Chapter 10

Decommissioning and Rehabilitation

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10. DECOMMISSIONING AND REHABILITATION

10.1 Rehabilitation Hierarchy and Goals

The Department of Environment and Heritage Protection (EHP) guideline – 'Rehabilitation requirements for mining projects' (EHP, 2012) (the EHP Guideline) describes the preferred rehabilitation hierarchy which, in order of decreasing capacity to prevent or minimise environmental harm, is:

1. Avoid disturbance that will require rehabilitation.
2. Reinstate a 'natural' ecosystem as similar as possible to the original ecosystem.
3. Develop an alternative outcome with a higher economic value than the previous land use.
4. Reinstate the previous land use (e.g. grazing or cropping).
5. Develop lower value land use.
6. Leave the site in an unusable condition or with a potential to generate future pollution of adversely affect environmental values.

The guideline outlines that the strategies listed higher in the hierarchy should be adopted in preference to those listed lower. Developing a lower value land use may however be appropriate if that use is acceptable to stakeholders and if all higher strategies are impractical. Leaving the site in an unstable condition or with potential to cause environmental harm will rarely be acceptable.

The rehabilitation goals, as described in the EHP guideline require rehabilitation of areas disturbed by mining to result in landforms that are:

- safe to humans and wildlife
- non-polluting
- stable
- able to sustain an agreed post mining land use.

10.2 Decommissioning and Rehabilitation Objectives

In accordance with the EHP guideline the following objectives have been derived for decommissioning and rehabilitation of areas disturbed by the project:

- The mine site will be safe to humans and fauna.
- Mining and rehabilitation will create a landform that is stable and with land use capabilities and/or suitabilities as determined in the Rehabilitation Management Plan (RMP). Mine wastes and disturbed land will be rehabilitated so that they are non-polluting and self-sustaining or to a condition where the maintenance requirements are consistent with an agreed post-mining land use.
- Surface and ground waters that leave the project area will not be degraded compared to their condition prior to the commencement of mining operations. Current and future water quality, other than water quality impacts associated with subsequent land users, will be maintained at levels that are within defined water quality criteria.
- Hazardous materials will be identified and adequately managed to ensure the site is non-polluting.

- Potential for acid mine drainage will be determined and will be adequately managed to ensure the site is non-polluting. Vegetation cover will be established to reduce rates of erosion and sediment loss.
- Final rehabilitation will be designed as permanent self sustaining landforms requiring no ongoing maintenance or management.

Specific rehabilitation objectives are described below for each mine domain. The mine domains are:

- waste rock dumps
- final voids
- mine infrastructure areas, including CHPPs
- co-disposal dams
- mine water management infrastructure (e.g. mine affected water dams)
- drainage diversions
- haul roads and other roads
- train loading facility
- linear infrastructure (e.g. power lines and water pipelines).

10.3 Land Use

10.3.1 Pre Mine Land Use and Land Suitability

The dominant land use within the project site is beef cattle grazing on areas cleared of remnant vegetation. Approximately 68% of the land within the project footprint is land that has been previously disturbed and modified to allow grazing of cattle. The remaining 32% comprises remnant vegetation, of which approximately 33% is Endangered or Of Concern Regional Ecosystem.

Chapter 14 describes the land suitability assessment for the project area which identified the land classes of the project site for beef cattle grazing as:

- Class 2 – 27%
- Class 3 – 15%
- Class 4 – 56%
- Class 5 – 2%.

10.3.2 Potential Post-mine Land Uses

The primary rehabilitation objective of the rehabilitation program will be to return the site to a stable and self-sustaining landform with a productivity level that conforms to a defined final land use. This will be achieved through:

- effective mine closure planning
- establishment of key performance indicators
- stabilisation of landforms
- revegetation with suitable species.

Mine closure planning will consider the choice of post-mining land use. This final land use may not necessarily be the original use. The final land use will largely be dependent on pre-mining land suitability, landholder preferences for land use, the potential uses of likely rehabilitated landforms, and the existing use or environmental values of surrounding land.

Determination of post-mining land use will be made in consideration of the rehabilitation hierarchy, as outlined in **Section 10.1**.

In accordance with the number one strategy of the rehabilitation hierarchy, the project will avoid disturbance, where possible. However, the nature of mining activities will result in disturbance. Those areas not proposed for disturbance will likely retain the pre-mining land use. **Chapter 14** describes the proponent's commitment to allowing ongoing use of the land for grazing outside operational areas on the project's mining leases.

As per the rehabilitation hierarchy the next preference following avoidance is the reinstatement of a 'natural' ecosystem as similar as possible to the original ecosystem. Factors to be considered when determining the feasibility of the reinstatement of a 'natural' ecosystem include ecological value of native vegetation to be disturbed, offsets proposed for native vegetation to be disturbed, benefits provided to landholders and technical feasibility of establishing effective and self-sustaining colonisation by the species which either existed pre mine or by species which are consistent with the selected habitat conservation value. The majority of remnant vegetation occurs within the footprint of the open pits and waste rock dumps. Reinstatement of 'natural ecosystems' on waste rock dumps may be feasible in the long term, however in the short term the rehabilitation objective is likely to be to stabilise the waste rock dumps and minimise erosion. This will be achieved by revegetation of waste rock dumps with fast-growing grass species, which may not represent the 'natural' ecosystem, to establish temporary vegetation cover to reduce erosion.

Where reinstatement of a 'natural' ecosystem is not feasible consideration will be made to the next strategy outlined within the rehabilitation hierarchy, being the development of an alternative outcome with a higher economic value than the previous land use. There will be limited opportunities for a post-mine land use with a higher economic value. However project infrastructure, such as dams and roads may be retained, which could contribute to a higher economic value of land.

It is considered likely that the rehabilitation strategy for the majority of disturbed areas (waste rock dumps) will be the reinstatement of the previous grazing land use at the same or lower land use suitability ranking.

There will be some areas of the mine site, such as the final voids, that are not returned to their previous land use. These areas will be developed to a lower value land use, but will be left in a stable condition that minimises the potential to generate future pollution or adversely affect environmental values.

Considerations and final determination of post-mine land use for the project site will be documented in the RMP, described below.

The proponent will develop a RMP which describes the post mine land uses within two years of the effective date of the environmental authority for the project. The RMP will be based on the following considerations:

- An inventory of existing land uses will be conducted. Aspects of this inventory are described in this EIS (refer **Chapter 14**) which finds that the land is primarily used for grazing of cattle on improved and native pastures with areas of remnant vegetation (described in **Chapter 18**). No areas are currently used for cropping. Further analysis of the intensity of grazing may be required to establish criteria for rehabilitation success following final rehabilitation. In addition the inventory of existing land use will consider farm infrastructure and existing land degradation due to historical agricultural practices.
- A description of the location and extent of land proposed to be disturbed by mining activities, as described in **Chapters 6, 7 and 8** of this EIS.

- An assessment of post-mining land suitability and post-mining land use options and their community benefits.
- An assessment of the feasibility to achieve the various options including any ongoing maintenance or management needs.

Table 10-1 describes, for each mine domain identified, the pre-mine land use, the post-mine land use objective and suitability classification, and the projective cover range percentage compared to an analogue site for rehabilitation. Detailed post-mine land uses for each domain will be confirmed in the RMP.

Table 10-1 Draft Final Land Use and Rehabilitation Schedule

Mine domain	Mine tenure	Pre-mine land use	Post-mine land use objective	Mine land suitability classification	Projective cover range (%)
Waste rock dumps	ML 10355, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Final voids	ML 10355, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Final Void	n/a	n/a
Mine infrastructure areas and CHPPs	ML 10355, 70434	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Co-disposal dams	ML 10355, 70434	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Mine water management infrastructure	ML 10355, 10356, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation, water storages	Class IV, water storages	50% analogue
Drainage diversions	ML 10355, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Haul roads and access roads	ML 10355, 10356, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation, roads for future use	Class IV, roads for future use	50% analogue
Train loading facilities	ML10355, 70434, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Linear infrastructure	ML 10355, 10356, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue

Table 10-2 provides the surface area and indicative maximum slope ranges for various mining landforms. The maximum slope ranges will be determined in the RMP.

Table 10-2 Landform Design Criteria

Disturbance type	Indicative maximum slope range %	Projective surface area (ha)
Final voids – high wall	0-214% or 65°	1,342 ha across four final voids
Final voids – low wall	0-100% or 45°	
Co-disposal facilities	0-20% or 11.5°	104
Waste rock dumps	0-20% or 11.5°	4,749
MIA, ROM pad	0-18% or 10°	255

10.4 Progressive Rehabilitation

The main features of the progressive rehabilitation process are:

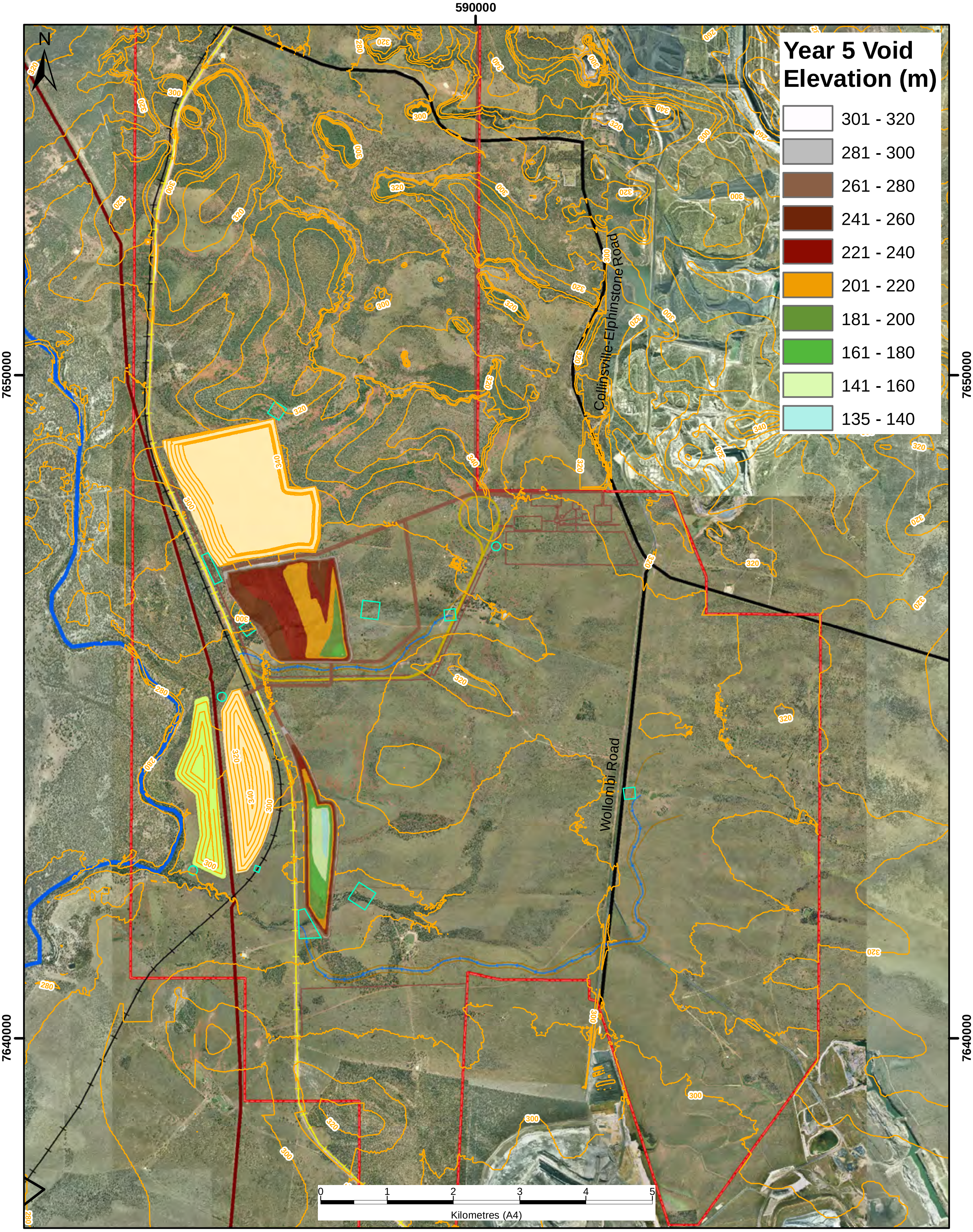
- constructing a stable land form consisting of out of pit and in pit waste rock dumps
- progressively constructing dumps to their final landform design, to minimise reshaping at the end of mining
- respreading of topsoil across available reshaped areas
- contour ripping immediately after topsoil placement to control erosion
- seeding with an appropriate seed mix prior to the wet season to maximise the benefits of subsequent rainfall
- managing direct rainfall and runoff from the rehabilitated landform in sediment dams.

Progressive rehabilitation will minimise the amount of land disturbed at any one time. The indicative programme for progressive rehabilitation of waste rock dumps is shown in **Figure 10-1**, **Figure 10-2**, **Figure 10-3**, **Figure 10-4**, **Figure 10-5** and **Figure 10-6**. These show rehabilitation at various stages, including waste rock dumps where the landform is being developed and areas of waste rock dumps where rehabilitation has been completed in year 5, 10, 25 and the final landform. Progressive rehabilitation will also include the rehabilitation of any areas disturbed during construction that are not required for ongoing operations.

The following decommissioning strategies are proposed for various remaining structures post-mine closure:

- Conduct of a contaminated land assessment of relevant locations. This may involve engaging a suitably qualified person (SQP) approved by EHP as a contaminated land specialist[1].
- Remediation or ongoing management of contaminated land as required. Ongoing management may include retaining parcels of the land on EHP's Environmental Management Register.
- Removal (or sale and removal if appropriate) of all items of the mine infrastructure area, and any temporary buildings and facilities, unless agreed with the post-mining landowner.
- Ripping, application of topsoil, and seeding of land
- Establishment of safety bunds and fencing for final void areas.

[1] For the purposes of preparing site investigation and validation reports and draft site management plans, an SQP is defined in the *Environmental Protection Regulation 2008*.



Legend

- Project Area
- Contours
- Completed Rehab
- Expit Waste Rock Dump
- Formed Roads
- Suttor River
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Train Loading Facilities
- Dam (mine affected, sediment affected, clean water)
- Alpha Coal Project Rail Line
- GAP Rail line
- Burdekin to Moranbah Pipeline

Progressive Rehabilitation Year 5	QCOAL GROUP
Figure 10-1	**Byerwen Coal Project**
Date: 31/01/2013	Author: samuel.ferguson Map Scale: 1:75,000 Coordinate System: GDA 1994 MGA Zone 55
Revision: R1	elp environmental and licensing professionals pty ltd

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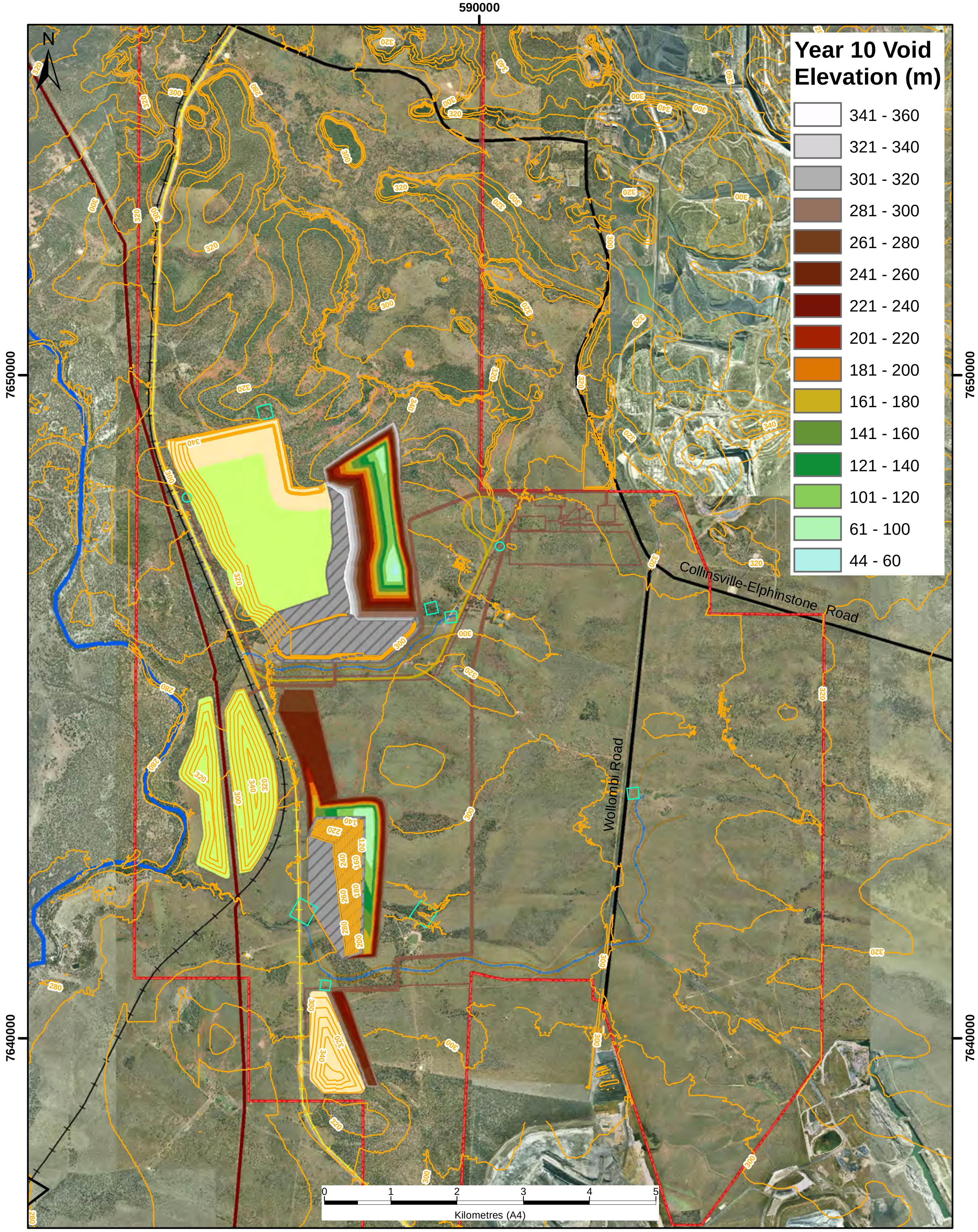

Legend

- Project Area
- Contours
- Completed Rehab
- Expit Waste Rock Dump
- Inpit Waste Rock Dump
- GAP Rail line
- Suttor River
- Formed Roads
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Dam (mine affected, sediment affected, clean water)
- Train Loading Facilities
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline

Progressive Rehabilitation Year 10	QCOAL GROUP
Figure 10-2	**Byerwen Coal Project**
Date: *4/02/2013*	**Author:** samuel.ferguson
	Map Scale: 1:75,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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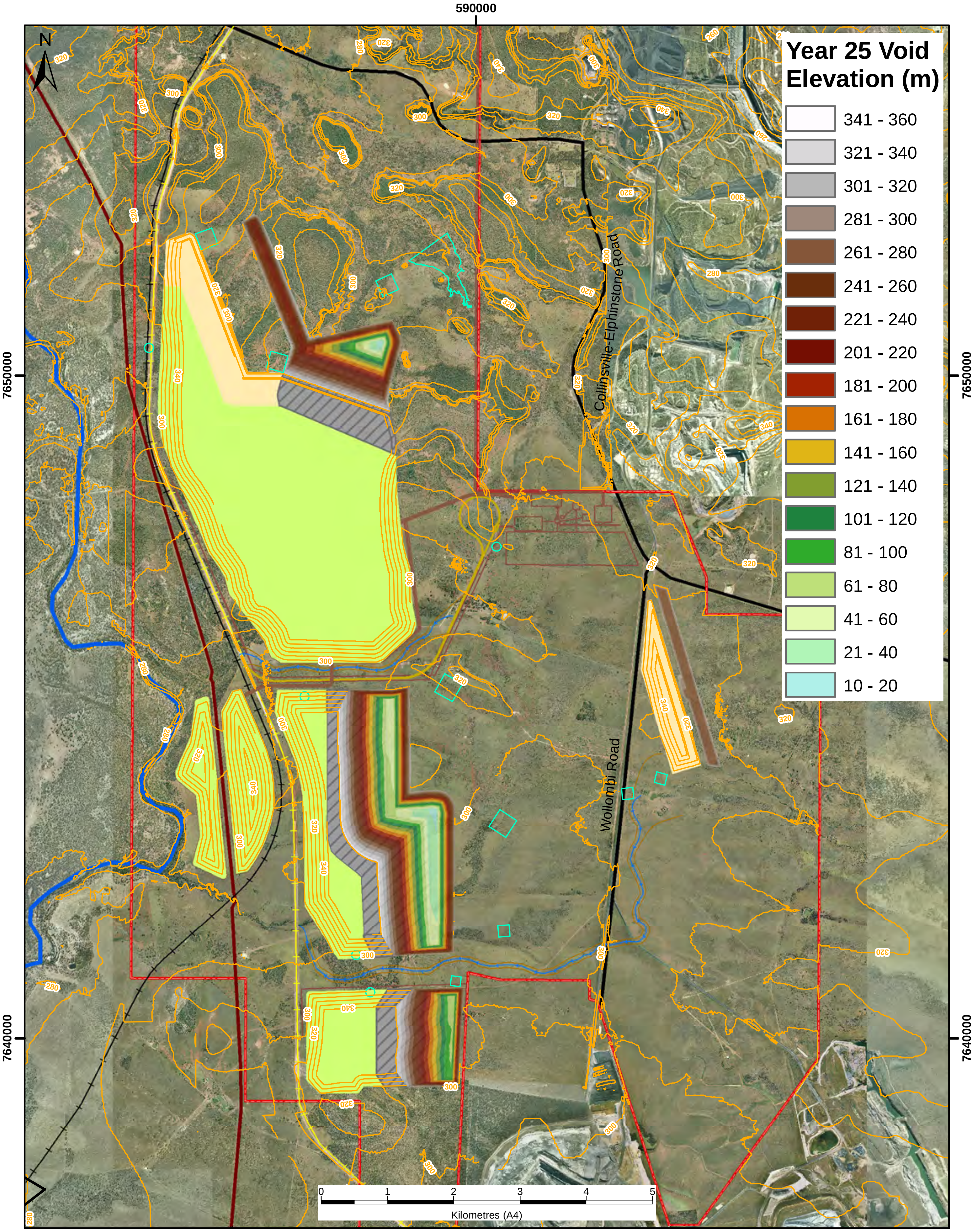

Legend

- Project Area
- Contours
- Completed Rehab
- Expit Waste Rock Dump
- Inpit Waste Rock Dump
- GAP Rail line
- Suttor River
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Train Loading Facilities
- Dam (mine affected, sediment affected, clean water)
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Progressive Rehabilitation Year 25 (South)	QCOAL GROUP
Figure 10-3	**Byerwen Coal Project**
Date: *31/01/2013*	**Author:** samuel.ferguson
	Map Scale: 1:75,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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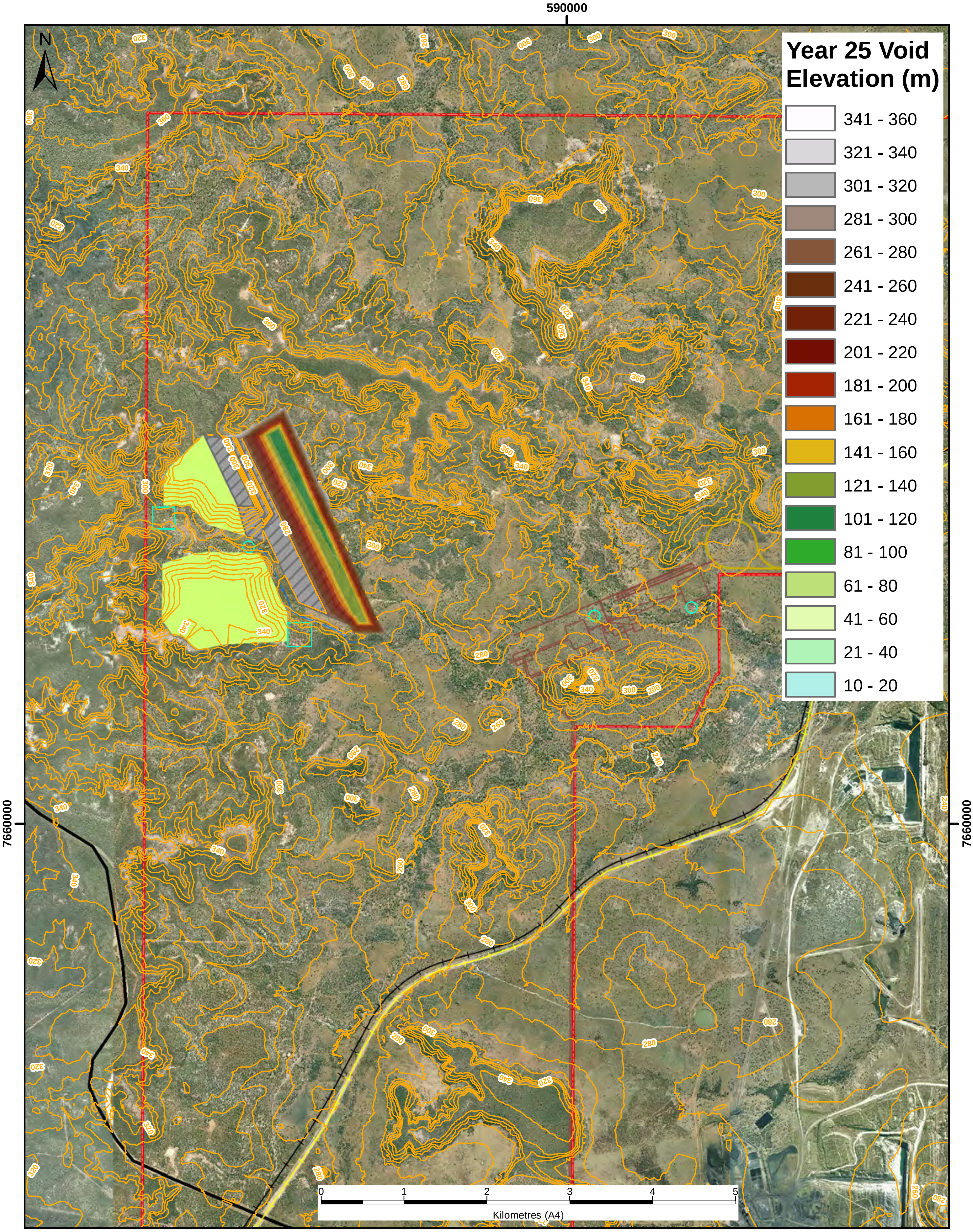

Legend

- Project Area
- Contours
- Completed Rehab
- Inpit Waste Rock Dump
- GAP Rail line
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Train Loading Facilities
- Dam (mine affected, sediment affected, clean water)
- Alpha Coal Project Rail Line
- Formed Roads

Progressive Rehabilitation Year 25 (North)

Figure 10-4

Byerwen Coal Project

Date: *31/01/2013*

Author: samuel.ferguson

Map Scale: 1:60,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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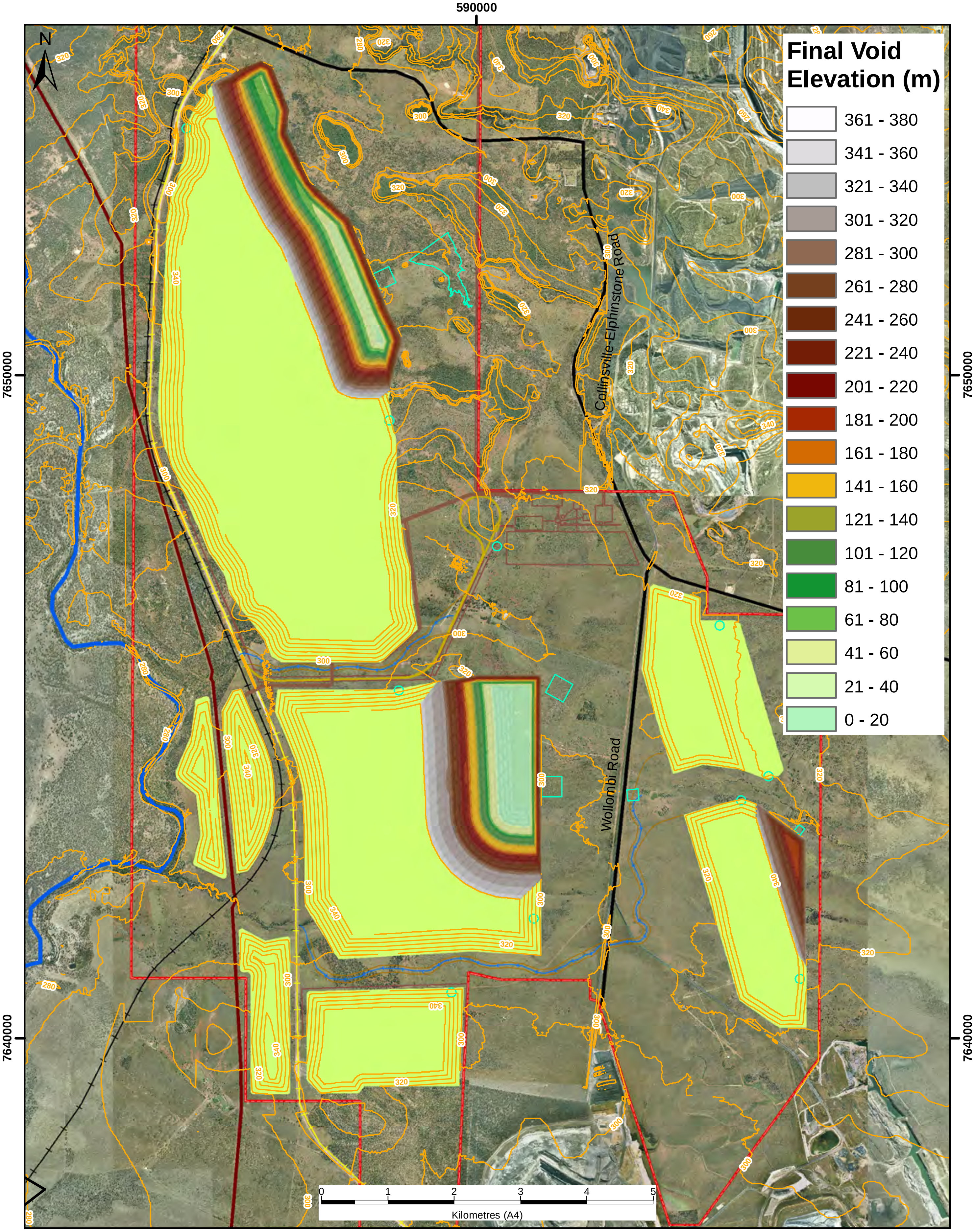

Legend

- Project Area
- Contours
- Completed Rehab
- Inpit Waste Rock Dump
- GAP Rail line
- Suttor River
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Train Loading Facilities
- Dam (mine affected, sediment affected, clean water)
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Progressive Rehabilitation Final Landform (South)

Figure 10-5

Byerwen Coal Project

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Date: 1/03/2013

Author: samuel.ferguson

Map Scale: 1:75,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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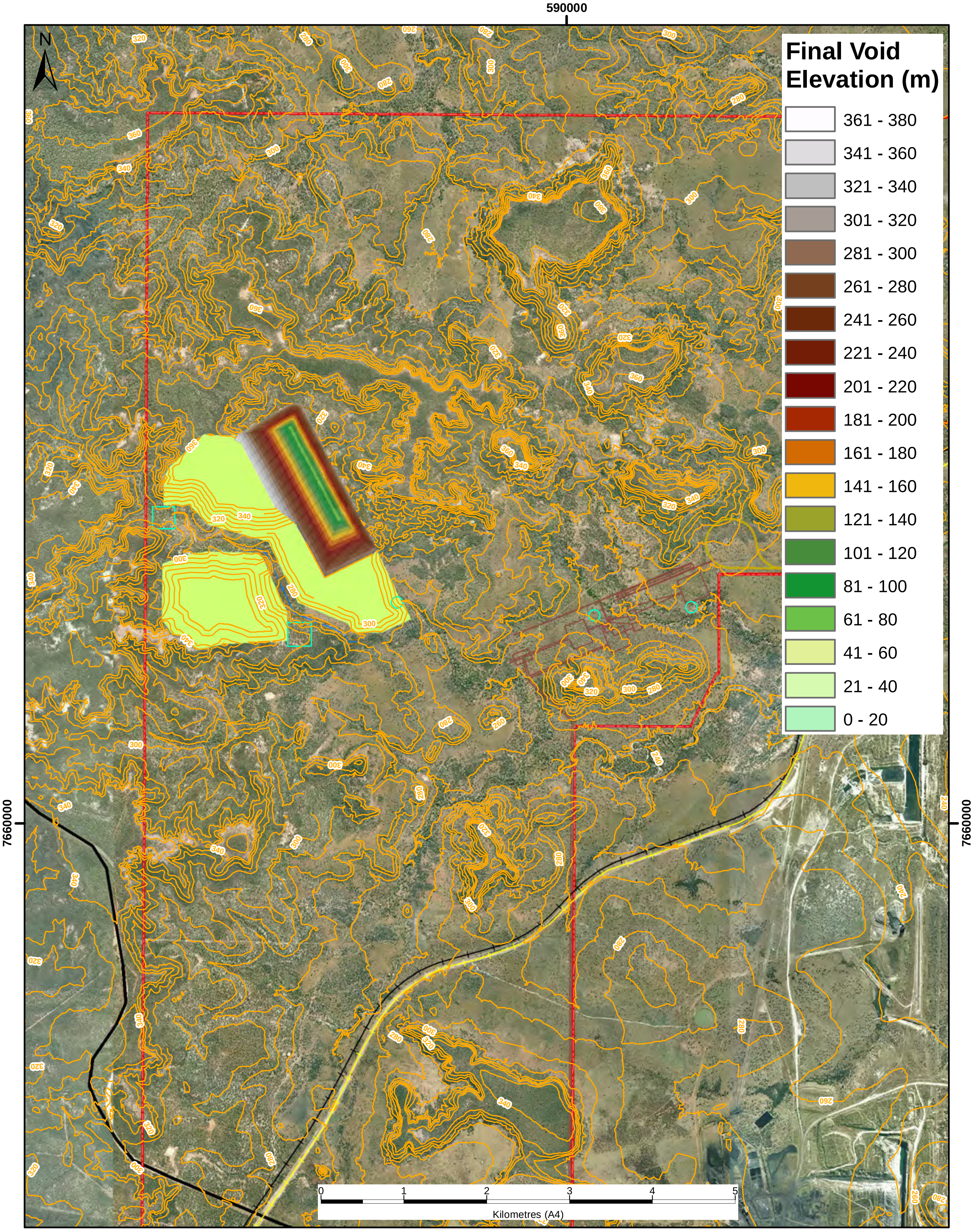

Legend

- Project Area
- Contours
- Completed Rehab
- Inpit Waste Rock Dump
- GAP Rail line
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Train Loading Facilities
- Dam (mine affected, sediment affected, clean water)
- Alpha Coal Project Rail Line
- Formed Roads

Progressive Rehabilitation Final Landform (North)	
Figure 10-6	**Byerwen Coal Project**
Date: *1/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:60,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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10.5 Rehabilitation and Decommissioning by Mine Domain

10.5.1 Waste Rock Dumps

The rehabilitation objectives for waste rock dumps are:

- Establishment of a post-mine land use in accordance with the RMP.
- Dump slopes are geotechnically stable.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Surface and near surface soil properties will support the proposed land use.
- Vegetation cover is established to minimise erosions rates.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Landform does not present a risk to people and stock.
- Ongoing management requirements are similar to non-mined land.

Waste rock dumps will be designed, shaped, capped with topsoil and revegetated in accordance with a Mine Waste Management Plan. The design of dumps is an important part of the rehabilitation process. Dumps will be designed and engineered to be geotechnically stable and safe. The final landform of waste rock dumps will be determined in the RMP. Dumps will be levelled out to cap all materials and shaped to provide a gently undulating landform. Final landforms are anticipated to be 60 m increased elevation compared to existing landform.

The characterisation of waste rock is described in **Chapter 9**. Typically in an open-cut mining operation weathered waste rock would be mined and dumped before unweathered materials, since weathered waste rock is closest to the surface. This is likely to be the case for the project and hence most weathered waste rock is unlikely to report to final landform surfaces. Therefore, weathered waste rock (not including topsoil and suitable subsoil) should not report to final waste rock dump surfaces to any significant extent, and should not pose significant management issues for the project. The geotechnical stability of waste rock will be determined to ensure that waste rock design and construction results in geotechnically stable dumps. Testing will also be undertaken to determine the propensity of waste rock to erode given that most waste rock materials are expected to be sodic, to varying degrees, with varying degrees of salinity.

As with most coal mines in the Bowen Basin that generate sodic materials, Permian (primarily unweathered) materials (Moranbah, Fort Cooper and Rangal Coal Measures) are generally more amenable to amelioration and vegetation growth, through the addition of fertiliser, than Tertiary materials (primarily weathered materials). Dump slopes will be well stabilised against erosion to reduce the risk of significant erosion of potentially dispersive sodic Permian materials.

For final rehabilitation of waste rock dumps, it is proposed that Permian waste rock be used for the outer slopes to limit potential for dispersion and erosion, with Tertiary waste rock preferentially disposed into the central (inner) zones of waste rock piles. Where this strategy cannot be fully achieved (due to mine waste scheduling) and Tertiary waste rock is required to report to outer surfaces there are two proposed options:

- establish a slope gradient of less than 10% with a cover of non-dispersive Permian material; or
- if steep outer slopes are required, a thick cover of durable rock will be placed, which may or may not be Permian material.

Chapter 9 identifies where waste rock is potentially sodic and potentially dispersive. Ideally, highly sodic and dispersive materials should be identified, selectively handled and placed within the core of spoil piles away from final surfaces, or returned to voids during mining. However, since most waste rock is expected to be sodic (to varying degrees), this method of managing sodic material may not be possible. Therefore, it is likely that material designated for use on final surfaces would require a topsoil cover or amendment if used as an additional source of topsoil.

Poor quality Permian material may also require covering with selective benign and erosion resistant material. Under certain circumstances sodic waste rock can be disposed close to final surfaces if the salinity is high and if the rate of salt release is low (leaching is controlled), as under these conditions the ability for the waste rock to become dispersive is balanced to some degree by the inherent salt concentration in the waste rock (which limits cation exchange processes). Research on some Australian mines has shown this to occur (Vacher *et al*., 2004), however the balance between the inherent salt concentration, the initial sodicity and the expected or potential rate of leaching (flushing) of salts must be carefully understood.

Notwithstanding, The proponent has committed to undertaking revegetation/rehabilitation field trials for waste rock materials when operations commence and bulk materials become available.

Irrespective of the waste rock reporting to the exterior of waste rock dumps, suitable topsoil and subsoils that have been stripped prior to mining will be applied to the surface of the dumps. A Soil Management Plan will be developed to identify the soils best suited to rehabilitation at the recommended depth (300mm) from the potentially available surface and subsurface materials. **Chapter 13** identifies that there is suitable surface and subsurface materials to achieve this depth of cover for rehabilitation. There are approximately 47 million m^3 of suitable surface and subsurface material, which provides sufficient volume to select the optimal soils for rehabilitation to a depth of cover of 300mm.

The rehabilitation strategy for establishing geotechnically stable and formed waste rock dumps is to:

- rip waste rock material to between 0.5 - 1 m
- apply stripped subsoils and topsoil material (minimum of 100 mm)
- scarify the surface (immediately before seeding)
- seed with an appropriate seed mix
- control weed species.

Ongoing monitoring of the success of rehabilitation will be undertaken in accordance with the RMP.

Surface run-off and seepage from waste rock dumps, including any rehabilitated areas, will be monitored for ‘standard’ water quality parameters, including pH, electrical conductivity, sulfate (and other major ions) and a broad suite of soluble metals.

10.5.2 Final Voids

The rehabilitation objectives for the final voids are:

- Post-mine land use is a void containing water that has little or no risk of overtopping.
- Voids are isolated from surface water flows.
- Water quality does not present a risk of environmental harm to surface waters or groundwater.
- Voids are stable over the long term.
- Safety risk to people, fauna and stock is managed and access to void water is limited.
- Future potential use of the voids is maximised (where practicable).

Typically, a single final void will remain after completion of mining for each pit. To reduce the number and footprint of final voids:

- SP2 will be backfilled with waste rock from SP1

- EP1 will be backfilled with waste rock from EP2
- WP1 will be backfilled with waste rock from SP1 and WP2 and a single final void will remain in the northern part of west pit (WP3).

The final landform will include four final voids in SP1, WP3, EP2 and NP.

A technical report has been prepared by KBR to assess of the risk of discharge from final voids and predict water quality within the final voids (refer **Appendix 13**). **Chapter 11** describes the findings of KBR's technical report, the results of which are summarised below:

- Water inflows from groundwater, surface water runoff and direct rainfall will result in the formation of pit lakes within these voids. These pit lakes will increase in depth and area slowly, over several hundred years, until a steady state condition is reached where water losses (evaporation) are equivalent to water inputs.
- An uncertainty analysis was completed that indicates that under no conditions will water from within the void rise to the final void rim. Therefore discharges to the surface water system should not occur.
- It is most likely that the steady state water level of all four pits will lie below the regional groundwater level, meaning that they will cause a permanent groundwater drawdown. As the voids will form a regional sink, environmental discharge to surrounding groundwater is not expected.
- Groundwater associated with the coal measures is expected to be the primary source of void water inflow. This groundwater is slightly alkaline and brackish and generally contains low concentrations of nutrients and metals. As the pit lakes mature, the salinity is expected to gradually increase causing strong and permanent stratification to occur. The salinity of near surface water is expected to be much lower than at depth, with high dissolved oxygen, neutral to slightly alkaline, with low to very low dissolved metal concentrations.

Final void water depth is unlikely to be at a depth where it can be accessed safely by fauna or livestock. Water quality is unlikely to be suitable for stock use or as a source of aquatic ecosystem habitat. Therefore the primary objectives of final void design will be to:

- isolate the void from surface water and groundwater systems by minimising the catchment extent and creating a permanent groundwater sink
- exclude humans, fauna and stock from the final voids.

This is the preferred approach as the void water quality is expected to be poorer than surface water systems and the void can be configured to avoid overflows. These objectives can be achieved by:

- constructing a bund around final voids (nominally minimum 2 m high with 4 m base and located 10 m beyond the area potentially affected by any instability of the pit highwall)
- limiting access to the final void through bund walls, tree planting, fencing, signage and landholder and community awareness.

Final void design will consider the geotechnical stability of high walls and low walls formed by waste rock dumps. The geotechnical or slope stability of the highwall will be determined through consideration all relevant variables (e.g. shear strength, number of benches, water inflows, fractures and faults) into engineering design. Drainage will be generally directed away from the highwall to limit slope deterioration.

The low wall (comprising the in-pit waste rock dumps) will be battered back from the angle of repose to ensure the long term geotechnical stability of the face. Determination of geotechnical stability will be based on an assessment of the waste rock material, the likely degree of settlement, and the degree of weathering expected in the long term. Drainage over the low wall will be minimised and controlled to reduce erosion. Erosion control can be achieved by limiting the length of slope, minimising the degree of slope and maximising the amount of protection provided to the surface by vegetation cover.

As described in **Chapter 16**, there is no risk of a watercourse flooding the final void. Surface water flows into the final void will be limited to the catchment of the void and part of the waste rock dumps. Bunds developed during operations to separate clean overland flows from mining operations will be retained during rehabilitation.

10.5.3 Mine Infrastructure Areas and CHPPs

The rehabilitation objectives for the mine infrastructure areas (including product and ROM coal stockpile, administration, workshop, maintenance, fuel storage and waste management areas) and CHPPs are:

- establishment of post-mine land use in accordance with the RMP
- hazardous or contaminated material or areas are identified and managed
- infrastructure is dismantled and removed
- erosion rates are managed to levels that do not compromise post-mine land use
- run-off or seepage water quality does not present a risk of environmental harm
- ongoing management requirements are similar to non-mined land.

The CHPP and mining support infrastructure will be dismantled and removed upon completion of the mining operations. The plant concrete bases and footings will be removed and the area ripped, reshaped and topsoil applied before revegetation. Drainage control through ripping, profiling or the provision of erosion control structures will also be undertaken. Any infrastructure that is considered to be of beneficial use to the subsequent landholder will be retained, if requested.

A contaminated land assessment of the coal stockpile areas, fuel storage area, chemical storage areas, waste storage/transfer areas, effluent treatment plant area, treated effluent irrigation area and any other potentially contaminated sites will be undertaken to identify any potential contamination. Management of any contaminated areas may include on-site remediation, removal to an appropriately licensed waste disposal facility or encapsulation on-site to prevent the release of contaminants. Where contaminated land cannot be remediated in the post-mining landscape it will be managed on-site.

Any metals or materials that may contaminate the site (e.g. batteries, waste oils) will be removed from site and disposed of at an appropriately licensed waste disposal facility.

Some wastes may be buried on site in the in-pit waste rock dumps, including tyres and construction waste. The majority of wastes will have low potential to cause contamination through seepage. Those wastes that have to the potential to cause contamination through seepage will be disposed of in cells within the waste rock dump that will contain any contaminated seepage. Any metal with the potential to react with waste rock and result in contamination of groundwater will not be disposed of in the in-pit waste rock dumps.

Drainage control through ripping, profiling or the provision of erosion control structures will also be undertaken. Any infrastructure that is considered to be of beneficial use to the subsequent landholder will be retained, if requested.

Once decommissioned, the rehabilitation strategy for infrastructure areas will be to:

- rip compacted areas to between 0.5 - 1 m

- apply stripped subsoils and topsoil material (average between 100-150 mm)
- scarify the surface (immediately before seeding)
- seed with appropriate seed mix
- control weed species.

10.5.4 Co-disposal Dams

The rehabilitation objectives for co-disposal dams are:

- Establishment of a post-mine land use in accordance with the RMP.
- Final landform is geotechnically stable.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Potentially contaminated materials are adequately managed.
- Vegetation cover is established to minimise erosions rates.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Landform does not present a risk to people and stock.
- No ongoing specific management requirements.

Two co-disposal dams, one near the southern CHPP and one near the northern CHPP, are proposed. These will be used for storing reject material during the initial years of operation of each CHPP (nominally the first 10 years of operations of each CHPP). In subsequent years, all reject material will be disposed of in-pit. The strategy for disposing of coarse and fine waste reject into pit voids will reduce the area of land required for the management of rejects.

Chapter 9 describes the characterisation of reject material. In summary:

- Potential coal reject is expected to generate alkaline, low- to medium-salinity run-off and seepage following surface exposure.
- The total sulfur concentration of all samples is generally low (75th percentile = 0.19%; 90th percentile = 0.4%), however some coal reject materials contain sulfide concentrations sufficient, on their own, to generate acid (i.e. in the absence of any neutralising materials).
- About 75% of potential coal reject samples, and therefore the bulk coal reject material, is expected to be NAF. About 20% of potential coal reject samples have been classified as potentially acid forming (PAF), with most of these samples having very low sulfur concentrations, and therefore have a ‘low capacity’ to generate significant acid.
- Total metal and metalloid concentrations in potential coal reject samples are low – below the applied health-based guideline levels for soils.

During operations, the characteristics of the co-disposed coal rejects will be further assessed to inform the RMP. The decommissioning, closure and post-closure aspects of coal reject co-disposal dams will also be addressed as part of the RMP.

The following general principles will be adopted for the closure of co-disposal dams:

- Co-disposal dam rehabilitation will be undertaken after drying of the dams.
- The rejects surface will be covered with a soil cover system and capped with a store and release capping layer, including clay layer and benign overburden material, to prevent further rainwater ingress into the rejects, and will be topsoiled and vegetated.

- The design of the soil cover system will be documented in the RMP, but will principally comprise a cover of suitable waste rock and topsoil to a final nominal re-profiled thickness of 3 m.
- Rejects will be covered with a capillary break if required to prevent the vertical movement of salts. The cover will be designed to provide a relatively flat low gradient final landform.
- The rehabilitated co-disposal dams will be vegetated with an appropriate seed mix.
- If required, co-disposal dams will be placed on the EHP's Environmental Management Register.
- The catchment of dams will be limited to the area within the embankments with clean water flows diverted around dams.
- Once the soil cover system is installed (and the out of pit co-disposal facility is 'closed'), surface water and groundwater will continue to be monitored for the same or similar suite of parameters as during operations of the facility.

Waste rock will be suitable to use as a soil cover, as it is alkaline, has low sulfur, is likely to have a high factor of safety and very low probability of acid generation, and will have excess capacity to neutralise any acidity generated by coal reject materials. However waste rock may potentially generate medium- to high-salinity surface run-off and seepage and will require a topsoil 'cap' to use as a growth medium.

10.5.5 Mine Water Management Infrastructure

The rehabilitation objectives for mine water management infrastructure (mine affected water dams, sediment dams, clean water dams and associated pipes and pumps) are the same as those for the co-disposal dams described in **Section 10.5.4**. There is potential for beneficial use of some mine water management infrastructure by landholders. Mine water management infrastructure will be retained where agreed by the post-mining landowner.

Any plan to retain water storage facilities post mining will consider the water quality and quantity requirements. These requirements will vary depending on whether the site is to be used for stock, wildlife, or human consumption, irrigation or recreational uses. Such a land use option may need separate hydrological and/or hydrogeological assessments. Criteria of achievement will show that all environmental and water quality requirements consistent with the use have been met and that the intended users of the water have a need for the facility. Responsibility for ongoing operation and management of dams, that will benefit the landholder, will be transferred to the landholder following mine closure.

Water storage dams will either be retained as water storages for the post-mining land use or rehabilitated. The rehabilitation process will entail dewatering, removal of any embankments, revegetation and monitoring. Rehabilitation will vary depending on the storage history. Dams that contained saline water or other contaminants may require further remediation. The general principles that will be adopted for closure of dams that contained saline water or other contaminants are the same as those for the co-disposal dams described in **Section 10.5.4**.

If not retained as water storages, water storage dams will be returned to grazing land as occurred pre-mining, and will generally be able to be used for beef cattle grazing. Dams that have contained saline water are likely to only be returned to cattle grazing land.

10.5.6 Drainage Diversions

The design of drainage diversions is described in **Chapter 8** and **Chapter 16**. The objectives for drainage diversions are to:

- create a drainage that operates as part of a self-sustaining stream system and promotes nutrient processing, ecological connectivity and sediment storage and transport

- whenever practical, avoid the use of artificial grade control structures or other structures that are likely to require maintenance beyond life of mine
- include natural, locally and regionally occurring geomorphic and habitat features
- create a drainage where the diversion and adjoining reaches establish a state of dynamic equilibrium (equal rates of sediment erosion and deposition).

The establishment of riparian vegetation will be a key component of drainage diversions. Riparian vegetation plays an integral role in creating and maintaining the stability of newly constructed channels and in providing habitat. There is a risk that a large flow event, in excess of the design storm event could occur in the diversion before riparian vegetation has become established to the point where it resists large flows.

Assessment of riparian vegetation will be undertaken as part of the detailed design to provide a basis for developing the detailed revegetation plan. Revegetation will include the use of a mixture of locally indigenous groundcover, shrubs and overstorey species and, if available, the introduction of woody debris for additional habitat once the vegetation has established.

Drainage diversions will be retained following mine closure, as they will have been designed though best-practice measures to provide stable landform and by mine closure, would be established with long-term riparian vegetation and aquatic habitat. At the conclusion of mining, the drainage diversions will be left in a stable and sustainable condition in line with the RMP. There should be no requirement for ongoing maintenance and management of diversions and levee banks following mine closure.

10.5.7 Haul Roads and Access Roads

The rehabilitation objectives for haul roads and access roads are:

- Establishment of post-mine land use in accordance with the RMP.
- Hazardous or contaminated material or areas are identified and managed.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Ongoing management requirements are similar to non-mined land.

A number of the roads may be retained for use by future landowners post-mine closure and rehabilitation. Agreement for ongoing use and management of roads will be sought with landholders or third parties. Some roads will also be temporarily retained following rehabilitation as access roads for rehabilitation monitoring purposes. This will be determined in consultation with stakeholders and local council.

Management of any contaminated areas may include on-site remediation, removal to an appropriately licensed waste disposal facility or encapsulation on-site to prevent the release of contaminants.

The majority of roads across in the project area will be highly compacted. Rehabilitation, where required, will accordingly require deep ripping, profiling, application of topsoil and seeding. Drainage construction will be applied where necessary.

Roads which are selected to remain at the project site post-mine closure may require sediment containment measures to minimise potential erosion and sediment entering into waterways.

10.5.8 Train Loading Facilities

The rehabilitation objectives for train loading facilities (TLFs) are:

- Establishment of post-mine land use in accordance with the RMP.

- Removal of infrastructure, unless approved for use by another party.
- Hazardous or contaminated material or areas are identified and managed.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Ongoing management requirements are similar to non-mined land.

At the end of mine life, the TLFs (incorporating rail loop and rail spur) will be decommissioned, including removal of all infrastructure (rails, sleepers) and rail ballast material except if the infrastructure is approved for use by another party.

Management of any contaminated areas may include on-site remediation, removal to an appropriately licensed waste disposal facility or encapsulation on-site to prevent the release of contaminants.

Following decommissioning, the TLFs will require deep ripping, profiling, application of topsoil and seeding.

10.5.9 Linear Infrastructure

The rehabilitation objectives for linear infrastructure (power lines and water pipelines) are:

- Establishment of a post-mine land use in accordance with the RMP.
- Removal of infrastructure, unless approved for use by another party or where removal of buried infrastructure would create more environmental damage than leaving in-situ.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Ongoing management requirements are similar to non-mined land.

The power lines/power poles and water pipelines may be retained, by agreement, for future use by landholders, local government or another project. If they are not retained, infrastructure will be removed from site and disturbance corridors will be undergo deep ripping, profiling, application of topsoil and seeding.

Buried water pipelines will be left in-situ as the pipeline rights of way will be progressively rehabilitated following construction and installation. This will avoid creating additional disturbance and rehabilitation requirements associated with removal of pipelines.

10.6 Rehabilitation Management and Monitoring

In the initial years of operation, out of pit waste rock dumps will be formed. Thus progressive rehabilitation will only commence once out of pit waste rock dumps are stabilised.

10.6.1 Soils Management

Unless soil quality dictates otherwise, surface soils and subsoils in areas proposed for disturbance will be stripped and stockpiled in the initial years of operation for use in rehabilitation once waste rock dumps are stabilised. Once waste rock dumps are stabilised, topsoil stripped in advance of the expanding open pit will be reused for rehabilitation with no or minimal stockpiling. The objective is to minimise the period of stockpiling so as to maximise the rehabilitation potential of the soils.

The management of surface soils and subsoils to be used in rehabilitation will consider the following:

- Surface material is invariably of greater agronomic value than waste rock and therefore will be salvaged where appropriate (to a nominal depth of 0.3 m) for use in rehabilitation activities.

- Where the disturbance activity involves surface infrastructure, such as roads and infrastructure areas, the decision to salvage surface soils and subsoils will be made in the context of the inherent limitations of these soils. Exposure of problematic soils (e.g. dispersive, saline and / or sodic) may present a greater environmental risk than not collecting the soils ahead of disturbance.
- Surface soil material (nominally 0 – 0.3 m) will be salvaged and stored separately. Any suitable soil below this (using recommended stripping depths) will also be harvested and stockpiled.
- Wherever practicable, salvaged soil material will be directly placed on areas to be rehabilitated.

The selection of locations for soil stockpiles will be incorporated into mine planning and drainage design. Soils stockpiles will typically be located in the footprint of future open pit areas to minimise the total disturbance footprint. The locations, creation date, source of soil, soil properties and volumes of all soil stockpiles will be recorded in a Soil Management Plan and this plan will be updated if stockpiles are relocated or if soils are used in rehabilitation.

Surface soils and subsoils will be stripped, handled and stockpiled separately. Soil quality declines in storage particularly after the first year. Where stripped soils cannot be directly placed, they will be stockpiled. Stockpiles will not exceed a maximum height of 2 m. Stockpiles will be located away from drainage lines or watercourses and areas that may be subject to flooding or water logging or where they could be impacted by vehicular traffic and contamination from mine wastes. Diversion banks or drains will be installed upslope of stockpiles to minimise run-on and stockpile erosion. Sediment fencing will be installed downslope of the stockpile to minimise sediment export.

Soil stockpiles will be sown with a protective cover (e.g. fast growing pasture species) selected for rehabilitation.

10.6.2 Erosion Control in Rehabilitation Areas

The objective during rehabilitation will be to establish long term sustainable erosion control, primarily through the establishment of vegetation cover. Temporary structures, such as contour banks, bunds, lined channels of water flow and sediment ponds, may be required in the initial phases of rehabilitation to contain sediment and erosion. The susceptibility of an area to erosion depends on a combination of factors including climatic conditions, nature of the terrain, soil characteristics and vegetation cover. Detailed assessments of these factors will be considered in rehabilitation planning. Erosion control of waste rock dumps will be a factor of slope angle, slope length and height. Sediment and erosion control is further described in **Chapter 13**.

The best means of erosion control is a dense, permanent vegetation cover. However, the establishment of vegetation takes time. The period of erosion susceptibility and the degree of possible erosion damage will be reduced by suitable management methods such as ripping the rehabilitation area, application of topsoil and sowing at the same time, sowing in favourable climatic conditions, using suitable species that are quick growing or bind the soil whilst limiting grazing and traffic.

Satisfactory rehabilitation of land disturbed by mining will be considered to have been achieved when erosion within the rehabilitated area is comparable to that within similar undisturbed areas in the same locality.

10.6.3 Vegetation Cover Management

Trials will be undertaken to establish the optimum species to provide vegetation cover of waste rock dumps and other disturbed areas. Success is dependent on climatic factors, soil quality, proposed land use, landform and drainage patterns. Revegetation techniques will consider the extremes in climate that exist at the site and potential long term changes in climate.

It is anticipated that where surface soils can be directly placed over final landforms, contained seed bank will be sufficient to regenerate the area. Direct seeding is the preferred method for enhancing regeneration of vegetation from soils. However other methods such as direct planting of nursery stock will be investigated. Where it is proposed to seed with native species, these will be collected, where possible, from surrounding undisturbed areas during the construction and initial operational periods. Collection will continue over the mine life. Maintenance of retained areas of existing vegetation could also provide a source of seed for mine rehabilitation works.

In some areas of disturbance the primary aim may be erosion control, in which case fast growing, sterile, annual grasses and legumes (that are not declared weeds or that do not have the potential to spread as weeds) may be preferred. Legumes provide the added benefit of introducing nitrogen to the soil. In other instances planting may be with native grasses or existing, exotic pasture species preferred for grazing. If native species are unsuccessful, introduced stoloniferous grasses will be used to achieve rapid surface coverage. Buffel grass or a similar species may be used in areas identified for grazing where a suitable buffer to native vegetation is established using a non-invasive cover crop mixed with native grass seed.

Where it is intended to plant woody vegetation or trees, these will be planted in areas where grass cover is controlled to prevent grass cover from out competing woody vegetation or trees. Native tree species, already present in the area will be planted in preference to other species.

Where appropriate, trees and logs cleared from disturbance areas will be relocated for later use in rehabilitation. Progressive rehabilitation of mined areas will incorporate the provision of nest hollows and microhabitat features such as trees and logs from existing cleared vegetation.

Surface preparation is critical to revegetation success. This may include contour ripping, even spreading of topsoil and other growth media and erosion and sediment controls. Fertiliser and other soil ameliorants are likely to be required to promote plant growth, with the type and quantity dependent on soils quality. Field trials may be conducted to determine optimal fertiliser regimes.

Some areas requiring rehabilitation may require specialist revegetation methods, such as steep slopes and dam embankments. For example, jute mesh or other suitable matting material is useful for steeper sloping land. Mulching or hydro-mulching may also aid rehabilitation and limit erosion.

Regardless of the species selected for revegetation, weed controls will be implemented on a regular basis. Weed control and management practices will be implemented on the entire project area, including control of declared weeds and other weeds with potential to impact revegetation success. Vehicle wash down facilities located at the mine site will be used to clean vehicles of weed seeds. Material or fill used in any works (including rehabilitation) that is imported to site, will be required to be inspected and declared weed free.

Planning for rehabilitation will consider annual or seasonal requirements and hence activities will be timed to ensure that erosion control structures, topsoil spreading and seeding operations are conducted at the optimal time of the year. As rainfall in the area of the project is annually unreliable, seeding operations may have to be delayed until appropriate weather conditions are available. In addition, irrigation of rehabilitated areas may be undertaken to promote growth.

10.6.4 Monitoring and Review

Monitoring and assessment of progressive rehabilitation processes will be undertaken throughout the project life. Assessment involves measuring indicators of rehabilitation success against established criteria.

It is generally expected that rehabilitation vegetation should be established within 2 years of planting. In the initial years of revegetation, monitoring will occur a number of times per year, but once vegetation is established monitoring may occur annually until completion criteria indicate successful revegetation. From this point monitoring may occur every three years until the surrender of the mining lease.

Monitoring of rehabilitation success will be conducted at locations representative of the range of conditions impacting the rehabilitating areas. Annual reviews will be conducted of monitoring data to assess trends and monitoring program effectiveness.

Monitoring of soil erosion in rehabilitated areas will be included as part of the rehabilitation program. Monitoring is useful to identify where soil conservation strategies (either structural measures or vegetation) are proving inadequate and where rectification measures are required.

If monitoring and assessment results indicate that the rehabilitation objectives may not be achieved, then the rehabilitation strategy will be modified. Non-compliance with the established objectives, completion criteria and indicators will trigger a review of processes such as planning and design, and/or repair and maintenance of failed rehabilitation work.

As rehabilitation technologies, strategies and monitoring techniques change and/or are improved over time, the proponent will regularly review and update the project's rehabilitation and monitoring procedures to include the most effective processes and strategies.

10.7 Completion Criteria and Indicators

A RMP will be developed for the project within two years of the effective date of the environmental authority. In accordance with the Strategic Framework for Mine Closure[2], the RMP will describe completion criteria and establish a set of indicators which will demonstrate the successful completion of the closure process.

In order to establish standards, completion criteria and indicators, the proponent will review all relevant legislation and industry codes of practice, and consult all stakeholders. Completion criteria will be developed that provide a clear definition of successful rehabilitation for each domain at the mine site.

For all indicators that are selected, the RMP will:

- state what objective(s) the indicator relates to
- justify the selection of the indicator, including how the relationship between the indicator and the objective has been established
- state how the indicator is to be measured
- state how the results will be reported and interpreted.

Completion criteria and indicators will be developed for:

- agricultural productivity of the land in accordance with pre-existing productivity benchmarks where areas are returned to a grazing land use
- suitable vegetation cover
- rates of erosion and sediment loss
- suitable soil quality
- geotechnical stability of rehabilitated areas, including slope length, slope angle, rate of sediment loss, geotechnical studies
- quality of water runoff at various upstream and downstream monitoring locations
- containment and treatment of any polluted runoff

[2] Australia and New Zealand Minerals and Energy Council and Minerals Council of Australia, Strategic Framework for Mine Closure 2000

- engineering standards and certifications for decommissioned and rehabilitated infrastructure
- remediation of any contaminated land.

Indicators of rehabilitation success that are applicable to revegetation include plant and litter cover, plant density and species composition, plant yields, presence and content of weeds, soil erosion, soil nutrient status, soil salinity and microbial population.

Where the intention is to reinstate the previous grazing land use the success of pasture species planting may be gauged by the whether the area can support the intended stocking rates.

Where the intention is reinstate a natural ecosystem, nearby undisturbed vegetation communities can be used as a reference to assess the success of rehabilitation. Vegetation surveys, as conducted for this EIS, will provide input into species dominant ecosystems and distribution and abundance of species. It is not intended, nor is it reasonably practicable, to create native vegetation communities with the same abundance and distribution of undisturbed native vegetation. Completion criteria will be nominated to represent rather than recreate exactly representative native vegetation communities. If areas are to be revegetated with native species, completion criteria and indicators may include measuring, relative to a representative site, vegetation cover, vegetation diversity, fauna and flora abundance, soil quality parameters, downstream water quality, landform stability and rates of erosion.

In addition completion criteria and indicators will be developed for the final void (and any other areas that are potentially not returned to grazing land) which include:

- geotechnical stability of the final void
- security and access to the final void.

Where dams are retained for the future benefit of landholders, completion criteria and indicators will be developed to establish the quality of the water and the risk posed by future changes in water quality.

Completion criteria to determine success of final rehabilitation and hence surrender of the mining lease will be developed in conjunction with the administering authority.

10.8 Mine Closure Planning

The proponent will develop a Mine Closure Plan four years prior to final coal processing. This section describes the processes involved in the mine closure planning, including the development of a Mine Closure Plan.

In keeping with the objective of ecologically sustainable development (ESD) as required by the *Environmental Protection Act 1994* (EP Act), the fundamental objective of mine closure is to attain operationally and economically feasible closure while taking into account community priorities, environmental requirements and sustainability of the rehabilitation and the final land use.

Rehabilitation and decommissioning strategies will be implemented to ensure that project areas which have been mined, affected by mining operations and/or affected by activities ancillary to mining operations are left:

- tidy and safe, with public safety risks reduced to acceptable levels
- with final landforms that are stable and resistant to erosive processes
- suitable for the agreed post-mining land uses
- within the limits of appropriate and agreed levels of contamination
- in a condition which satisfies community, agency and landowners expectations
- in a condition that meets the agreed discharge licence conditions

- in compliance with all EM Plan and Plan of Operation commitments.

The proponent will prepare a Mine Closure Plan which will list the specific operational activities required to be undertaken in order to complete rehabilitation and decommissioning of the project. The criteria for achieving self-sustaining final landforms will be developed as part of the Mine Closure Plan calling upon site specific rehabilitation trials, monitoring and research programs.

The Mine Closure Plan will:

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

10.8.1 Stakeholders

The Mine Closure Plan will identify stakeholders and interested parties. This includes employees, management, shareholders, local businesses and services providers, landholders, neighbours and nearby residents, local government, NGOs and community groups, conservation organisations, regulators and other government agencies.

A consultation programme will be developed to communicate and engage with stakeholders and interested parties. Consultation will commence prior to the decommissioning and final rehabilitation stages of the project.

10.8.2 Closure Planning

Mine closure planning will adopt a risk based approach and will incorporate technical, economic social and long term considerations. The Mine Closure Plan will include a number of subsidiary plans which typically include: a final rehabilitation plan and a decommissioning plan.

The RMP is considered as the first stage of planning for land use post mining activities (refer to **Section 10.3**), requiring consideration of longer term objectives during operation. The RMP is intended to be a “living” document that will be reviewed and updated during mining operations and will be part of the Mine Closure Plan.

Adequate financial provision will be made for the cost of mine closure.

10.8.3 Implementation

The accountability for resourcing and implementing the Mine Closure Plan will be clearly identified. Adequate resources will be provided to assure conformance with the Mine Closure Plan. The on-going management and monitoring requirements after closure will be assessed and adequately provided for.

10.8.4 Standards and Completion Criteria

Completion criteria are an agreed set of environmental indicators which, upon being met, will demonstrate successful rehabilitation of the site. Completion criteria will be developed that are specific to the mine, and reflect the unique set of environmental, social and economic circumstances of the site. Standards and completion criteria will recognize the legislative framework and consider all relevant industry codes of practice existing at the time of closure. Completion criteria are the basis on which successful rehabilitation is determined and will be developed in consultation with stakeholders.

Specific performance indicators will be developed to measure progress in meeting the completion criteria. The environmental indicators are intended to demonstrate whether the ecological processes which will lead to successful rehabilitation are trending in the right direction. This will enable early intervention and remedial actions where trends are not positive.

10.8.5 Relinquishment

The proponent will provide financial assurance for the decommissioning and rehabilitation costs associated with disturbances during the operational period. Relinquishment of this financial assurance will only occur once the regulator is satisfied that decommissioning and rehabilitation is successful.