and fauna: pest species.
- Groundwater quantity and quality.
- Soil quality.
- Surface water quality and stream sediment quality.
- No unauthorised disturbance to site of cultural significance.
- Public safety is compromised as a result of mining legacy.

8.7.2 Maintenance

Following rehabilitation of the site there will be a requirement for maintenance, particularly during the initial one to two years following closure. Maintenance of the site will continue until all lease conditions and completion criteria have been met. These activities are likely to involve repair to surface water drainage structures, repair of any erosion areas or the reseedling of areas due to poor vegetation establishment. More specifically, where monitoring has identified erosion, weed invasion, failure of revegetation (to any material degree) or excessive browser damage to regenerating vegetation, maintenance activities will be implemented to ensure regeneration progresses successfully and rapidly.

8.8 Closure Costs

The cost estimate for rehabilitation of the site has been prepared using the draft Mines and Energy Security Calculation Form (DRDPFR, 2009). The cost estimate is based on the assumption that a third party undertakes the rehabilitation and decommissioning works at the end of mine life and that there is no revenue from resaleable items. The estimated cost (Table 8.4) is \$43.5 million. A full breakdown of the estimated closure costs is provided in Appendix 5.

Table 8.4 Summary of estimated closure costs

Domain	Estimated Cost (\$AUD)
Site Infrastructure	\$2,436,231
Extractive Workings	\$368,890
Hard Rock Pits	\$28,303,722
Water Dams and Ponds	\$12,540
Waste Rock Storages	\$2,367,500
Exploration	\$2,183,800
Access and haul road	\$1,851,120
Sub total (domains and other sundry items)	\$37,523,803

Table 8.4 Summary of estimated closure costs

Domain	Estimated Cost (\$AUD)
Post closure monitoring	\$187,495
Contingency (5%)	\$5,656,695
Total (nearest \$500,000)	\$43,500,000

8.9 Schedule

The progress of closure planning (including progressive rehabilitation) will be reported on an annual basis as part of the operation's annual Mining Management Plan. A conceptual closure timeline for the project is shown in Table 8.5, where Year 1 corresponds to the commencement of mining.

Table 8.5 Schedule for rehabilitation of each domain

Domain	Year											
	1	2	3	4	5	6	7	8	9	10	11	12
Site infrastructure												
Accommodation camp												
Administration offices												
Airstrip												
Borefields												
Crushing and screening plant												
Main workshop and stores area												
Power station												
Extractive workings												
Borrow pits												
Hard rock pits												
Hard rock pits												
Water dams and ponds												
Surface water retention ponds												
Waste rock stockpiles												
Waste rock stockpiles												
Exploration												
Drillholes, pads, sumps and costeans												
Access tracks and gridlines												
Access and haul roads												
Access road												
Haul roads												
Monitoring												
Monitoring												