HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Environmental Impact Statement

25 Decommissioning and Rehabilitation

Section 25 Decommissioning and Rehabilitation

25.1 Rehabilitation Strategy

25.1.1 Introduction

This section of the Environmental Impact Statement (EIS) includes an overall rehabilitation strategy for the Alpha Coal Project (Mine) (the Project) which provides reference to the planned rehabilitation of the final landforms and related facilities, including but not limited to the:

- Open cut mining areas;
- Tailings Storage Facility (TSF); and
- Ancillary infrastructure areas (including hardstands, roads, etc).

This section specifically includes the following key aspects relating to this specific mine site rehabilitation:

- The control and management of mine waste (i.e. overburden, coarse rejects and fine tailings);
- Proposed rehabilitation methods;
- The management of topsoil resources for use in rehabilitation of the site;
- Description of the planned progressive re-vegetation of areas across the mine site;
- The integration with on-going and future rehabilitation activities across the wider mining area; and
- Rehabilitation monitoring and maintenance requirements which may apply.

These aspects are discussed further in the sections below.

25.1.2 Queensland Legislation and Guidelines

The Queensland Department of Environment and Resource Management (DERM) require that land disturbed by mining is rehabilitated to achieve stable and beneficial agreed uses. The three mandatory rehabilitation requirements stipulated by DERM include landform stability, beneficial use, and protection of water quality. These elements are further defined as:

- Stable landform – includes both erosional and geotechnical stability. Erosional stability is typically achieved through the appropriate placement spoil to a final landform design standard followed by adequate top-soiling, re-vegetation and surface water management. Geotechnical stability is typically achieved through the correct design of low wall and high wall slopes and batters and the correct placement of spoil materials during the mine life.
- Beneficial use – refers to the final land use being beneficial to the community from an ecological or agricultural perspective or a combination of the two. It may include stable native bush land or grazing land with no ongoing liability to the community.
- Preservation of downstream water quality – existing and future use of the downstream water is not to be compromised. Silt, salt and acid above acceptable levels are not to be released from spoil or final voids to groundwater or surface water.

The strategies and methods described in this section for progressive and final rehabilitation of disturbed areas comply with the rehabilitation goals and objectives of the Queensland Environmental Protect Agency (EPA) (predecessor to DERM) *Guideline 18: Rehabilitation requirements for mining projects* in relation to intergenerational equity, protection of biodiversity and maintenance of essential ecological processes.

25.1.3 Rehabilitation Principles

Rehabilitation of the disturbed land associated with mining will proceed as soon as areas become available for rehabilitation. In some situations, however, rehabilitation may be delayed due to interactions with other nearby areas that are unavailable for rehabilitation. Where this is the case, temporary rehabilitation methodologies may be applied to provide short-term stabilisation of the areas.

The rehabilitation of disturbed land at the mine site will be conducted so that:

- Suitable species of vegetation are sown/planted and established to achieve the nominated post-mine land uses;
- The potential for water and wind induced erosion is minimised, including the likelihood of environmental impacts being caused by the release of dust;
- The quality of surface water released from the site is such that releases of contaminants are not likely to cause environmental harm;
- The water quality of any residual water bodies (other than the final void) is suitable for the nominated use and does not have the potential to cause environmental harm; and
- The final landform is stable and not subject to slumping, subsidence, or erosion which will result in the agreed post mining landform not being achieved.

25.1.4 Proposed Post Mining Land Use

Prior to mining, the Project site has been used mainly for agricultural use, typically cattle grazing. Much of the area is has been partially cleared. Several isolated areas have been enhanced for fodder species to supplement grazing on native and introduced pastures.

Rehabilitation of the Project disturbance area will return a stable landform capable of uses similar to those prior to disturbance. To achieve this, the nominated post-mine land use for the site is a mosaic of bushland and grazing. The mosaic will, where possible, link remnant native vegetation and aim to return some conservation values. In terms of soil conservation and agricultural land suitability, the proposed impacts are considered manageable and the proposed post-mining land use of low density cattle grazing is considered achievable.

In order to sustain the desired land use without degradation, it is important that the land (post-mining) only be used in accordance with the limits of the agricultural suitability class. Soil conservation practices such as stocking rate control and establishment or re-establishment of permanent pasture are proposed for rehabilitated areas where the proposed post mining land use is grazing. The overriding principle is to maintain the most beneficial future use of land that can be sustained in view of the range of limiting factors. The proposed post-mining grazing land will provide and sustain a sufficient bulk of nutritious forage in addition to the following management considerations:

- The ability to access and manage livestock;
- Flood free and relatively dry ground conditions;
- Adequate stock drinking water and shelter; and
- Stock routes throughout the land.

25.1.5 Proposed Post Mining Land Classification

25.1.5.1 *Land Suitability*

The suitability of rainfed broadacre cropping as a land use on the Project site is mostly limited by nutrient deficiencies in the soil profile. Several of the soil units are shallow and/or have sodic subsoil. The soils are also limited by their plant available water capacity. Soils in the steeper areas of the Project site have additional limitations in respect to rockiness and erosion. The vast majority of the proposed disturbance area is classified as Rainfed Broadacre Cropping Land Suitability Class 4 with some Class 5 occurring on the disturbance area's eastern margin. In general, the land on the Project site is considered marginal and unsuitable to cropping and has severe to extreme limitations.

The suitability of beef cattle grazing on the Project site is mostly limited by nutrient deficiencies within the soil. Water erosion and poor water (quality and quantity) availability, primarily due to the shallow nature of the soil, are also considered limiting factors within some soils. The Project site is classified as Beef Grazing Land Suitability Classes 3 and 4. The land is suitable to marginally suitable for beef grazing and has moderate to severe limitations. The distribution of these land suitability classes is provided in Volume 2, Section 5.

The post mining landform will be constructed and rehabilitated to ensure that a similar proportion of land suitability classification as the pre-mining landscape is attained.

25.1.5.2 *Good Quality Agricultural Land*

The majority of the proposed Project disturbance area (approximately 82%) has been assigned as Class C2. That is, suitable for native pastures due to limitations which preclude cultivation for improved pastures or crop production. This aligns with findings of the land suitability assessment which found a majority of the site was either suitable or marginally suitable for beef cattle grazing with severe limitations. Small tracts of land (approximately 18% of disturbance area) have been assigned an agricultural land suitability class of C1. That is, suitable for native pastures due to limitations that preclude cultivation for crop production (Volume 2, Section 5).

The post mining landform will be constructed and rehabilitated to attain an agricultural land suitability class of C2.

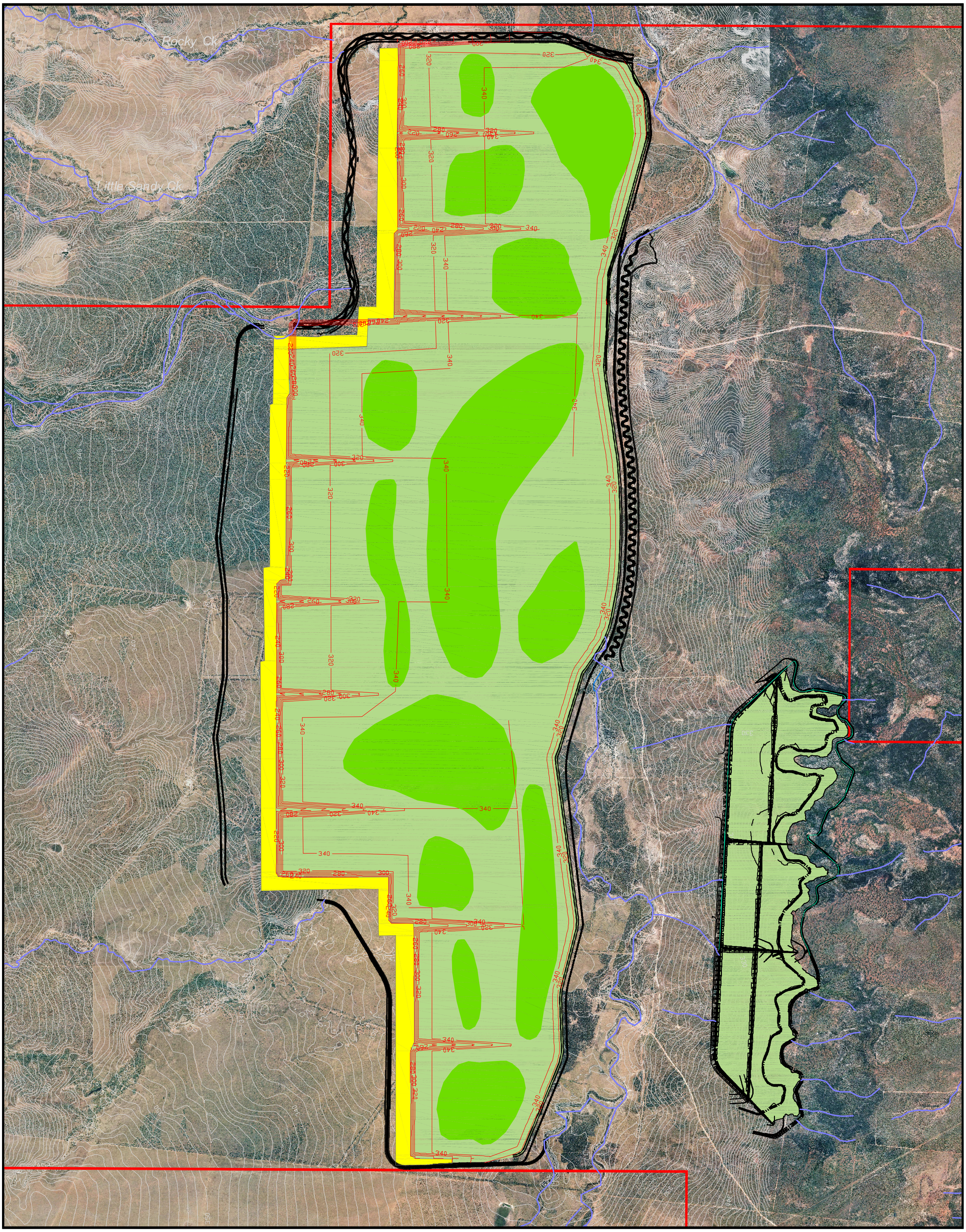
25.1.6 Landform Design and Planning

Rehabilitation planning at the Project site will aid in minimising the total area of disturbance at any one time, thus reducing the potential for wind-blown dust, visual impacts and increased sediment-laden run-off.

Rehabilitation will be designed to achieve a stable final landform compatible with the surrounding environment. This will involve the reshaping, using large dozers, of the majority of overburden emplacement slopes to 10° or less. Should slopes exceed 10°, additional drainage and revegetation works will have to be carried out. These control measures will enhance erosion / sediment control and aid in groundcover establishment.

Treed vegetation along the toe of rehabilitation areas will not be cleared unless an unacceptable safety or erosion risk remains.

Where possible, rehabilitation planning will attempt to maximise opportunities for a diverse post-mining landscape and land-use. It is presently proposed that the final land-uses of the rehabilitated site will include a mixture of grazing and bushland. Creek diversions draining the site will have riparian areas rehabilitated to a pre-mining standard to include a diverse vegetative community of native trees, shrubs and grasses. Monitoring will be undertaken to ensure that objectives are being met. A conceptual final landform and rehabilitation plan is shown as Figure 25-1.



Data supplied by GSS.

Mining Lease Application (MLA70426) Boundary	Ramps and low wall
Watercourse	Native trees, shrubs and ground covers
Final void	Exotic pasture

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NOT TO SCALE

Datum: GDA94, MGA Zone55

N W E S

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Alpha Coal Project
Environmental Impact Statement

FINAL REHABILITATION

Job Number 4262 6580
Revision A
Date 24-09-2010

Figure: 25-1

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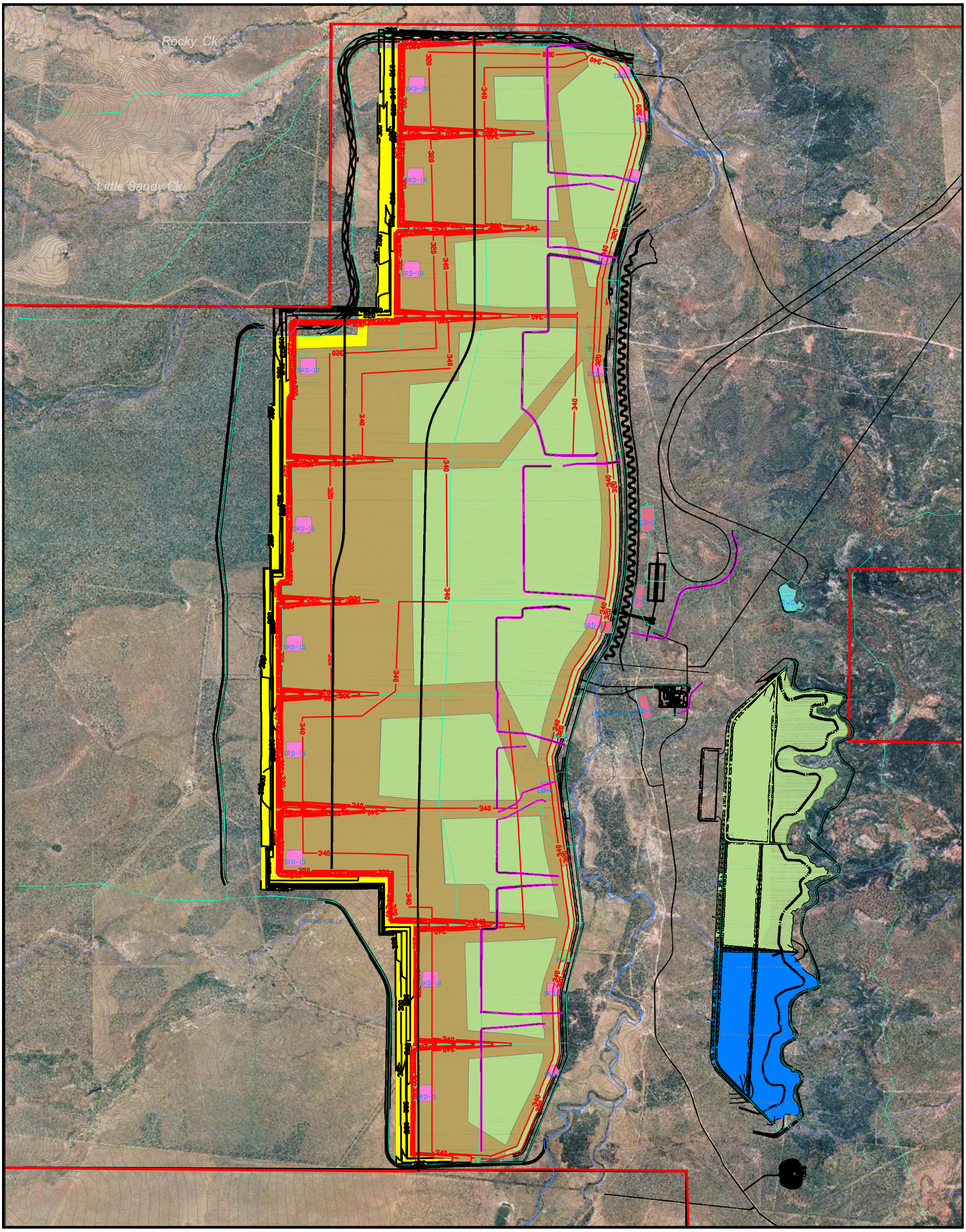
25.1.7 Staged Rehabilitation Approach

Rehabilitation will be progressively undertaken on areas that cease to be used for mining or mine-related activities within two years of becoming available, to reduce the amount of disturbed land at any one time. Results of progressive rehabilitation will be used to refine rehabilitation methods for future application such as the selection of appropriate drainage measures and plant species for re-establishment. Areas available for progressive rehabilitation and the types of disturbance at those sites will be detailed in the mine's Plan of Operations.

Table 25-1 below shows the total area of planned progressive rehabilitation throughout the life of the Project. The conceptual landform and rehabilitation status at year 30 is shown in Figure 25-2.

Table 25-1: Progressive rehabilitation throughout the life of the Alpha Coal Project (Mine)

Year from commencement of operations	Total area of rehabilitation completed (ha)
Year 5	123
Year 10	298
Year 20	3,236
Year 30	5,643



Data supplied by GSS.

	Mining Lease Application (MLA70426) Boundary		Watercourse		Pit Dewatering Dam		Environmental Dam
	Year 30 Catchments		Drains		Raw Water Dam	300	Contours
	Rehabilitation Year 30		Spoil		Sediment Dam	300 / 300	Rehab/Pit Contours
	Infrastructure		Pit		Tailings Storage Facility		

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Datum: GDA94, MGA Zone55

N W E S

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Alpha Coal Project
Environmental Impact Statement

ANTICIPATED REHABILITATION STATUS AT YEAR 30

Job Number 4262 6580
Revision A
Date 24-09-2010

Figure: 25-2

File No: 42626580-g- 2108.dwg

25.1.8 Management of Mining Waste

Project mine waste generated through mining (overburden) and coal processing (rejects and tailings) has been defined for the EIS as mining waste. Volume 2, Section 16 provides an assessment of the geochemical characteristics of the Project mining wastes and their management with a detailed geochemical report provided in Volume 5, Appendix J.

It is planned that following development of the initial open pit boxcut area, all coarse reject materials will be stored as in-pit spoil piles. In contrast, fine coal reject (tailings) is proposed to report to an out-of-pit tailings storage facility (TSF) located to the east of the open pit. However, as additional information becomes available and new opportunities present themselves, the Proponent is investigating the feasibility of accommodating tailings materials in the open pit after year 5 of operations, when mine planning allows and sufficient storage capacity becomes available.

Overburden will predominantly be stored within the open pit. Initially, the overburden produced by mining the boxcut area will be stored at an out-of-pit overburden emplacement area adjacent to the low wall on the eastern side of the open pit. Some of the overburden has the potential to be saline and/or sodic and any out-of-pit overburden will be managed to ensure that saline and/or sodic materials do not report to final top and bench surfaces and batters. During the first year of operation if there is insufficient capacity within the in-pit overburden piles, coarse reject material will be encapsulated in the out-of-pit emplacement area.

Saline and/or sodic materials will be placed within the core of the overburden emplacement area before covering with more benign materials, reshaping and adding topsoil and vegetation as part of the staged rehabilitation process. Some rock mulching may also be required on final batters to limit potential erosion from surface runoff and any requirement for this approach this will be assessed during rehabilitation field trials.

During the first year of mining, the coarse rejects will be truck-hauled adjacent to the low wall edge of the boxcut area (Volume 2, Section 16). Coarse rejects placed at the low wall edge of the boxcut area will be clay encapsulated before being further encapsulated with at least 5 m of spoil. Once adequate storage capacity is available in-pit, the coarse reject material will be placed in the in-pit voids between the dragline spoil. Coarse reject placement will be sequenced such that capping of the rejects will be completed progressively as the working face progresses down dip.

Coarse reject material placed in the in-pit voids between the dragline spoil will be compacted (during truck placement) in 1 to 2 m layers and capped with a clay cover prior to covering with at least 10 m of spoil material. Topsoil will be placed onto the re-profiled slopes.

Fine coal reject (tailings) will report to a purpose-built TSF in a slurry form. Given the arid climate of the region, the tailings surface is expected to dry out relatively quickly and form a dense compact solid material, which will facilitate a cover placement and rehabilitation at the end of mine life. It is expected that an enhanced ‘store and release’ cover system will be most appropriate for TSF closure.

The TSF design is detailed in Volume 2, Section 16 and Volume 5, Appendix J. The design criteria include:

- An initial operational design life of five years;
- An indefinite long term life once closed and rehabilitated;
- Negligible seepage of the contained water to the surrounding surface and subsurface environs;
- Adequate flood storage to alleviate the risk of discharge from the tailings dam cells and the decant pond to the environment;
- An emergency spillway;

- Efficient reuse of process water; and
- All embankments and slopes designed for stability and strength to commonly recognised and legislated guidelines/standards.

The TSF will be designed to minimise any adverse environmental effects due to seepage from the impoundments via compaction of existing soils, a liner system, appropriate embankment drainage, an underdrainage system, recovery of surface water, and management of tailings deposition.

In order to minimise the catchment areas reporting to the TSF, upstream clean water cut-off drains will be constructed to divert runoff around the proposed TSF structure into natural watercourses downstream of the embankments. These drains will be phased to tie in with the proposed staged development of the tailings cells (if required). All the cut off drains have been sized based on a 1% annual exceedence probability (AEP) time of concentration event (1 in 100 year) with an allowance for 500 mm of freeboard.

The drains will be topsoiled and grass seeded with rock protection provided at significant bends. Additionally all outlets from the drains to the natural surface will contain rock protection to minimise scour and assist in dissipating the runoff into sheet flow.

Additional detail on the closure methodologies for these facilities is discussed in Section 25.2.

25.1.9 Topsoil Management

The Proponent recognises the importance of appropriate soil identification, stripping and management practices for successful mine rehabilitation and the achievement of the desired post mining land use(s). To achieve these outcomes the Proponent will implement measures to effectively manage topsoil through the mining and rehabilitation process. Detailed site soil management plans will be developed prior to the commencement of mine construction. These will include a topsoil management plan (TMP) and an erosion and sediment control plan (ESCP).

The TMP will specifically address topsoil stripping, stockpiling (includes specific locations), the development of topsoil inventories for the Project site, handling, re-spreading, amelioration and seedbed preparation.

25.1.9.1 *Soils Resource*

A detailed description of the identification of appropriate topsoil resources within the Project site and their management is included in Volume 2, Section 5 and Volume 5, Appendix C. An inventory of available soil will be maintained to assist in the management of topsoil materials for planned rehabilitation activities. The details of the topsoil budget for the Project area is presented in Table 25-2.

Based on field and laboratory assessments, ten soil management units (SMUs) were identified within the Project site. These SMUs were classified as Britt, Waylon, Surbiton, Nelson, Malika, Rhi, Titus, Garret, Linda and Dunrobin.

The Surbiton, Rhi, Linda and Dunrobin SMUs all posses a non-sodic surface layer before levels of exchangeable sodium increase to sodic or strongly sodic within the upper 50 centimetres (cm) of the profile. Salinity also increases with depth within these profiles, but only two levels were considered slightly saline by 90-100 cm depth. An exception to this is the Linda SMU which becomes sodic within the first 0.2 m and moderately saline by 0.4 m, increasing further with depth.

With the exception of the Linda, Malika and Rhi SMUs, the soils of the Project site are all considered suitable for stripping to a depth of 0.1 – 0.3 m and stockpiling of the topsoil layer for post mine rehabilitation efforts. All soils are considered largely deficient of major soil nutrients.

Table 25-2: Topsoil budget for the Alpha Coal Project (Mine)

Soil Management Unit	Surface Area (Total Project Site) (ha)	Approximate Surface Area to be Disturbed (ha)	Percentage of Total Disturbance Area (%)	Stripping Depth (m)	Approximate Volume of Topsoil Available for Rehabilitation (m^3)
Britt	670	36.4	0.2	0.4	**145,600**
Titus	11,040	1220.9	5.4	0.5	**6,104,500**
Garret	23,720	9,628.5	42.8	0.2	**19,257,000**
Waylon	1,620	750.4	3.3	0.2	**1,500,800**
Nelson	8,690	4,632.0	20.6	0.3	**13,896,000**
Dunrobin	3,400	0	0.0	0.2	**0**
Surbiton	270	0	0.0	0.2	**0**
Linda	4,930	3,708.0	16.5	0.1	**3,708,000**
Malika	2,300	858.6	3.8	0	**0**
Rhi	8,190	1,664.7	7.4	0	**0**
Total	**64,830**	**22,500**	**100**	**-**	**44,611,900**

25.1.9.2 *Topsoil Stripping and Handling*

The TMP will include detailed protocols for soil stripping, stockpiling, and handling. The following proposed techniques will be adopted to prevent excessive soil deterioration:

- Topsoil will be maintained in a slightly moist condition during stripping. Material will not be stripped in either an excessively dry or wet condition;
- Stripped topsoil will be placed directly onto re-graded overburden or other disturbed areas and spread immediately (if mining sequences, equipment scheduling and weather conditions permit) to avoid the requirement for stockpiling;
- Soil will be graded or pushed into windrows with excavators, graders or dozers for loading into rear dump trucks by front-end loaders. This is the preferred method as it minimises compression effects of the heavy equipment that is often necessary for economical transport of soil material;
- The surface of soil stockpiles will be left in as coarsely textured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming;
- Where possible, a maximum stockpile height that prevents biological and structural degradation will be maintained. Clayey soils will be stored in lower stockpiles for shorter periods of time compared to soils that have a coarser texture;
- Free-draining stockpiles will be created to minimise the formation of anaerobic zones. Stockpiles will be formed in a chevron profile with batters graded to achieve slopes approaching 18°, where practicable;
- If long-term stockpiling is planned (i.e. greater than 12 months), stockpiles will be seeded and fertilised. An annual cover crop species that produce sterile florets or seeds will be sown. A rapid growing and healthy annual pasture sward provides sufficient competition to minimise the emergence of undesirable

weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil;

- Prior to re-spreading stockpiled topsoil onto re-graded overburden or other disturbed areas (particularly onto designated tree seeding areas), an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and / or scalping of weed species prior to topsoil spreading; and
- Topsoil will be spread to a minimum depth range of 0.1 m (steep slopes) to 0.2 m (flatter areas). Soil re-spreading on steep slopes at depths exceeding 0.1 m can be deleterious because of the "sponge" effect which can cause slippage of the topsoil from the slope. Flat areas will be topsoiled at a minimum depth of 0.2 m.

25.1.9.3 *Topsoil Respreading and Seedbed Preparation*

Suitable topsoil will be re-spread directly onto reshaped disturbance areas. Where topsoil resources allow, it will be spread to a nominal minimum depth range of 0.1 to 0.3 m on all rehabilitation areas. Specific topsoil respreading depths for different post mining landform elements will be specified in the Project's TMP and ESCP.

The spreading of topsoil, addition of soil ameliorants and application of seed will be carried out in consecutive operations to reduce the potential for topsoil loss to wind and water erosion.

Thorough seedbed preparation will be undertaken to ensure optimum establishment and growth of vegetation. All topsoiled areas will be lightly contour ripped (after topsoil spreading) to create a bond between the soil and the subsoil/capping materials. Ripping will be undertaken on the contour and the tynes lifted for approximately 2 m every 200 m to reduce the potential for channelised erosion. Ripping will be undertaken when soil is moist and immediately prior to sowing for best results. The respread topsoil surface will be scarified prior to, or during seeding, to reduce run-off and increase infiltration.

Some of the soils in the Project site exhibit sodic properties. Sodic soils are not optimal for rehabilitation works as the clay particles tend to disperse and swell producing poor physical soil conditions. These conditions include water-logging and hard-setting crusts which in turn negatively affect infiltration rates, plant-available water capacity, seedling emergence, and root development. Topsoil resources for rehabilitation works have been selected to minimise potential soil sodicity effects (Volume 2, Section 5). For some soils, the application of soil ameliorants that decrease soil dispersibility and increase soil aggregate stability will be an important soil rehabilitation management tool.

Soil organic matter increases soil aggregate stability and adding carbon as a soil ameliorant will improve soil structure. Carbon ameliorants such as mulch will be beneficial for rehabilitated landforms within the Project site. Organic amendments will supplement elevated organic carbon levels in the Project site's soils to improve structural stability. Fertiliser additions will be undertaken upon routine receipt of soil test results during a proposed progressive soil testing program.

The soils within the proposed disturbance areas are mildly acidic to alkaline. Given that the Project falls outside "low-lying coastal areas" in accordance with State Planning Policy 2/02 - Planning and Managing Development Involving Acid Sulphate Soils (Department of Infrastructure and Planning, 2002), an assessment of the risk of acid sulphate soils was not undertaken during the site's soil survey.

25.1.9.4 Erosion and Sediment Control

Erosion potential of the 10 soil management units (SMUs) situated on the Project site is described in Volume 2, Section 5.1.3.1. Some of the SMUs have the potential to exhibit severe sheet and gully erosion and will need to be carefully managed.

A detailed ESCP will be developed prior to the commencement of construction works. The principle objectives of the ESCP will be as follows:

- To minimise erosion and sedimentation from all active and rehabilitated areas, thereby minimising sediment ingress into surrounding surface waters;
- To ensure the segregation of 'dirty' water (surface runoff from disturbed catchments (e.g. active areas of disturbance, stockpiles and rehabilitated areas (until stabilised)) from clean water (surface runoff from catchments that are undisturbed or relatively undisturbed by project-related activities and rehabilitated catchments), and maximise the retention time of dirty water such that any discharge from the Project site meets the relevant water-quality limits;
- To minimise the volume of water discharged from the Project site but, should the discharge of water prove necessary, ensure sufficient settlement time is provided prior to discharge such that suspended sediment within the water meets the objectives identified in the point above;
- To manage surface flows upstream of the Project site so that rehabilitation and coal mining activities are not affected by flooding. Clean water diversion channels and creek diversions will be constructed prior to commencement of mining;
- To prevent erosion of the ephemeral watercourses that traverse the site;
- To develop sustainable long-term surface water features following rehabilitation of the site, including implementation of an effective re-vegetation and maintenance program; and
- To monitor the effectiveness of surface water and sediment controls and to ensure all relevant surface-water quality criteria are met.

One of the primary design aspects of the Project is the prevention of clean water in ephemeral drainage channels entering the active disturbance area. This will be achieved through the use of levees, cut-off drains, dams and diversions, as well as the containment of dirty water in sediment dams within the active areas of the Project to limit any uncontrolled runoff.

Effective erosion and sediment control for the Project site will require appropriate activities to be carried out over the life of the Project including:

- Construction;
- Operations; and
- Rehabilitation and Closure.

The effectiveness of erosion and sediment controls during the operational and closure stages will be optimised through effective mine planning and design. Suitable strategies will include:

- Designing and operating drainage systems for the life of the mine so that they do not cause erosion. This will involve scour protection and energy dissipaters located at outlets;
- Designing the final mine geometry to create a landform that allows free drainage of surface runoff while minimising erosion. This includes designing an appropriate drainage system that avoids erosion;
- Staging open cut mining to minimise the operational area exposed at any one time. This helps to reduce the potential for erosion and the extent and capacity of erosion and sediment control measures required, especially where the operational area has the potential to drain to a waterway; and

- Stormwater reuse as part of the overall water-management strategy for the site to avoid or reduce discharge of contaminated water. A range of non-potable water uses will be available on the mine site such as dust suppression, process water and irrigation of tree plantings.

The proposed water management system for the Project is described in Volume 2, Section 11 and Volume 5, Appendix F.

Where practical, it is proposed to segregate water within the mine site according to its quality to minimise the stored volumes of water with high concentrations of contaminants. This would allow containment of water requiring treatment (e.g. settling suspended sediment) and water suitable for direct discharge (e.g. undisturbed catchments) to be diverted.

The clean surface water systems comprise:

- Diversion of Lagoon Creek and Sandy Creek around the mine site;
- Clean water catch drains to divert minor catchments around the mine site, where practical; and
- Highwall dams and levees upslope of the pit to reduce inflows and velocities from undisturbed catchments.

'Dirty' water runoff from disturbed areas will be captured in sediment dams to allow suspended solids to settle. The Proponent proposes to utilise water in the process and also have the ability to release this captured water to Lagoon Creek when water quality discharge criteria have been met.

Sediment dams will allow time for coarse sediments to settle and, if necessary, allow a flocculent to be added to remove fine or dispersive sediment to meet allowable turbidity discharge limits.

Sediment dams will be provided to intercept as much runoff from the overburden dump as practical. The eastern portion of the overburden dump drains east, and sediment dams will intercept dirty runoff before it reaches Lagoon Creek. The eastern sediment dams overflow to a drain running along the western side of the main haul road. The overflow drain discharges to a final sediment dam, which can discharge to Lagoon Creek when conditions are met. The western portion of the overburden dump drains to the pits, and sediment dams have been provided to intercept dirty runoff before it reaches the pit. Water captured in the western sediment dams (SD11 to SD20) will be pumped back to the eastern sediment dams. However, the western sediment dams will overflow to the pit during large storm events (Volume 2, Section 11).

A total of 21 sediment dams are proposed to manage runoff from the site over the life of the Project. The proposed sediment dam locations have been selected so that runoff from disturbed areas will be intercepted and appropriately managed before release into the creek system.

25.1.10 Re-vegetation

25.1.10.1 *Re-vegetation Program Implementation*

A revegetation strategy is proposed for the Project disturbance area that seeks to compliment desirable post-mining land use objectives whilst maintaining effective erosion and weed controls.

Re-vegetation activities will be scheduled to occur after the completion of reshaping, re-topsoiling and drainage works. Where possible, the timing of these works will enable a preferred seasonal sowing of pasture and tree seed in autumn or spring.

On prepared surfaces, selected tree, shrub and pasture species will be sown using seed stock and/or planted depending on the species, slope gradients and area to be revegetated. Tree and shrub species will be established at a density and richness consistent with the nominated post-mine ecosystem.

25.1.10.2 *Species Selection*

Plants selection for areas to be returned to bushland will focus on those species that will successfully establish on the available growth medium, species that that will bind the soil and species that will result in a variety of structure and food/habitat resources, with an aim to establishing woodland to open forest. Native species will be established through direct seeding or planting of tube stock/nursery-raised stock from local propagules. Seed will be collected from site where possible to ensure it is adapted to environmental conditions in the area.

Prior to application, some of the tree seed (e.g. Acacia spp) will be appropriately pre-treated in order to break dormancy restrictions to promote earlier germination, develop more robust seedlings, wider and more uniform germination and increased germination rates.

Tree and shrub establishment on site will be dominated by the direct seeding method, a proven technique used at coal mines in the nearby Bowen Basin. A proposed tree, shrub and groundcover mix, based on the species list from the flora assessment (Volume 2, Section 9) is provided in Table 25-3. The species dominate the Project area's vegetation communities and represent a combination of canopy, sub-canopy, shrub, lower shrub and groundcover strata.

Table 25-3: Recommended Native Species Mix

Scientific Name	Common Name
Acacia harpophylla	Brigalow
Eremophila latrobei	False Sandalwood
Carissa ovata	Currant Bush
Eucalyptus melanophloia	Silver-leaved ironbark
Petalostigma pubescens	Quinine Bush
Eucalyptus populnea	Poplar Box
Carissa ovata	Currant Bush
Triodia mitchelli	Soft Spinifex
Aristida calycina	Dark Wiregrass
Callitris glaucophylla	White Cypress Pine
Panicum decompositum	Native Millet
Artistida latfolia	Feathertop Wiregrass
Eucalyptus melanophloia	Silver-leaved Ironbark
Eucalyptus populnea	Poplar Box
Acacia cambagei	Gidgee
Carrisa ovata	Current Bush

Eucalyptus camaldulensis	Red River Gum
Sporobolus caroli	Fairy Grass
Pennisetum cillare	Buffel Grass
Melaleuca tamariscina	Weeping Bottlebrush
Calytrix microcoma	Desert Star Flower
Triodia pungens	Soft Spinifex
Eucalyptus thozetiana	Thozet's Box
Eremophila mitchelli	False Sandalwood
Eremophila latrobei	Crimson Turkey Bush
Carissa ovata	Current Bush
Acacia shirleyi	Lancewood
Eucalyptus similis	Queensland Yellowjacket
Triodia pungens	Soft Spinifex
Heteropogon contortus	Black speargrass

A combination of native and introduced pasture species will be used on the bushland sites to ensure the quick establishment of a continuous groundcover, thereby reducing the risk of erosion. Legumes may also be selected to assist in the supply of bio-available nitrogen to the soil. If the use of introduced grasses and/or legumes is deemed necessary for erosion control in the bushland areas, pasture seed and fertiliser will be applied at a lower rate than for pasture outcomes to reduce competition with tree seed and/or seedlings. Native and exotic pasture species (warm season perennial, cool season perennial, yearlong green perennial and annual) will be sown where the risk of erosion is less and on the more protected aspects of landforms. Introduced, stoloniferous grass species (e.g. Rhodes Grass, Indian Couch) will be sown on the steeper slopes as their growth habit provides more extensive coverage in a shorter time.

Aerial sowing and ground broadcasting will be conducted for both tree and pasture seed as the preferred sowing methods and grazing will be restricted whilst the vegetation is establishing.

All revegetated areas will be monitored to ensure long-term groundcover establishment and success. Revegetation techniques will be continually developed and refined over the life of mine through an ongoing process of monitoring at the site and recognition of other industry experiences.

25.1.10.3 *Special Treatment Areas*

Additional erosion control measures such as the application of 'hydromulch' will be considered, particularly in drainage lines and steeper batter areas e.g. infrastructure "cut and fill" batters. For example, sugar cane mulch as slurry provides cover for the soil to improve pasture growth, modifying the soil surface to control erosion, or a combination of both. Securely pressed against the surface of the soil, the mulch provides a high degree of erosion control and improves moisture availability to establishing pasture. The mulch also has the effect of protecting the soil surface against raindrop impact, improving the micro-environment for seed germination and establishment by reducing evaporation losses, and assisting in the control of surface erosion caused by raindrop impact and overland water flow.

25.1.11 Tailings Storage Facility Rehabilitation

25.1.11.1 *External embankment slopes*

The proposed concept of rehabilitation of the external slopes of the TSF embankments is to establish naturally occurring halophytic vegetation without cultivation or irrigation. This will be achieved by developing a select fill layer on the outer face of the embankments and covering it with a layer of approximately 0.2 m of topsoil. The external slopes will be designed to allow access for any future planting and maintenance and to comply with regulatory requirements. Rock armouring will also be considered if necessary to prevent excessive slope erosion.

25.1.11.2 *Surface capping*

Efficient management of the Project TSF will require progressive rehabilitation of the storage surface area. Rehabilitation of a particular cell will only start once the tailings discharge operation is complete within that cell (Volume 2, Section 16). Rehabilitation will be progressive with works to start on the first available cell once tailings disposal ceases and sufficient drying out has occurred

Capping trials are expected to be undertaken in the initial TSF cell after five years of operations. Specific areas will be established for conducting the trials under site specific conditions. The aims of the capping trials will be to optimise the rehabilitation design (capping thickness, type of materials and drainage measures). The purpose is also to investigate various growing methods and vegetation species. Design of the rehabilitation works for both the external batter slopes and over the surface area of the TSF, including capping, landforms and drainage will be evaluated further at the detailed design stage.

25.1.12 Weed Management

The presence of weed species has the potential to be a major impact on revegetation and regeneration activities. In addition to this, the presence of weed species within the surrounding land has the potential to significantly decrease the value of the native vegetation. Weed management will be a critical component of mine rehabilitation and landscape reconstruction.

Weeds will be managed across the site through a series of control measures, including:

- Hosing down at risk mine vehicles and equipment in a wash down area before and after entry to site;
- Scalping weeds off topsoil stockpiles prior to re-spreading topsoil;
- Regular inspections of rehabilitation to identify potential weed infestations; and
- Identifying and spraying existing weed populations on-site together with ongoing weed spraying over the life of the mine.

The spread of weeds will be managed by using the measures above. The monitoring and control of weed populations using herbicides within the site, particularly in the areas to be stripped and on topsoil stockpiles, will assist.

Weed control, if required, will be undertaken in a manner that will minimise soil disturbance. Any use of herbicides will be carried out in accordance with appropriate requirements to minimise the risk to downstream water quality. Records will be maintained of weed infestations and control programs will be implemented according to best management practice for the weed species concerned.

25.1.13 Rehabilitation Success Criteria

Preliminary success criteria (or closure criteria) for the rehabilitation of the mine areas have been provided in the Environmental Management Plan (Volume 5, Appendix P). 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 handed back to stakeholders in a productive and sustainable condition.

The success criteria have been developed to 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 bushland and grazing. For each element, standards that define rehabilitation success at mine closure are provided. Based on the generic indicators, each criterion will be further developed to be specific, measurable, achievable, realistic and outcome based, and to reflect the principle of sustainable development. The further development of each criterion will be based on results of research, monitoring of progressive rehabilitation areas and risk assessments. The success criteria will be reviewed every 3 to 5 years with stakeholder participation to ensure the criteria remain realistic and achievable.

25.1.14 Rehabilitation Monitoring

Regular monitoring of the rehabilitation will be required during the vegetation establishment period, to demonstrate whether the objectives of the rehabilitation strategy are being achieved and whether a sustainable landform has been provided.

In addition to rehabilitated areas, 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 that the Project site must replicate.

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 proposed rehabilitation monitoring programme details are provided in the Environmental Management Plan (Volume 5, Appendix P). Monitoring of the rehabilitated areas will broadly involve the following:

- Ongoing chemical analysis of topsoil;
- Comparison of soil erosion rates and rill and gully dimensions with measurements taken from reference sites;
- Comparison of vegetation measurements with measurements taken from reference sites;
- Ongoing analysis of water quality parameters in accordance with the development consent and environmental protection licence conditions from data collected monthly at water storages, ramps and pits, sedimentation dams and sewage effluent outfalls on-site, and continually from creeks (upstream and downstream of mine); and

- Visual surveillance including the use of digital photogrammetry / low level oblique or vertical aerial photography to monitor changes over time in the rehabilitation (e.g. changes in vegetation structure, erosion rates and landform drainage).

More specifically, monitoring of specific parameters will be undertaken to determine the level of achievement of success criteria.

25.1.15 Rehabilitation Maintenance

Maintenance of rehabilitated areas will be undertaken where necessary and in response to results of the monitoring program, to ensure success criteria are met, or in the case of progressive rehabilitation, are projected to be met at the time of mine closure. Depending on the criteria to be achieved, examples of maintenance works could include re-seeding or planting of tube stock of tree and/or shrub species to meet required revegetation parameters and implementation of erosion protection measures to reduce erosion rates.

Post-mining surveys of the rehabilitation will be undertaken across the site to determine whether the site meets success criteria and whether this result is being maintained over time. Once this occurs and the site is relinquished, the land will be returned to the relevant stakeholders and maintenance of the rehabilitation will no longer be required.

25.2 Infrastructure Decommissioning and Closure

25.2.1 Decommissioning of Infrastructure, Plant and Buildings

25.2.1.1 Site Preparation

Prior to the commencement of any demolition works on the site the following activities will be undertaken:

- All sumps will be dewatered and the excess coal material removed from around the coal handling and preparation plant (CHPP);
- All items will be decommissioned, de-oiled, depressurised and isolated; and
- All hazardous materials will be removed and disposed of to appropriately licensed facilities.

25.2.1.2 Site Services

All services including power, water, data and telephone for the entire 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. Switch room buildings will be disconnected and demolished. The substations will be removed from the site and either used on another project or sold as a going concern.

25.2.1.3 Infrastructure and Buildings

All sumps will be dewatered and the excess coal removed prior to the commencement of demolition. In addition all items of equipment will be de-oiled, degassed, depressurised and isolated and all hazardous materials removed from the site.

All buildings, including the main administration building, workshop, CHPP and fixed plant (including stacker / reclaimers, conveyors & gantries, transfer points, thickener tank, coarse reject hopper, vehicle wash, etc) will be required to be demolished and removed from the site. Where possible assets may be re-used or sold to other mines.

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 either being taken to a licensed landfill or buried in the backfill of the final voids (if appropriate). Only inert wastes will be placed in the backfill.

The bitumen roadways, car parks and hardstand areas around the CHPP, workshop and administration areas will be ripped up with the inert waste material being placed in the open cut voids and buried.

25.2.1.4 Contaminated Land

At closure, a preliminary sampling and analysis program (Phase 1) will be implemented to determine whether an assessment (Phase 2 – detailed investigation of contamination involving drilling, etc) should be conducted to quantify the amount of contaminated material that will need to be bio-remediated on site.

25.2.2 Bulk Earthworks and Site Rehabilitation

25.2.2.1 Infrastructure, Plant and Buildings

The carbonaceous material on the base of the run of mine (ROM) and product stockpile areas will be stripped to a depth of at least 0.5 m and buried in the low wall of the open cut void. Where possible the material will be considered for reprocessing before the CHPP goes off line.

The entire CHPP and infrastructure areas will be dozer trimmed to facilitate the appropriate drainage of surface runoff from the site. Appropriate surface water management structures (contour banks, drains and settlement ponds) will also be constructed. The site will be rock raked to remove all surface rocks to a size of less than 500 mm and ripped to a depth of at least 1 m. Fertiliser and pasture/tree seed will be applied to assist establish pasture post-mine land use.

25.2.2.2 *Hardstand and Haul Roads*

Contaminated, carbonaceous or unsuitable (gravel, etc) material will be removed from the haul roads and hardstand surfaces and disposed of and covered in the low wall area. Minor dozer reshaping work will be undertaken to ensure surface level consistency with the surrounding areas. Any creek crossings (i.e. culverts, etc) will be removed and the pre-existing drainage line re-instated (where applicable). The site will be rock raked to remove all surface rocks to a size of less than 500 mm and ripped to a depth of at least 1 m. Fertiliser and pasture/tree seed will be applied to assist establish pasture post-mine land use.

A light vehicle access road is to be maintained to enable inspections of the site following closure of the mine. All roadside markers (tyres and guideposts) and signs are also to be removed from within the area once mine closure activities within the pit area have been completed.

25.2.2.3 Dams and Surface Water Features

All sedimentation dams which assist in the water flow from the final rehabilitated surface will be retained following mine closure. The other dams will be removed and the original drainage paths re-established, wherever possible.

The TSF cap will be designed and constructed so that the surface will be free draining. The tailings will be capped with a layer of compacted clay or similar impermeable substance over which a layer of free draining material will be placed. Topsoil will then be used to resurface the area which will then be revegetated. This will inhibit ponding and infiltration thus reducing potential leachate.

25.2.3 Void Management

Following closure of the site, several key environmental issues will be considered for the long term management of the void. The areas are outlined below.

25.2.3.1 Objectives

The primary objectives of the void management strategy are to:

- Propose mitigation measures to minimise potential impacts associated with the final void;
- Propose measures for the management and monitoring the potential impacts of the void over time; and
- Present options for the final land use of the void following the completion of mining.

25.2.3.2 Final Void Management

Void Water Quality

Final void modelling (Volume 2, Section 12) will allow for predictions of the water quality within the void. Conceptualisation indicates that the final void will act as a sink based on negative climate balance, thus the risk of impacting the regional groundwater system is considered negligible. Once this modelling is complete, actions will be taken during the closure process regarding the control of external sources of water into the void. Risks of decant and uncontrolled discharge to the surface water system will be assessed and managed.

The following aspects will be considered with respect to assessing final void water quality:

- Stratification of water column (pseudo static pit water level);
- Concentration of dissolved salts resulting from runoff, direct rainfall, groundwater ingress, and evaporation;
- Control of surface flow into the void;
- Determination of recharge rates through the backfill /spoil;
- Groundwater inflows; 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. Depending on the agreed final void use, an ongoing water monitoring program will be instigated to confirm the modelled outcomes.

Void Slope Stability – Low Wall

Stability of the low wall will be achieved through implementing the following:

- The low wall will be battered back from the angle of repose to ensure that long term geotechnical stability of the face. Determination of geotechnical stability will be based on an assessment of the spoil material, the likely degree of settlement, and the degree of weathering expected in the long term. Subject to this assessment the sides of the final void will be battered back to 17° where required;
- Drainage on and over the low wall will be minimised through the construction of drainage control structures;
- Erosion of the low wall will be controlled by limiting the length of slope, minimising the degree of slope, and by the establishment of suitable vegetation;
- Battering of the low wall against the bottom of the high wall will enhance stability; and
- Benching of the spoil material may need to be considered in some areas in order to achieve geotechnical stability and to minimise erosion.

Void Slope Stability – High Wall

To ensure the safety of the final void, the surrounding final slopes will be left in a condition where the risk of slope failure is minimised.

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, further investigations will be undertaken to confirm the criteria above and appropriate action will be taken to ensure effective long term safety, stability and management of the void.

Spontaneous Combustion

While spontaneous combustion may not occur at the site, it has been included for reference as it is often an issue associated with final voids.

Spontaneous combustion above ground commonly occurs in waste dumps containing reject coal material, in unconsolidated heaps where oxygen can come into contact with the coal and heat can't dissipate. The problem is compounded when rainfall events cause erosion, progressively exposing the coal. Spontaneous combustion may also occur in the coal seams exposed in the remaining highwall of the final void.

The following will be undertaken to reduce the potential for spontaneous combustion to occur:

- Accumulations of coal material, particularly pyritic, will be buried under inert spoil;
- Any remaining coal spalling will be removed from the highwall where possible;
- If any coal on the highwall face is prone to spontaneous combustion, it will be sealed with water, clay or inert soil where possible; and
- Should any outbreaks of spontaneous combustion occur in the final void, details on the materials involved, presence of pyrites, location, date, time and climatic conditions will be recorded. This will be undertaken as part of the ongoing inspection and monitoring post closure of the mine.

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 to low walls and high walls.

Surface water flow can cause slope deterioration and ultimate failure. Drainage will be directed away from the highwall face through the construction of interceptor channel drains around the perimeter of the highwall and spoon drains will be utilised on the upslope side of all benches. Water will then be directed to the void in a controlled manner. This will allow voids to only collect water direct from rainfall and runoff from rehabilitated areas through the surface water management system.

Drainage over the low wall will be minimised through constructing surface water diversions, and drainage on the wall will be limited and controlled to reduce the erosion potential.

The regraded low wall area will be stabilised with structural soil conservation earthworks (banks, drains, drop structures, etc), and vegetation endemic to the area. Pasture establishment will provide sufficient ground cover to minimise low wall erosion.

Low wall slopes with gradients of 17° or less will be sown conventionally via ground broadcasting. Low wall slopes exceeding 17°, and where structural soil conservation earthworks cannot be used, will be hydromulched to enhance the surface stability of the slopes by hastening vegetative germination and establishment.

Safety

At mine 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 and low wall can induce failures or mass movement. To ensure the stability of the high walls and low walls they will be battered back to a stable slope angle as required;
- Exposed coal seams will be covered with inert material to prevent ignition either from spontaneous combustion, bush fires or human interference;
- 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 m safety berm, as well as a 2.1 m 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 m intervals along the safety fence;
- Surface runoff from land surrounding the void will be diverted from entering the void so as to prevent flooding of the pit and potential development of instability of the void 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.

25.2.3.3 Final Void Use

Final voids represent a potential danger to people, native wildlife and stock, as well as a possible source of environmental contamination from water accumulation.

Subject to an additional environmental assessment and an associated mining application, continued open cut mining may be a viable future use. The highwall may also be considered as an underground mine entry point for future mining. Should mining be discontinued at year 30, the final void will be left in a safe condition where backfilling is not reasonably practical. Available options for post mining land use are mainly determined by the location and nature of the void.

Long term mine planning will seek to infill the void with overburden, reject and tailings to the maximum practical extent, however the void will remain at the end of mine life. Final voids will essentially serve to negate potential for downstream pollution and will potentially form a water storage facility that may be suited to limited stock use.

25.2.4 Post Closure Monitoring and Management

Following closure of the mine the existing environmental monitoring program will be maintained until all decommissioning and rehabilitation works have been completed. Notwithstanding this, there may be the need to establish some additional monitoring sites depending on the nature of the decommissioning works and also in response to finding possible sources of pollutants to the environment.

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