

Sydney Construction Materials



Rehabilitation and Landscape Management Plan

Newnes Junction Sand & Kaolin Extraction Project

December 2010

SCM01-002



GSS ENVIRONMENTAL
Environmental, Land and Project
Management Consultants

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1.0 INTRODUCTION

1.1 Background

Newnes-Kaolin Pty Ltd, trading as Sydney Construction Materials (SCM), proposes to develop an open pit operation to extract friable quartzose sandstone at Newnes Junction, on the Newnes Plateau approximately 10 km east of Lithgow (see **Figure 1**). SCM proposes to transport the sandstone off-site by rail for processing of the constituent minerals - kaolin and silica sand. Off-site processing will yield fully graded construction sand for the manufacture of ready mixed concrete, a range of high-purity silica specialty sands, and a range of refined kaolin products. The general layout of the operation is shown on **Figure 2**.

With total estimated reserves of over 20Mt, the pit life is expected to exceed 21 years. Approximately 1.1Mt per annum will be extracted on average, with a maximum expected of 1.4Mtpa. Areas adjacent to the quarry have been extensively quarried/mined for construction sands and coal.

The quarry operation will be located on the ridgeline between the Rocla Quarry (adjacent to the south) and the Clarence Colliery pit top (adjacent to the northwest). The proposed disturbance area is approximately twenty five (25) hectares. Bordering the east of the site is the Blue Mountains National Park (BMNP), which is part of the Greater Blue Mountains World Heritage Area, containing the headwaters of the Wollangambe and Coli Rivers wilderness areas. The proximity to, and importance of, the BMNP has been a driver for conservative and sustainable water and soil management for the development. This resulted in the principle underlying design criteria set by SCM to protect potential receiving waters.

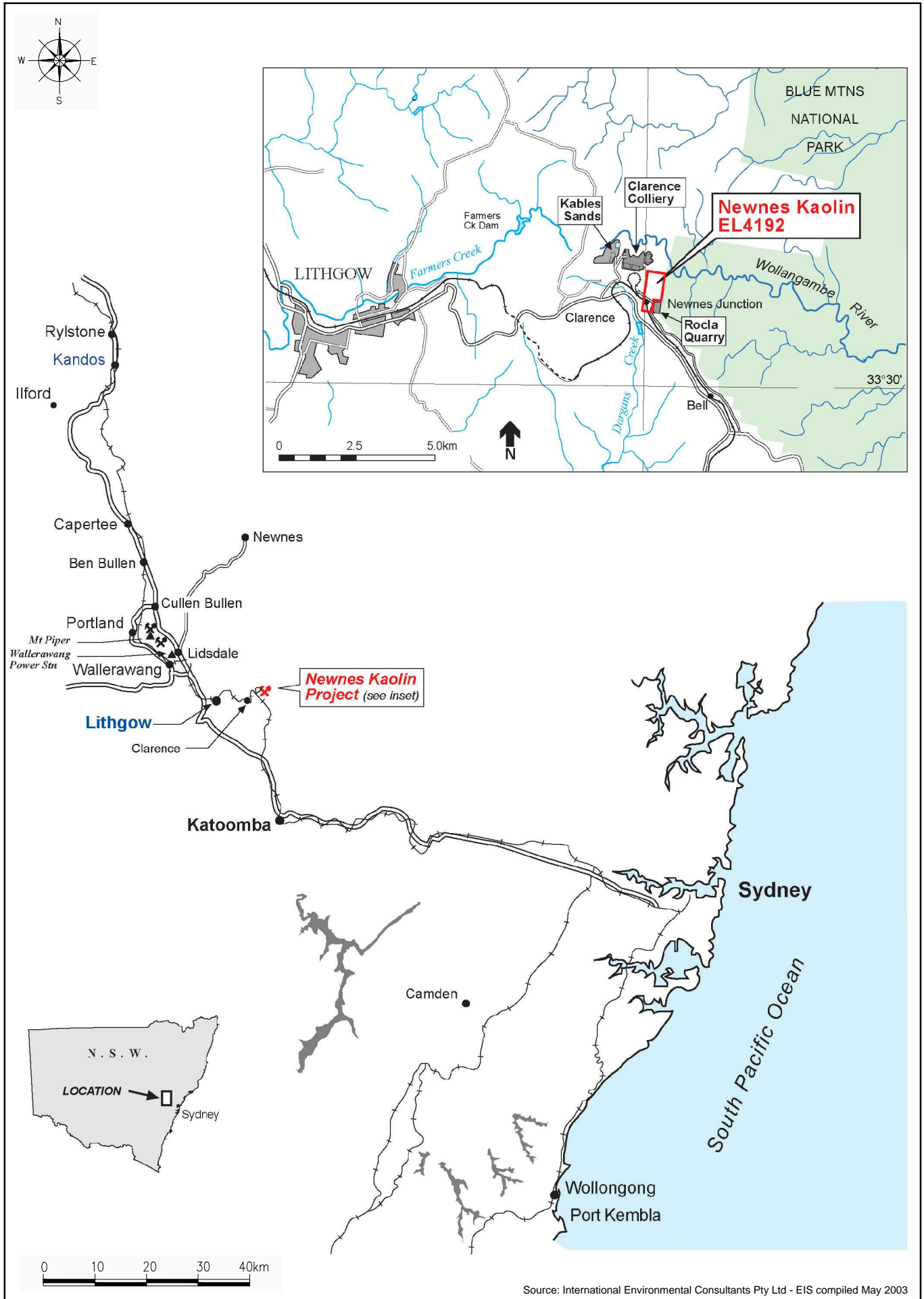
Development Consent for the proposed operation of a kaolin mining and sand quarrying operation was issued in 2006 under Section 80 of the *Environmental Planning and Assessment Act 1979*. The following Rehabilitation and Landscape Management Plan has been prepared to comply with Conditions 31, 32, 33 and 34 of the Development Consent (DA 329-7-2003 23).

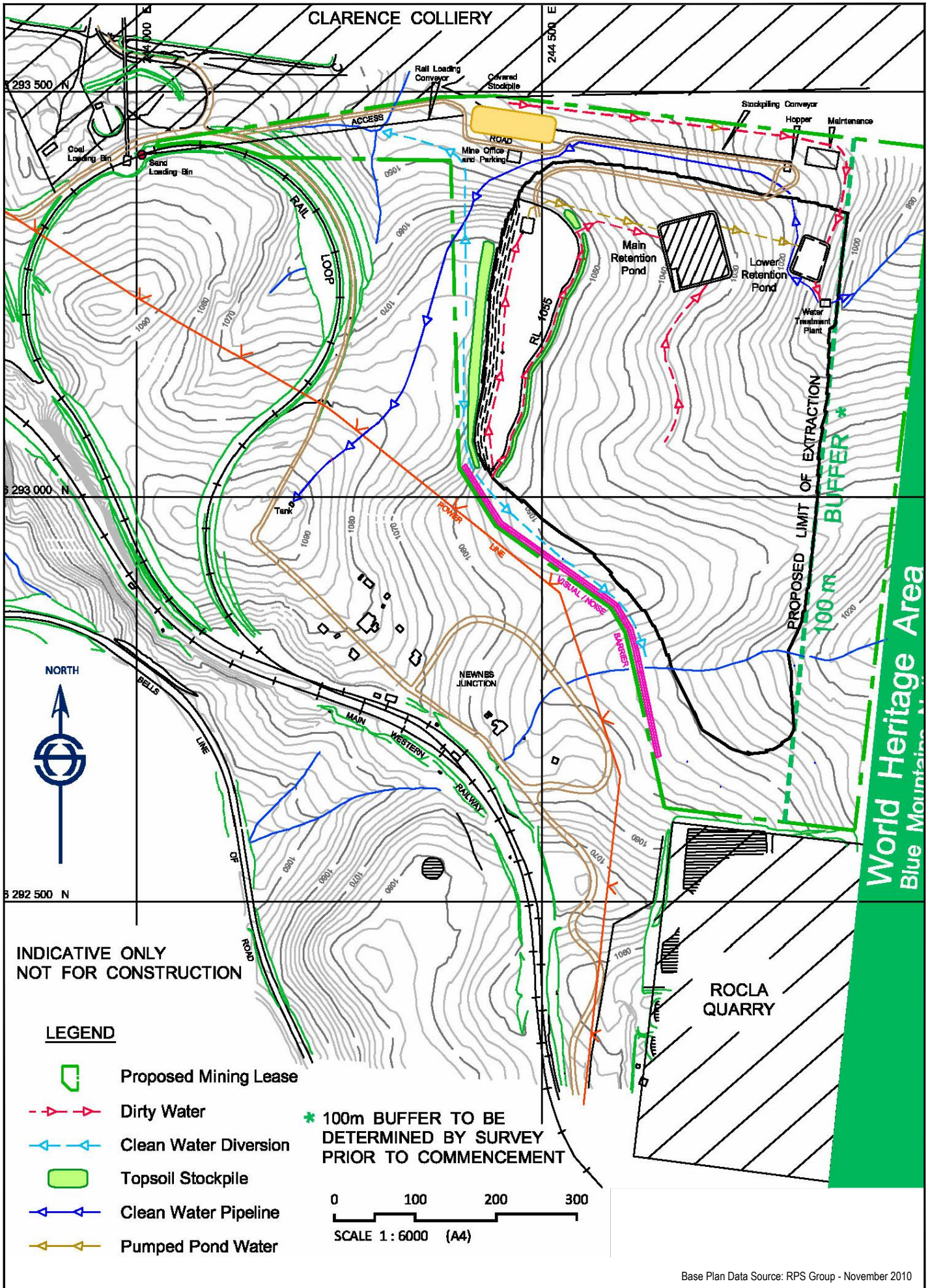
1.2 Overview of Operations

The resource at the site comprises friable sandstone which breaks down readily into its constituent minerals, including kaolin, silica and for the most part, sand. The operation is an open cut sand/kaolin mining operation on a 25 hectare portion of the site. The operation includes the following key components:

- Extracting up to 20.6 million tonnes of friable sandstone;
- Utilisation of a surface miner and self-loading scrapers for material extraction;
- Delivery of the material to the Clarence rail loop for transport to Sydney for crushing and processing/kaolin recovery;
- Producing 1.4 million tonnes of extracted material a year, including up to 1.28 million tonnes (Mt) of sand and 119,000 Mt of kaolin a year (only sand will be produced for the first 5 years);
- Operating the mine/quarry for a period of approximately 20 years;
- Creation of an acoustic barrier between the operation and the township of Newnes Junction; and
- Progressively rehabilitating the pit benches, and the ultimately rehabilitating the open cut void to free draining wetland.

From the Clarence Colliery rail loop, the raw material is transported by rail to an industrial site in the Greater Sydney Metropolitan Area for crushing, processing and recovery of products including building sand, specialty sands, gravels and kaolin.





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1.3 Purpose & Objectives

The objectives of the Rehabilitation and Landscape Management Plan are the following:

- To meet the requirements of the Development Consent relevant to the operations at SCM;
- To establish objectives for the rehabilitation of disturbed land that will result from mining at the SCM operations;
- To achieve acceptable post-disturbance land use suitability;
- To create a stable post-disturbance landform;
- To preserve downstream water quality; and
- Re-establish vegetation habitats that will support fauna communities.

The Rehabilitation and Landscape Management Plan contains the following main components:

- **Rehabilitation Management Plan** (see **Section 2.0**);
- **Final Void Management Plan** (see **Section 3.0**); and
- **Mine Closure Plan** (see **Section 4.0**).

1.4 Regulatory Requirements

Based on the Development Consent issued under Section 80 of the *Environmental Planning and Assessment Act 1979* (DA 329-7-2003 23), GSSE has noted dot points 31 through 35, which relate to rehabilitation and landscape management of the site.

Table 1 below lists the Development Consent conditions that were utilised as the basis for the preparation of the Rehabilitation and Landscape Management Plan and where specific components are addressed in the report.

Table 1 – Development Consent Requirements for the Newnes Junction Sand and Kaolin Extraction Project

Condition	Section Where Addressed
Rehabilitation	
31. The Applicant shall progressively rehabilitate the site to the satisfaction of the Director-General and the DPI, in a manner that is generally consistent with the concept final landform described in the Supplementary Report (shown conceptually in Appendix 2).	
Rehabilitation and Landscape Management Plan	
32. Prior to carrying out any development, the Applicant shall prepare and subsequently implement a Rehabilitation and Landscape Management Plan for the development in consultation with DNR, DEC, DPI, DEH and Council, and to the satisfaction of the Director-General: This plan must include a:	
a) Rehabilitation Management Plan;	2.0
b) Final Void Management Plan; and	3.0
c) Mine Closure Plan.	4.0
33. The Rehabilitation Management Plan must include:	
a) rehabilitation objectives for the site;	2.1
b) description of the short, medium, and long-term measures that would be implemented to rehabilitate the site;	2.3
c) detailed assessment and completion criteria for the rehabilitation of the site;	2.4

d) detailed description of how the performance of the rehabilitation of the mine would be monitored over time to achieve the stated objectives;	2.3.8
e) describe in detail the measures that would be implemented over the next 3 years to rehabilitate and manage the landscape of the site.	2.3
34. The Final Void Management Plan must:	
a) justify the planned final location and nature of the final void;	3.2
b) incorporate design criteria and specifications for the final void based on verified groundwater modelling predictions and re-assessment of post-extraction groundwater equilibration;	3.3
c) assess the potential interactions between surrounding waterbodies and the final void; and	3.4
d) describe what actions and measures would be implemented to: <ul style="list-style-type: none"> • minimise any potential adverse impacts associated with the final void; and • manage and monitor the potential impacts of the final void until the mining lease for the development is relinquished. 	3.5 3.5
35. The Mine Closure Plan must:	
a) define the objectives and criteria for mine closure and post-extraction management;	4.1
b) investigate options for future use and conservation of the site;	4.4.2
c) describe the measures that would be implemented to minimise or manage the ongoing environmental effects of the development; and	4.5
d) describe how the performance of these measures would be monitored over time.	4.5

1.5 Guidelines

This Rehabilitation and Landscape Management Plan has been prepared in accordance with the requirements of the following relevant strategic land use planning and resource management plans and policies relating to mine rehabilitation and mine closure.

- G.J Summerhayes (1999) *The Rehabilitation of Coal Mines & Opportunities for Integrated Post Mining Land Uses*, Part 2, Invited Papers included in the Synoptic Plan for Integrated Landscapes, prepared by Andrews Neil for the NSW Department of Minerals Resources;
- The Department of Environment & Heritage (2002) – Best Practice Environmental Management in Mining Booklet for Mine Closure;
- Department of Environment (1998) Landform Design for Rehabilitation, Best Practice Environmental Management in Mining;
- The Strategic Framework for Mine Closure (ANZMEC & MCA, 2000); and
- Leading Practice Sustainable Development Program for the Mining Industry – Mine Closure (Federal Department of Industry, Tourism and Resources).

2.0 REHABILITATION MANAGEMENT PLAN

2.1 Rehabilitation Objectives

The objectives of the proposed rehabilitation strategy are to:

- Minimise the environmental impact of the expanding operation during development and operational phases, ensuring that protection of water quality and erosion control works are key priorities, and that progressive rehabilitation is completed as soon as possible;
- Ensure that site drainage and sedimentation structures remain stable and functional under extreme rainfall events;
- Ensure that vegetative matter and topsoil is made available for the site rehabilitation as required;
- Guarantee that the resource is extracted and the site rehabilitated in a manner that will ensure the quality of surface runoff and groundwater infiltration at all times; and
- Produce a final “walk away” landform that is geotechnically stable and blends aesthetically into the surrounding landforms, yet as far as possible does not limit possible future land uses.

2.2 Conceptual Final Landform

The vegetation of the area currently supports an open eucalyptus woodland forest. The broad rehabilitation objective for the post-quarry landform is to establish a similar landuse. The topography of the final landform will consist of a large number of small, stepped sandstone benches formed in an amphitheatre configuration, each with a revegetated bench (refer to **Figure 3**). The void will be some 450m wide and 400m long at its western edge, and 650m long at its eastern edge. Until such time that extraction has ceased, rehabilitation will occur around the perimeter of the pit only along the sandstone benches, and will not involve the pit floor.

Once operations have ceased, all buildings and infrastructure will be removed from the pit. These areas will be reshaped and ripped where necessary for topsoiling and revegetation. It is proposed that the haul road will remain for use in the ongoing management of the site and for fire fighting purposes. The pit floor will be vegetated with appropriate native species to create a stable, free draining wetland. The wetland will be formed as a shallow depression with the low point in the location of the final retention pond in the north east corner of the pit. It is anticipated that sedges and other wetland plants endemic to the area will colonise the wetland area to form a swamp ecosystem analogous to that in Gooches Crater.

2.3 Progressive Rehabilitation and Revegetation

Native open woodland vegetation cover currently occurs over most of the proposed quarry site. It is proposed to re-establish a similar cover to the majority of the post-quarrying landform. Native vegetation will largely be established using directly applied seed and from the seed store within re-spread topsoil. Supplementary native pasture and/or tubestock seeding will be undertaken where specific species combinations are required. A plant nursery will be established at the site to propagate all tubestock to be used during the rehabilitation process.

Rehabilitation of the site will be undertaken in a progressive manner, commencing with terraced landscaping. As the surface miner progresses through the resource, 2 meter wide benches will be left every 3 meters of depth to provide a horizontal platform on which native flora species will be established. Irrigation of newly planted vegetation will be provided by seeping mine water from the pit walls.

The revegetation program (“terrace landscaping”) will progressively re-establish native tree / shrub / ground cover and will stabilise reshaped and benched areas. Benches will be deep ripped to actively promote infiltration of water which will enhance soil moisture requirements for direct tree seeding and minimise surface runoff to underlying benches and the pit floor dirty water control system. Revegetation will also visually screen disturbed areas and will re-establish habitat for native fauna (refer to **Figure 3**).

On completion of mining, the pit floor will be re-shaped and revegetated with wetland plant species to form a free draining wetland environment.

The main reasons for engaging in progressive rehabilitation include:

- To mitigate the visual impact of the mine throughout its life by providing a vegetated wall at all times;
- To reduce the rehabilitation task that would otherwise result at quarry closure;
- To allow for enhanced integration into the surrounding vegetation; and
- To minimise erosion, improve water quality and ensure landscape stability.

The following table (**Table 2**) details the short, medium and long term measures that will be implemented across the site with regard to rehabilitation.

Table 2 – Short, Medium and Long Term Rehabilitation

Rehabilitation	Activity
Short Term	<ul style="list-style-type: none"> • Stabilise disturbed areas through use of cover crop and engineered measures • Establishment of visual landscaping, particularly around the perimeter of the pit area • Provide surface water capture, treatment and release through clean and dirty water diversions
Medium Term	<ul style="list-style-type: none"> • Undertake progressive rehabilitation of the benches of the void as they become available • Maintenance of established rehabilitation areas (vegetation and drainage works) • Control of weeds, vermin and feral animals
Long Term	<ul style="list-style-type: none"> • Provide a stable final landform with high biodiversity that is consistent with the surrounding environment • Maintenance of established rehabilitation areas • Provide weed control in completed rehabilitation areas • Provide feral animal control in completed rehabilitation areas • Maintain drainage and sediment control structures • Monitor rehabilitation success in terms of physical and biological parameters

Further detail on rehabilitation methods and establishment is discussed below in **Sections 2.3.1 - 2.3.8**.

2.3.1 Surface Preparation

The de-compaction of soil is important in assisting rapid tree growth through deep root growth and enhanced soil water infiltration. Ripping depth must be sufficient to penetrate any near-surface rock or clay. Inadequate site preparation and weed control are often the two biggest single factors responsible for tree revegetation failure. Thorough site preparation will be undertaken to ensure rapid establishment and growth of seedlings. All proposed seeding areas will be deep ripped to an indicative depth of 400 – 500 mm.

2.3.2 Direct Seeding

Direct seeding (via broadcasting) is preferred over tube stock planting as it enables a far greater success rate, limits the need for ongoing maintenance (e.g. watering) and is the most effective method in achieving a successful rehabilitation outcome.

Proposed species for revegetation have been selected from local native species as identified by HWR (2004) in the *Flora Assessment – Sand Extraction and Kaolin Project, Newnes Junction*. Not all native trees and shrubs are suited to direct seeding due to their innate germination requirements. In cases, it may be required to supplement with some tubestock to increase biodiversity. A mixture of native trees and shrubs will be sown onto the majority of the reshaped and benched pit areas following topdressing and site preparation. Tree and shrub seeding using endemic species will complement natural regeneration from seed contained within the soil seed bank. The mix used for revegetation of the disturbed quarry area will include many of the major tree and shrub species shown in **Table 3** below.

Table 3 – Recommended Species Mix for Quarry Rehabilitation

Recommended Species List
Eucalyptus piperita (Sydney Peppermint)
Eucalyptus sieberi (Silvertop Ash)
Eucalyptus sclerophylla (Scribbly Gum)
Lomatia silaefolia (Crinkle Bush)
Daviesia latifolia (Broad-leaf Bitter-pea)
Banksia spinulosa (Hairpin Banksia)
Acacia terminalis (Sunshine Wattle)
Epacris pulchella (Wallum Heath)
Telopea spesiosissima (Waratah)
Acacia byoeana
Acacia flocktoniae (Flockton Wattle)
Eucalyptus pulverulenta (Silver-leaved Mountain Gum)
Prostanthera cryptandroides (Mint Bush)
Pultenaea glabra (Smooth Bush-Pea)

Seed will be sourced from local NPWS licenced seed collectors. Some native species have difficult dormancy mechanisms that need to be broken before germination can occur. Native seed for revegetation of the quarry will be appropriately pre-treated in order to break dormancy restrictions. Subject to sufficient follow up rain, high initial tree densities can be expected. These high densities will quickly help stabilise and screen the site and will result in healthy mature tree stands over time. It is intended to create, over time, a mosaic of variable native species and plant densities representative of that currently occurring in the area. Growth rates of between 1 and 2 metres per year can be initially expected for many of the more dominant trees and shrubs.

Correct treatment and application of seed in the appropriate ratios is important in controlling emerging weeds and in allowing the tree stand to develop in a positive direction. The native tree and shrub seed mix will be sown at a total combined rate of approximately 7 kg/ha. Seed will be broadcast evenly onto

topdressed areas. It will not be buried. Seeding will be conducted in late spring, summer and early autumn giving superior results due to higher ground temperatures.

2.3.3 Scheduling of Works

Some twenty five (25) hectares of native woodland vegetation will be disturbed by quarrying over the duration of the project. Rehabilitation work will be undertaken *progressively* as soon as reshaped, benched and topsoiled areas become available. **Figure 4** illustrates the timing and sequencing of active quarrying for the revised staged extraction plan and therefore provides an indication of revegetation scheduling given that seeding will be undertaken immediately after extraction areas are exhausted.

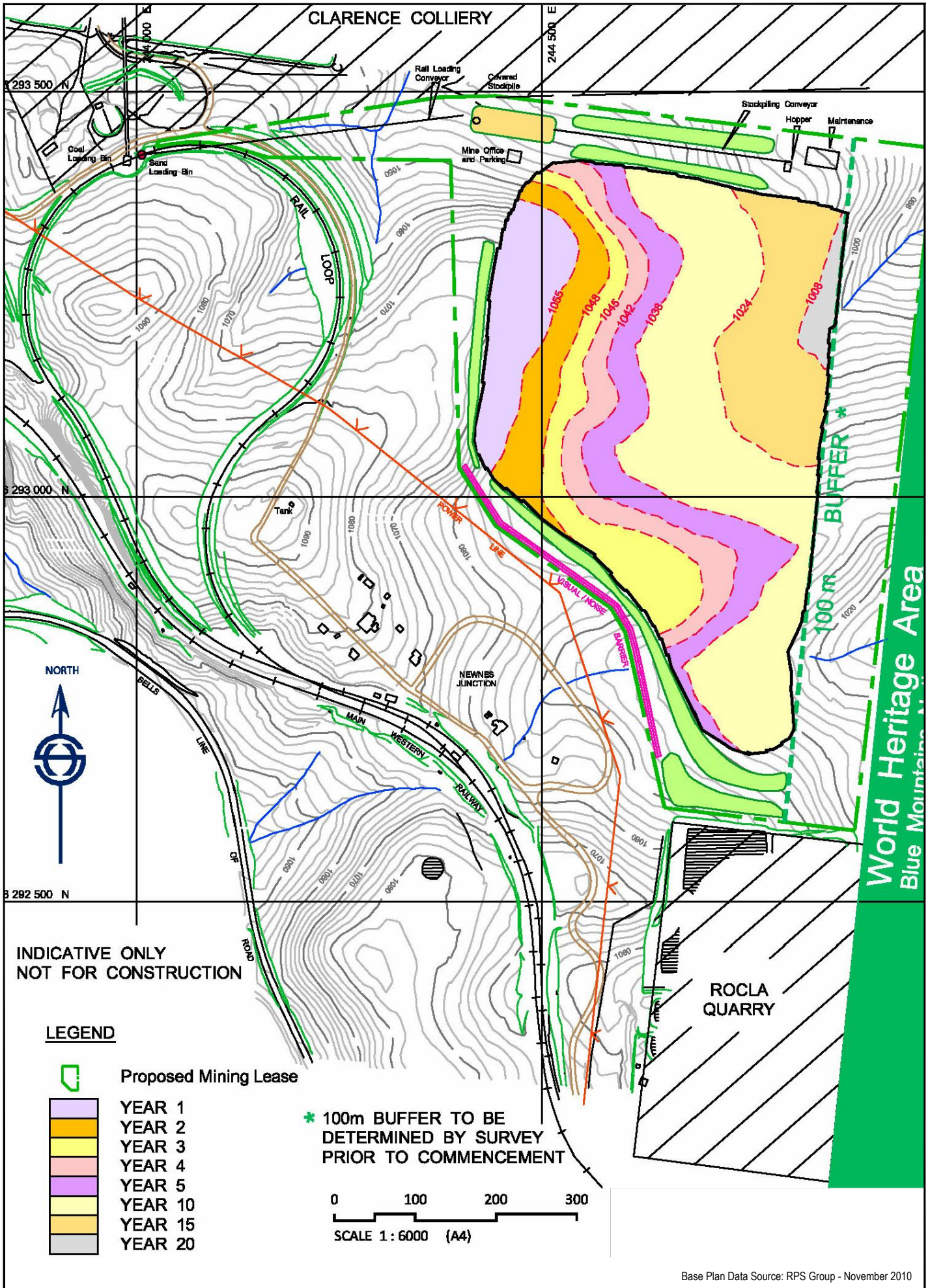
2.3.4 Final Land Use

The area currently supports open eucalyptus woodland forest. The broad rehabilitation objective for the post-quarrying landform is to establish a similar land use. The topography of the final landform will consist of a large number of small, stepped sandstone benches formed in an amphitheatre configuration, each with a revegetated berm. The amphitheatre void will be some 450m wide and 400m long at its western edge, and 650m long at its eastern edge. Until such time as extraction has ceased, rehabilitation will occur around the edges of the pit only, and will not involve the pit floor. Once operations have been completed, all buildings and infrastructure will be removed from the pit. These areas will be reshaped and ripped where necessary for topsoiling and revegetation. It is proposed that the haul road will remain for use in the ongoing management of the site rehabilitation and for fire fighting purposes. The pit floor will be vegetated with appropriate native species to create a stable, free-draining wetland.

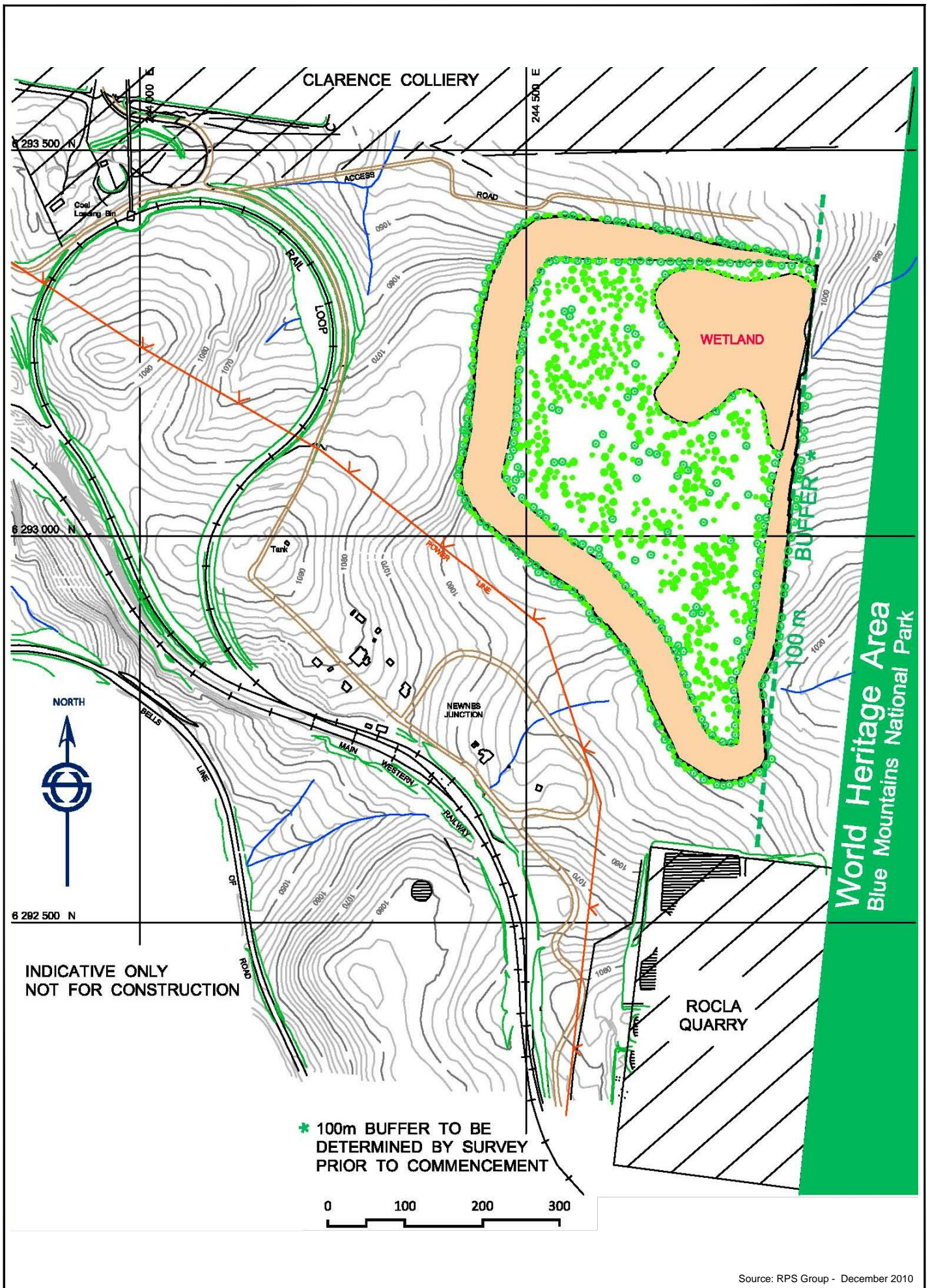
The concept for a functioning wetland in the final void is illustrated in **Figure 5**. At the completion of operations, the extraction pit will have an expected floor level grading from RL 989.5 m AHD on the eastern side adjacent to the retention pond to 993 m AHD on the western side. The final operational activity will be to excavate sufficient extra material to fill the remaining retention pond (located on the eastern side of the pit) to a level consistent with the surrounding excavated area. A small retention pond (about 20 m³) will be retained to provide an extraction point for water to be pumped to the treatment plant.

During the initial phase of rehabilitation the water management system will continue to operate in a similar manner to the final operational phase with offsite discharge only occurring by means of water released from the treatment plant. The treatment plant will be operated so as to retain a wetland swamp area with a maximum depth of 0.5 m in the centre of the remnant depression.

The wetland will be formed as a shallow depression with the low point in the location of the final retention pond in the north east corner of the pit. The area surrounding the location of the final retention pond will be graded at flatter slopes (typically 0.5%) than used elsewhere in the pit (1.0%) in order to create a free form shallow depression with a total area of about 4 ha. It is anticipated that sedges and other wetland plants endemic to the area will colonise this wetland area to form a swamp ecosystem analogous to that in Gooches Crater, a natural crater feature located approximately 2 km north west of the project area, as shown in **Plate 1** below.



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Plate 1 - Gooches Crater (courtesy Hughes Trueman, 2004)

Once vegetation has fully established (approximately 5 years), the site will be reconfigured to permit free drainage of water from the site once the wetland/swamp is filled to a depth of 0.5 m. A channel will be excavated through the rock at an elevation of 990 m AHD (0.5 m above the base of the wetland swamp) to allow free drainage from the pit into the existing northern creek that drains into the Blue Mountains National Park.

Once a channel has been excavated to allow overflow from the wetland to discharge off-site, the wetland will be dependent on water supply from the contributing catchment of approximately 24ha. The water balance model developed for the operational phases of the project has been modified to account for the expected runoff characteristics of the rehabilitated catchment and used to assess the wetting and drying behaviour of the wetland as a result of surface runoff.

2.3.5 Fencing, Weed and Feral Animal Control

Fencing will be erected and maintained to exclude and prohibit the movement of persons and vehicles into areas that have been rehabilitated. The fencing will be routinely checked and repaired where necessary.

Weeds present one of the most significant problems to the creation of forest ecosystems. The minimisation of grass and weed competition over the first six (6) to twelve (12) months after seeding is critical to successful tree establishment. Weed control will be undertaken on an “as required” basis should cyclical weed invasion events. As trees establish and mature they will compete and eventually eliminate most weeds and grass underneath. For this reason, dense direct seeding (as opposed to planting) is an effective long-term weed control mechanism that reduces maintenance significantly, particularly ongoing weed control. Weeds in most tree-seeded stands typically disappear after 18 months to two years.

A feral animal control strategy will be implemented to contain the spread of weeds and detrimental impact on rehabilitation areas by feral animals. Goats, foxes, cats, rabbits, pigs and dogs will be controlled in accordance with Livestock Health and Pest Authority procedures.

2.3.6 Rehabilitation Maintenance

Due to the hardiness of young directly sown tree seedlings (compared to planted tubestock), these trees require minimal maintenance. Directly seeded seedlings require no watering while planted seedlings (tubestock) may require extensive watering if conditions remain dry. No maintenance fertiliser will be required for tree areas. Effective control of weed species within rehabilitated areas will be a critical and essential component of the proposed revegetation plan. Weed and noxious animal control will be undertaken on all rehabilitation areas according to relevant state and local government legislation and policy.

All erosion and sediment control measures will be maintained in a functioning condition until individual areas have been deemed “successfully” rehabilitated. Structural soil conservation works will be inspected after high intensity rainfall so that de-silting and prompt repairs and/or replacement of damaged works can be initiated as required.

2.3.7 Topsoil Management

A number of soil stockpiles will be established around the western and northern edges of the pit. Both open and covered stockpiles will be utilized where relevant to operations. Due to material characteristics, handling requirements require the main resource stockpile (of around total 12, 000t split into two areas of premium and standard grade product) located to the north of the site near the loader to be fully covered by a protective roof over the entire stockpile area.

Stockpiles will be protected with sediment fencing and planted with a sterile cover crop (annual species) to ensure stabilisation. Surface drainage in the vicinity of the stockpiles will be configured so as to direct any runoff into the pit. As previously outlined, the surface of the pit is designed to control all runoff as infall to the dirty water management system (ponds and treatment plant), with no uncontrolled discharge from the pit.

Topsoil stripping within the disturbed area will be undertaken when the soil is in a slightly moist condition thus reducing damage to soil structure. The soil materials will not be stripped in either a dry or wet condition. Stripped material will be placed directly onto the disturbed areas and spread immediately if excavation sequences, equipment scheduling and weather conditions permit.

If longer term stockpiling (ie greater than 6 months) is required, a maximum stockpile depth of two (2) metres will be maintained to preserve viability and reduce soil deterioration. Soil stockpiles will be sown with the sterile cover crop (annual species).

Where the stockpile is not wholly contained within the “closed loop” water management system, temporary sediment control measures such as sand bags and silt fences will be used to prevent sediment from leaving the area. Stockpiles will be placed in areas so as to avoid impediment of natural localized drainage lines and minimise the likelihood of water ponding against the stockpile.

Topsoil will be re-spread in the reverse sequence to its removal, so that the organic layer, containing any seed or vegetation, is returned to the surface. Topsoil will be spread to a minimum depth of 50 mm on 3:1 or steeper slopes and to a minimum depth of 100 mm on flatter slopes. Re-spreading on the contour will aid runoff control and increases moisture retention for subsequent plant growth.

Re-spread topsoil will be levelled to achieve an even surface, avoiding a compacted or an over-smooth finish.

2.3.8 Rehabilitation Monitoring

Regular monitoring of the rehabilitated areas will be required during the initial vegetation establishment period and beyond to demonstrate whether the objectives of the rehabilitation strategy are being achieved and whether a sustainable, stable landform has been provided. **Table 4** presents the recommended monitoring program, including the specific aspects and elements to be monitored and monitoring frequencies for those various aspects.

Monitoring will be conducted periodically by independent, suitably skilled and qualified persons at locations which will be representative of the range of conditions on the rehabilitating areas. Annual reviews will be conducted of monitoring data to assess trends and monitoring program effectiveness. The outcome of these reviews will be included in each Annual Environmental Management Report (AEMR).

In addition to the rehabilitated areas, at least two (2) reference sites will be monitored to allow a comparison of the development and success of the rehabilitation against a control. Reference sites indicate the condition of surrounding un-mined areas.

In developing the rehabilitation monitoring program, the following aspects will be taken into consideration.

- Replicated monitoring sites are needed in representative rehabilitation areas of different ages. One monitoring site per 20 to 40 ha is recommended for each major age class of the rehabilitation areas.
- Sites should be monitored 12 months after establishment and then every 2 years.
- A standard monitoring plot design for areas rehabilitated with trees. The design includes:
 - 2 m x 2 m quadrates – these will provide some estimate of statistical variance, so that if required, statistical analyses can be undertaken to objectively compare different rehabilitation treatments and changes over time;
 - a 20 m x 10 m plot overlying the 2 m quadrats and located 5 m either side of the centerline, for ease of monitoring; and
 - a 50 m erosion monitoring transect on contour, running through the centre of the plot.

Figure 6 shows the monitoring plot design that is to be adopted for the monitoring an area revegetated with trees.

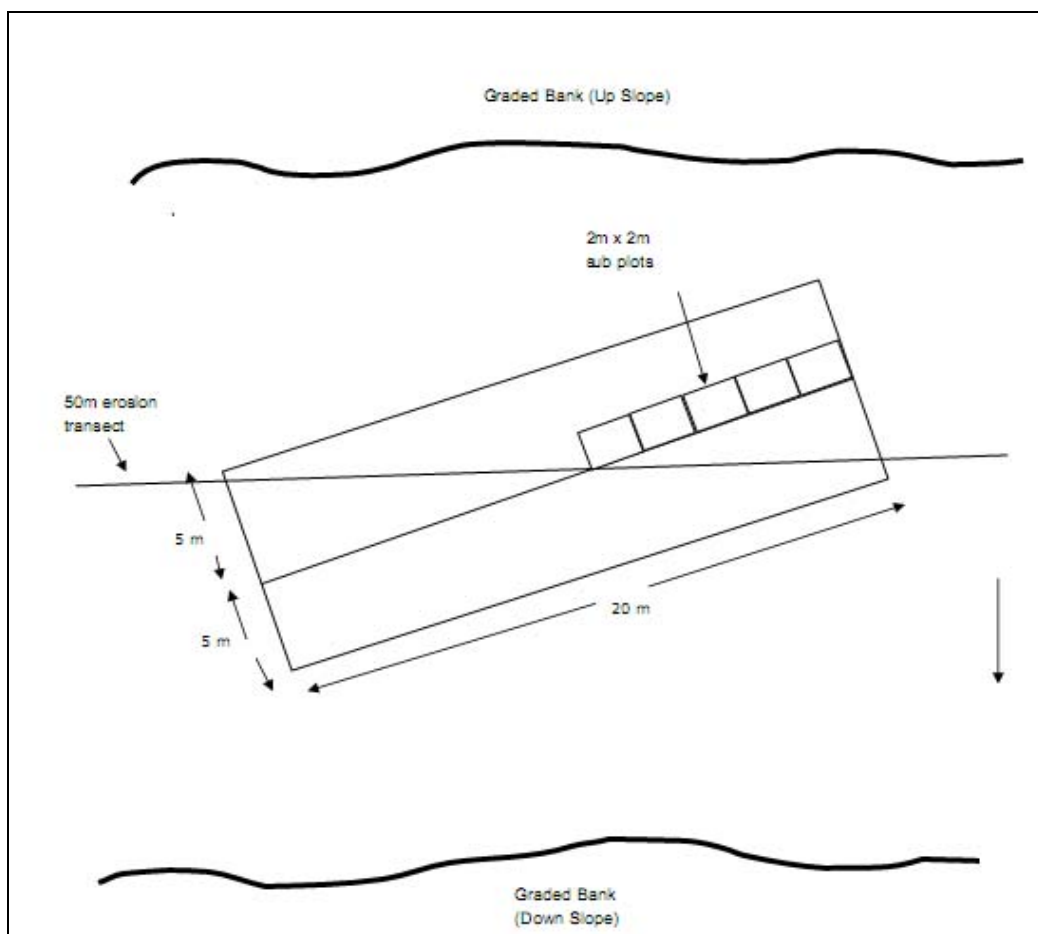


Figure 6 – Typical Monitoring Plot Design

Rehabilitation methods will be improved as additional knowledge develops from monitoring data collected through these programs. More specifically, monitoring of the elements in **Table 4** will be undertaken to determine the level of achievement of success criteria.

Table 4 – Proposed Rehabilitation Monitoring Program

Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
Ecosystem Establishment		
General Description	<ul style="list-style-type: none"> Describe the vegetation in general terms, e.g. mixed eucalypt woodland with grass understorey and scattered shrubs, dense Acacia scrub, etc. 	12 months after establishment and then every 2 years
2m x 2m quadrats	<ul style="list-style-type: none"> Count the number of plants of all species, excluding grass Measure live vegetation cover for understorey and grasses (separately) using a line intercept method Record details of ground cover (litter, logs, rocks etc.) 	12 months after establishment and then every 2 years
20m x 10m plots	<ul style="list-style-type: none"> Count, by species, all trees >1.6m tall. Tag and measure DBH of trees >1.6m tall, to a maximum of 10 for any one species. Record canopy cover over the whole 20m centreline when trees are tall enough Subjectively describe tree health, by species if relevant, noting signs of drought stress, nutrient deficiencies, disease and severe insect attack. Where health problems are noted, record the percentage of unhealthy trees. Record any new plant species not present in the smaller plots, including any problem and declared noxious weeds Take five surface soil samples (e.g. at approx. 5m intervals along the centreline) and bulk these for analyses of: pH, EC, chloride and sulfate; exchangeable Ca/Mg/K/Na; cation exchange capacity; particle size analysis and R1 dispersion index; 15 bar and field capacity moisture content; organic carbon; total and nitrate nitrogen; total and extractable phosphorus; Cu, Mn and Zn. 	12 months after establishment and then every 2 years
50m transect	<ul style="list-style-type: none"> Along the 50m erosion monitoring transect, record the location, number and dimension of all gullies >30cm wide and/or 30cm deep. Erosion pins should be established in plots located in newer rehabilitation to record sheet erosion if present 	12 months after establishment and then every 2 years
Rehabilitation in general	<ul style="list-style-type: none"> When traversing between monitoring plots, note the presence of species of interest not previously recorded (e.g. key functional or structural species, protected species, noxious weeds), as well as obvious problems including any extensive bare areas (e.g. those greater than 0.1ha). Observations such as this can provide useful, broad scale information on rehabilitation success and problems. 	12 months after establishment and then every 2 years
Photographic record	<ul style="list-style-type: none"> For each 20m x 10m plot, a photograph should be taken at each end of the plot, along the centreline looking in. 	12 months after establishment and then every 2 years

Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
Habitat	<ul style="list-style-type: none"> General observations relating to the availability and variety of food sources (e.g. flowering/fruited trees, presence of invertebrates etc). Availability and variety of shelter (e.g. depth of leaf litter, presence of logs, hollows etc). Presence/absence of free water in the rehabilitated areas 	12 months after establishment and then every 2 years
Fauna	<ul style="list-style-type: none"> General observations of vertebrate species (including species of conservation significance). Detailed fauna surveys including presence and approximate abundance and distribution of vertebrate species (focussing on species of conservation significance). 	After rehabilitation is three years old undertake monitoring biennially in both Autumn and Spring
Weeds and pests	<ul style="list-style-type: none"> Species identity. Approximate numbers/level of infestation. Observations of impact on rehabilitation (if any). 	Quarterly during the first two years and biennially after that. Inspections should be opportunistic after significant rainfall events.
Geotechnical Stability		
	<ul style="list-style-type: none"> Assessment of the stability of batters and also looking at surface settlements (sink holes). In particular where these features could impact on the performance of any surface water management system. Surface integrity of landform cover/capping (measurement of extent of integrity failure). Presence / absence of landform slumping. 	Annually
Surface and Groundwater		
	<ul style="list-style-type: none"> Groundwater quality and depth. Efficiency of landform surface water drainage systems (integrity of banks and drains) Water quality including pH, EC and total suspended solids of water in water storages, and pits, sedimentation dams. 	Quarterly or following rainfall events Monitoring of receiving waters

2.4 Preliminary Rehabilitation Success Criteria (Completion Criteria)

The following preliminary success criteria for the rehabilitation areas are included in **Table 4**. The success criteria are performance objectives or standards against which rehabilitation success in achieving a sustainable system for the proposed post-mine land use is demonstrated. Satisfaction and maintenance of the success criteria (as indicated by monitoring results) will demonstrate that the rehabilitated landscape is ready to be relinquished from the mine's financial assurance and could be handed back to stakeholders in a productive and sustainable condition.

The success criteria comprise indicators for vegetation, fauna, soil, stability, land use and safety on a landform-type basis that reflects the nominated post-mine land use of an open eucalyptus woodland forest.

For each element, standards that define rehabilitation success at mine closure are provided. Based on the generic indicators in **Table 5**, each criterion will be further developed to be specific, measurable, achievable, realistic and outcome based, and to reflect the principle of sustainable development. This will be based on results of further research and ongoing monitoring of the progressive rehabilitation areas. The

success criteria will be reviewed every three (3) to five (5) years with stakeholder participation to ensure the nominated success criteria remain realistic and achievable.

Table 5 – Preliminary Rehabilitation Success Criteria

Rehabilitation Element	Indicator	Criteria
1. Final Void		
Landform stability	Slope gradient	High wall faces exhibit long-term geotechnical stability and a geotechnical report has been completed. Competent rock high wall to have slope of <70° to the horizontal. Ramp walls not backfilled exhibit long-term geotechnical stability and a geotechnical report has been completed.
	Erosion control	Average soil loss per annum per domain unit is <40 tonnes/ha/yr (sheet erosion). Erosion mitigation measures have been applied to ensure slope stability
	Surface Water Drainage	Use of contour banks and diversion drains to direct water into stable areas, sediment control basins or final void.
Water quality	Salinity (electrical conductivity)	Electrical conductivity of any void water may not exceed 1,500 µS/cm
Topsoil	Salinity (electrical conductivity)	Soil salinity content is <0.6 dS/m.
	pH	Soil pH is between 5.5 and 8.5.
	Sodium content	Soil Exchange Sodium Percentage (ESP) is <15%.
	Nutrient cycling	Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micro-nutrients are present.
Vegetation	Land use	Where ramps and in-pit spoil design allow, area accomplishes and remains as a healthy working bushland ecosystem (although pasture grasses may be used as required).
	Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 m ² in area or >10 m in length down slope.
	Species composition	Establishment of vegetation comprise a mixture grasses, shrubs / trees (where possible) suitable for establishment on steeper slopes.
	Resilience to disturbance	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species.
	Sustainability	More than 75% of individual grasses and shrubs/trees are healthy when ranked healthy, sick or dead.
Safety		Risk assessment has been completed and risk mitigation measures have been implemented. Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected generally in accordance with relevant guidelines and Australian Standards.
2. Quarry Plant/Industrial Areas		
Landform stability	Slope gradient	Areas have gradients of <2°.

Rehabilitation Element	Indicator	Criteria
	Erosion control	Erosion mitigation measures have been applied. Average soil loss per annum per domain unit is <40 tonnes/ha/yr (sheet erosion).
	Surface Water Drainage	Use of contour banks and diversion drains to direct water into stable areas or sediment control basins.
Water quality		As for 1.
Topsoil		As for 1.
Vegetation	Land use	Buildings, water storage, roads (except those used by the public) and other infrastructure have been removed unless stakeholders have entered into formal written agreements for their retention. Areas are readily accessible and conducive to safe management activities. Predicted economics and /or benefits have been defined and agreed by the stakeholders.
	Surface cover	As for 1.
	Species composition	Subject to proposed land use, comprise a mixture of native trees, shrubs and grasses representative of regionally occurring native woodland where possible OR palatable, nutritious pasture grass species are present.
	Resilience to disturbance	As for 1.
	Sustainability	More than 75% of individual grasses and trees / shrubs are healthy when ranked healthy, sick or dead.
Fauna	Vertebrate species	Representation of a range of species characteristics from each faunal assemblage group (e.g. reptiles, birds, mammals), present in the ecosystem type, based on pre-mine fauna lists and sighted within the three-year period preceding mine closure. The number of vertebrate species does not show a decrease over a number of successive seasons prior to mine closure.
	Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.
	Habitat structure	Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including: a variety of food plants; evidence of active use of habitat provided during rehabilitation such as nest boxes, and logs and signs of natural generation of shelter sources including leaf litter.
Safety		Risk assessment has been undertaken in accordance with relevant guidelines and Australian Standards and risks reduced to levels agreed with the stakeholders. Closure documentation includes the contaminated sites register which identifies contaminated sites and the treatment applied.

3.0 FINAL VOID MANAGEMENT PLAN

3.1 Objectives

The primary objectives of the Final Void Management Plan section of this Rehabilitation and Landscape Management Plan include the following:

- Propose mitigation measures to minimise potential off-site impacts associated with the final void;
- Propose measures to be incorporated in the final landform which aim to minimise potential safety hazards to the general public; and
- Assess the potential interaction of the final void with the surrounding waterbodies.

3.2 Justification for Nature and Location of the Final Void

The following design and environmental criteria were considered when determining the nature and location of the final void. These include:

- Minimising the area of disturbance;
- Progressing extraction from the north to the south to mitigate the impacts of the operation on Newnes Junction residents;
- Constructing a large sump during the pre-extraction phase to capture runoff from disturbed areas and prevent any uncontrolled discharge into the adjacent Blue Mountains National Park;
- Providing adequate buffers between the proposed open pit development and the Blue Mountains National Park to the east;
- Diverting clean water around disturbed areas to ensure that water collected within the pit is minimised;
- Designing site batters to minimise erosion;
- Minimising water, noise, and visual impacts generated by the operation;
- Progressively rehabilitating disturbed areas; and
- Rehabilitation of the site in a manner that guarantees the long term environmental, ecological and aesthetic integrity of the area,

3.3 Void Design Criteria and Specifications

In order to minimise any potential adverse impacts associated with the water balance of the final void, the design criteria and specifications have been based on groundwater modelling predictions and an assessment of the post mining groundwater equilibrium.

The initial groundwater modelling was undertaken by Kalf and Associates (2004) during the Environmental Impact Assessment Phase. Predictive groundwater modelling was undertaken to assess the long-term implications for both local and regional groundwater flows. The model predicted that there would be no adverse groundwater impacts as a result of the proposed void, however validation of the model predictions is required, once actual baseline monitoring data is collected.

A Groundwater Monitoring Program (GWMP) has been developed to characterise baseline groundwater conditions and monitor the potential groundwater impact over the life of the mine (Aquaterra, 2010). Once baseline conditions have been established and suitable data is available, the existing model will be

recalibrated to verify or re-assess the impacts of the proposed final void. This is planned to be undertaken in 2011.

3.4 Void Water Interaction with Surrounding Waterbodies

In July 2010, Aquaterra undertook a review of groundwater impacts at the site by considering the predictive groundwater modelling prepared by Kalf and Associates (2004) for the EIS. This predictive modelling was undertaken on water held within the proposed void to assess the long-term implications for local and regional groundwater flows. The model suggested that there would be no adverse groundwater impacts as a result of the proposed void.

The groundwater flow system immediately after the end of mining, and for up to two years thereafter, was predicted to stay fundamentally the same, except at relatively shallow depth in the vicinity of the mine where flow is directed into the void due to local capture zone effects driven by the reduced water table levels (ie. prior to establishment of a new equilibrium). The deeper groundwater flow would not be affected and would continue to flow towards the river as it did prior to mining (Kalf and Associates, 2004), mainly because the size of the pit is small compared to the width and depth of the aquifer.

The modelling predicted that the void would become an 'elevated wetland'. The wetland will receive direct rainfall and local runoff from the pit walls, along with groundwater inflow from the south-west, where groundwater elevations are higher than the base of the pit. Surface water will flow out of the wetland at the north-east corner, where there is no pit wall (ie. where the northern and eastern pit walls meet the natural surface), and the base of the residual pit void is approximately 30m above the pre-mining water table. The groundwater flow system also remains largely unchanged in that flows proceed from south-west to north-east at depth below the pit, with local-scale interception at the south-west corner of the pit, where the final pit floor level is up to 20 metres below the pre-mining water table.

As a result, groundwater and surface water quality is predicted to remain virtually unchanged in the wetland area because of the rate of inflow and continual flushing and discharge to the north-east. Much of this good quality excess water will be returned to Wollangambe drainage system.

3.5 Minimisation of Adverse Impacts from the Final Void

3.5.1 Void Water Quality

Water should only be permitted to accumulate in the void if it maintains a quality that does not compromise its intended final use or surrounding groundwater systems. The aim is to provide a biologically viable water resource for the surrounding environment. The following aspects need to be considered with respect to managing final void water quality:

- Concentration of elements resulting from the quarrying of material;
- Control of surface flow into the void;
- Groundwater inflows and outflows; and
- Rainfall and evaporation.

All of the above have the potential to impact on the water quality of the final void and its potential end use.

The final water quality in the pit lake is dependent on a host of factors including the oxygen status of the lake, pH, hydrogeological flow system, composition of wall rock / back fill, concentration through evaporation (evapo-concentration), and biological activity (Water and Rivers Commission, 2003).

As discussed above, the residual open pit void has been designed as a 'throughflow system', with net groundwater and surface water outflow removing salinity from the pit void lake, thus maintaining the lake water at very good quality, without changing the beneficial use status of the surface and groundwater quality from sub-potable/irrigation quality (Aquaterra 2010).

Post closure a water monitoring program will need to remain in place to closely monitor any changes to chemistry within the void. Further detail regarding the interaction between the final void and surrounding groundwater systems is discussed above in **Section 3.4**.

3.5.2 Void Slope Stability

To ensure the safety of the final void, the surrounding final slopes should be left in a condition where the risk of slope failure is minimised. This requires that the highwall is battered back from the vertical to a stable overall slope angle.

The following will need to be considered when assessing the geotechnical stability of highwalls:

- Long term groundwater levels;
- Long term final void water levels;
- Height and inclination of slope and number and spacing of intermediate benches;
- Shear strength of the highwall soils and rocks;
- Density and orientation of fractures, faults, bedding planes, and any other discontinuities, and the strength along them; and
- The effects of the external factors, such as surface runoff.

Prior to closure, investigations will be undertaken to confirm the criteria above.

3.5.3 Control of Surface Inflow

The control of surface inflow into the final void is essential for the long term management of water quality within the pit and will also aid in the control of erosion.

Surface water is a possible cause of slope deterioration and ultimate failure. Drainage will be directed away from the highwall face through the construction of interceptor channels around the perimeter of the highwall and spoon drains will be utilised on the upslope side of all benches.

The catchment area of the final void will be minimised by the installation of diversion drains. This will reduce the amount of water reporting to the final void.

3.5.4 Safety

At quarry closure, one of the main priorities for the void will be to render it safe in terms of access by humans, livestock and wildlife. The following will be considered at the time of closure to ensure that the void is left in a safe manner. These include:

- Instability of the high wall can induce failures or mass movement. All high walls are to be left geotechnically stable;
- A barrier at a safe distance from the perimeter of the void to prevent human access will be constructed. The highwall areas will be secured by the construction of a trench and a 2 meter safety berm, as well as a 2.1 meter security fence along the entire length of the remaining high wall. This is to provide an engineered barrier between the pit and the surrounding area. The trench and berm is to be constructed in such a way that it will physically stop most vehicles;
- Suitable signs, clearly stating the risk to public safety and prohibiting public access will be erected at 50 meter intervals outside the safety fence;
- Surface runoff from land surrounding the void will be diverted from entering the void so as to prevent the instability of the walls; and

- Shrub and/or tree planting along the outside edge of the bund wall will be implemented where practicable to lessen the visual impact of the wall, and will be in accordance with the agreed post-mining rehabilitation criteria and land use.

3.5.5 Monitoring and Management

After decommissioning works have been undertaken, whether progressive or final, a monitoring program will be designed to demonstrate that the completion criteria have been met and that the site is not resulting in any off site effects.

This period should also be used to plan for remedial action where monitoring demonstrates completion criteria are unlikely to be met. If progressive rehabilitation has been successful, with stabilisation and revegetation meeting completion criteria this last phase of closure may be shortened. It is, however, unlikely to be less than five (5) years in duration (ANZMEC/MCA 2000).

The post closure monitoring and measurement program will be similar to that undertaken during operation of the mine only scaled back to focus on those aspects of the site that have the potential to cause pollution or is being used as an indicator to verify the success or failure of the rehabilitation works (e.g. noise monitoring will not be required once all decommissioning and rehabilitation activities at the mine have ceased).

Further detail on post-closure monitoring and management is discussed below in **Section 4.6**.

3.6 Final Void Rehabilitation

As discussed above in **Section 2.3**, it is proposed to re-establish a native open woodland vegetation cover to the majority of the post-quarrying landform. Native vegetation will largely be established using directly applied seed and from the seed store within re-spread topsoil. Supplementary native pasture and/or tubestock seeding will be undertaken where specific species combinations are required. A plant nursery will be established at the site to propagate all tubestock to be used during the rehabilitation process.

Rehabilitation of the site will be undertaken in a progressive manner, commencing with terraced landscaping. As the surface miner progresses through the resource, 2 meter wide benches will be left every 3 meters of depth to provide a horizontal platform on which native flora species will be established. Irrigation of newly planted vegetation will be provided by seeping mine water from the pit walls.

The revegetation program ("terrace landscaping") will progressively re-establish native tree / shrub / ground cover and will stabilise reshaped and benched areas. Benches will be deep ripped to actively promote infiltration of water which will enhance soil moisture requirements for direct tree seeding and minimise surface runoff to underlying benches and the pit floor dirty water control system. Revegetation will also visually screen disturbed areas and will re-establish habitat for native fauna.

On completion of mining, the pit floor will be re-shaped and revegetated with wetland plant species to form a free draining wetland environment.

4.0 MINE CLOSURE PLAN

4.1 Mine Closure Objectives

The principal objectives of mine closure planning incorporated into this decommissioning and mine closure section include:

- Providing an overall framework for mine closure including rehabilitation and decommissioning strategies that are consistent with I & I-MR expectations;
- Establishing clear and agreed criteria, which can be used to provide the standard against which the final mine rehabilitation and post mining land use can be assessed;
- Reducing or eliminate adverse environmental effects once the mine ceases operation;
- Ensuring closure is completed in accordance with good industry practice; and
- Ensuring the closed mine does not pose an unacceptable risk to public health and safety.

4.2 Closure Methodology – Decommissioning of Infrastructure, Plant and Buildings

The following sections summarise the key aspects related to the decommissioning and closure of the site infrastructure, plant and buildings. It assumes that all buildings and other infrastructure are demolished and removed from the site despite the potential for them being used after mining (subject to the landholders requirements). It is considered likely that at least some aspects of the existing infrastructure will be used post mining, however they are not able to be identified at this time.

It also assumes that no materials are recovered (reused) or recycled (i.e. scrap steel) following the demolishing of the buildings and infrastructure.

4.2.1 Site Services

All services including power, water, data and telephone on the site will be isolated, disconnected and terminated to make them safe. The inspection pits and junction boxes for underground services will be sealed. Generally all underground services will be made safe and left buried in the ground. Overhead power lines will be removed and the materials (i.e. poles and wire) recovered for potential re-sale or recycling as applicable.

4.2.2 Infrastructure and Buildings

All sumps will be de-watered and de-silted prior to the commencement of demolition. In addition all items of equipment will be de-oiled, degassed, depressurised and isolated and all hazardous materials (HAZMATs) removed from the site.

All infrastructure, including the demountable site office, equipment servicing area, fixed plant (including conveyors, drives, feeders, transfers, train loading conveyor, etc) will be demolished and removed from the site. Where possible assets may be re-used or sold to other operations.

The remaining items will be demolished, removed and transported from the site as required. All recoverable scrap steel will be sold and recycled, with the remaining non-recyclable wastes being taken to a licenced landfill. Prior to disposal, all wastes will be assessed and classified in accordance with *Waste Classification Guidelines (DECC, 2008)*.

All concrete footings and pads will be broken up to at least 1.5 m below the surface. The waste concrete will be crushed to produce an aggregate that can either be used on the site or sold for some other beneficial use.

All remaining areas will then be reshaped, deep ripped, topsoiled and seeded in accordance with **Section 2.0** above.

4.2.3 Roadways, Car Parks and Hardstands

The roadways, car parks and hardstand areas around the processing and administration areas will be ripped up and the inert waste material taken from site and disposed of at a licenced landfill.

All areas will then be reshaped, deep ripped, topsoiled and seeded in accordance with **Section 2.0** above.

4.2.4 Fuel Farm and Lubricant Storage Area

Leading up to closure, a preliminary sampling and analysis programme (Phase 1) will be implemented to determine whether a more detailed assessment (Phase 2 – detailed investigation of contamination involving drilling, etc) should be conducted. This will quantify the amount of contaminated material that will need to be bio-remediated on site or sent off site for disposal at a licenced facility.

4.3 Closure Methodology – Earthworks and Rehabilitation

4.3.1 Dams, Diversions and Surface Water Features

All sedimentation dams which assist in the treatment of dirty at the site will be retained, where required, following mine closure. All dams will be assessed for structural integrity and upgrade works completed if the dam is to be retained. Any of the remaining dams that would not be required would be removed and the original drainage paths re-established wherever possible.

4.3.2 Open-Cut Void

Throughout the operational phase of the project, there will be progressive rehabilitation of disturbed areas around the open cut. The nature of the friable sandstone requires relatively shallow ripping and selective extraction from horizontal benches to optimise grade separation. Consequently, the quarry will be developed with very shallow benches and rehabilitated as the pit progresses. This progressive rehabilitation technique means there will be very little rehabilitation required on the final void at closure apart from the pit floor.

The nominal bench height within the pit will be 3 m high. A 2 m berm will be created on each bench during the extraction of the bench below it. This method of extraction will allow for the 2 m berm to be revegetated as the bench is extracted, enabling progressive rehabilitation of the mine walls. In normal hardrock quarries, the bench heights are usually some 5 times higher, rendering rehabilitation work difficult and impossible to commence until the later stages and/or completion of extraction.

Once the edges of the first bench have been taken, a 2 m wide area around the perimeter of the excavated area can be rehabilitated adjacent to the 3m pit wall, while extraction continues on this area and the next bench.

The rehabilitation will occur progressively and will involve the following:

- Surface preparation of the area by ripping;
- Placement of at least 10 cm of topsoil on a 2 m wide area of the bench around the edge of the pit; and
- Planting of native shrubs and trees on the topsoiled bench. It is proposed to undertake some tree planting in the early stages of the project. These rehabilitated areas will assist in minimising the visual impacts of the mining activities from the adjacent National Park. By the time open pit operations have reached an advanced stage, these rehabilitated areas will be well established and these terraces will form part of the final landform.

The areas to be rehabilitated can be prepared, topsoiled and revegetated using the unmined working bench for access. Extraction of the next bench will cease at the edge of the rehabilitated berm and then continue down into the next bench. The site topography will allow for continued access to all benches.

At quarry closure, the final bench will be shaped and the pit floor will be raised and re-profiled to create a free draining wetland that will be revegetated with local plant species conducive to a wetland environment.

4.4 Post Mine Land Use

4.4.1 Land Capability

The proposed mining activities will not have a significant impact on land capability in the area. No impacts will occur on adjacent lands and the only impacts will be associated with the area immediately impacted by the mining operation.

The area contains a valuable state resource and the proposed development will involve extracting this resource prior to returning the area to native vegetation.

Following completion of mining, the area surrounding the open cut void will be rehabilitated and returned to native vegetation. The land capability of this area will not alter from current land capability although the area of the open cut void will be altered in terms of topography. The land is currently not suited for grazing or agriculture and is best vegetated. It is not proposed to use this area for grazing or other agricultural purposes after mining. Rather, the mined area will be rehabilitated with native species and will have a similar land capability to the current area.

4.4.2 Final Land Use Options

Following the completion of mining in this area, and rehabilitation of the landscape, the future land capability of the site will be similar to that of the current site although the topography will be substantially different. The final land use will be determined in consultation with relevant community and authority bodies closer to mine closure however, the site will be progressively rehabilitated and the final landform is likely to consist of a benched basin with a water body located at the base of the basin which will become a free draining wetland. Native vegetation to be progressively re-established on the benches will be capable of supporting native fauna.

Ultimately, the site could be used for recreational purposes or left as vacant vegetated land for conservation purposes. Once revegetation works are established and the void floor has been flooded, the lake could serve as valuable water storage for local wildlife.

4.5 Post Closure Monitoring and Measurement

4.5.1 Current Monitoring and Measurement Programs

As per **Schedule 3** of the Project Approval, SCM are required to implement operational monitoring and measurement programs at the site. These monitoring and measurement programs include:

- Surface Water Monitoring Program;
- Groundwater Monitoring Program;
- Noise Monitoring Program;
- Flora and Fauna Monitoring Program;
- Air Quality Monitoring Program; and
- On-site Meteorological Monitoring.

4.5.2 Decommissioning Monitoring and Measurement Programs

Following closure of the quarry, the existing monitoring network will be maintained until all decommissioning and rehabilitation works at the site have been completed. At this point those elements of the network that related specifically to the quarry operation will be reviewed and rationalised in consultation with the appropriate authorities and in accordance with the Project Approval.

Notwithstanding this, there may be the need to establish some additional monitoring sites depending on the nature of the decommissioning works, and in response to finding possible sources of pollutants to the environment that currently may not be known.

The type and location of this monitoring will be determined during the decommissioning phase of the mine site.

4.5.3 Post Closure Monitoring and Measurement Programs

Whilst the post closure monitoring and measurement program will be similar to that undertaken during operation of the mine it will be scaled back to focus on those aspects of the site that have the potential to cause pollution or are being used as an indicator to verify the success or failure of the rehabilitation works.

Table 6 provides a summary of the recommended post-closure monitoring and measurement for specific areas across the site. It is recommended that the monitoring program be undertaken until such times that the data from monitoring demonstrates that the site is no longer contributing to, or has the potential to contribute pollutants to the surrounding environment, and that the landform and established vegetation is stable and sustainable.

Table 6 – Summary of Monitoring and Measurement Recommended for Post Closure

Area	Parameter	Possible Sampling / Monitoring Approach
Infrastructure, Buildings & Industrial Areas.	<ul style="list-style-type: none"> - Erosion and Sediment - Dust -Vegetation establishment - Biotic Activity - Water Quality 	<ul style="list-style-type: none"> - Visual inspections (sediment), photos - Depositional Dust Gauges/ PM10 & TSP HVAS - Transects, tree density, % cover, photos - Flora/Fauna survey. - pH, TDS, EC, metals, nutrients
Open-Cut Void	<ul style="list-style-type: none"> - Erosion and Sediment - Dust -Vegetation establishment - Biotic Activity - Water Quality 	<ul style="list-style-type: none"> - Visual inspections (sediment), photos, sediment loading runoff/ erosion pins - Depositional Dust Gauges. - Transects, tree density, % cover, photos - Flora/Fauna survey. - pH, TDS, EC, metals, nutrients - Visual, photograph, inspections
Rehabilitation Areas	<ul style="list-style-type: none"> - Erosion and Sediment -Vegetation establishment - Biotic Activity - Water Quality 	<ul style="list-style-type: none"> - Visual inspections (sediment), photos, sediment loading runoff/ erosion pins - Transects, tree density, % cover, photos - Flora/Fauna survey. - pH, TDS, EC, metals, nutrients k
Water Management Infrastructure	<ul style="list-style-type: none"> - Erosion and Sediment - Geotechnical Stability - Biotic Activity - Water Quality 	<ul style="list-style-type: none"> - Visual inspections (sediment), photos - Visual, soil sampling/ mechanical testing, engineering assessments. - Flora/Fauna survey. - pH, TDS, EC, metals, nutrients

4.5.4 Rehabilitation Monitoring

Until the mining lease has been relinquished, regular field inspections should be undertaken of all rehabilitated area, particularly waterways, banks, sediment control dams and diversions. The monitoring program should assess signs of failure, sedimentation, erosion and any other areas that may require repair. The inspection should also include the presence of noxious weeds with a weed spraying program to be implemented as required. The frequency of the field inspections could be reduced once it can be demonstrated that the vegetation is established and the final landform is stable. For more detail on **Rehabilitation Monitoring** refer to **Section 2.3.8** above.

5.0 REPORTING AND REVIEWING

5.1 Reporting

All internal and external reporting will be done in accordance with the requirements detailed in the Project Approval, which includes reporting within the AEMR. The AEMR will be prepared in accordance with Condition 5, Schedule 5 of the Project Approval.

Further information on the reporting requirements is available within the site Environmental Management Strategy.

5.2 Review

The extractive operation has a mine life of approximately 20 years, during which time the mine plan may be changed or altered depending on operational circumstances. Therefore the RLMP will be regularly updated, where needed, to capture these mine plan changes. Five (5) years prior to mine closure the RLMP will be reviewed addressing the final mine plan and any changes that may have occurred since the previous RLMP.

6.0 ROLES AND RESPONSIBILITIES

The site Environmental Manager is responsible for overseeing the implementation of this RLMP. The General Manager (or his delegate) is responsible for:

- Delegating tasks associated with this RLMP when the Environmental Manager is absent;
- Providing adequate resources to implement this RLMP; and
- Providing adequate training to employees and contractors regarding their requirements under this RLMP.

7.0 REFERENCES

ANZMEC/MCA (2000) Strategic Framework for Mine Closure;

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