ENVIRONMENTAL ASSESSMENT

Duralie Extension Project

SECTION 5
REHABILITATION

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5 REHABILITATION

This section summarises the approach to rehabilitation and landscape management for the Project. It provides a detailed description of the proposed rehabilitation/mine closure strategy for the DCM and describes how this strategy would be integrated with the offset proposal (Section 4.8.3).

Appendix N presents a detailed description of the proposed integrated approach to rehabilitation, including a Final Void Management Plan.

The results of rehabilitation initiatives undertaken to date at the DCM are documented in the AEMR and the MOP in accordance with the DII-Minerals & Energy's Mining, Rehabilitation and Environmental Management Process (MREMP). The MOP would continue to be periodically reviewed and updated over the life of the Project to incorporate the rehabilitation concepts and activities.

5.1 REHABILITATION STRATEGY AND GOALS

Rehabilitation of the existing DCM is undertaken progressively and has the following general principles:

- to create physically and chemically stable landforms which are consistent with the local surrounding environment;
- to minimise land disturbance through progressive rehabilitation and mine planning;
- to provide visual amenity through tree and shrub establishment, mounding and/or bunding;
- to create flora and fauna corridors and habitats;
- to establish permanent, self-propagating vegetative cover; and
- to achieve final land uses that meet community and regulatory expectations and infrastructure needs in consideration of the pre-mining land use (i.e. predominately grazing) and conservation values.

The above principles would continue to be applied for the Project. Table 5-1 describes short-term, medium-term and long-term objectives that describe how the site would be progressively rehabilitated and integrated into the landscape. The rehabilitation and revegetation concepts for the Project described in this section build upon, and are consistent with, these objectives.

5.1.1 Existing Duralie Coal Mine Rehabilitation

Rehabilitation activities at the DCM to date have focused on the southern portion of the existing out-of-pit waste rock emplacement. Approximately 16 ha of the waste rock emplacement have been rehabilitated, with a further five hectares shaped, dressed with topsoil and seeded (Plate 5-1). In addition, DCPL has also planted vegetation screens at strategic locations to assist with the screening of mine landforms and infrastructure.

5.1.2 Stratford Coal Mine Rehabilitation

Rehabilitation at the SCM commenced in 1995 and is relatively more advanced than the rehabilitation conducted to date at the DCM. The performance of the SCM rehabilitation areas provides a relevant indication of the likely performance of the Project rehabilitation because:

- the DCM and SCM are owned by the same parent company, GCL, and therefore, operate with the same rehabilitation principles (including progressive backfill and direct topsoil placement);
- similar climatic conditions given SCM is located only approximately 20 km to the north;
- similar rehabilitation land use objectives of native vegetation with cattle grazing;
- similar revegetation species;
- similar water management objectives, including irrigation of rehabilitated areas; and
- similar design parameters for final landforms (e.g. batter slopes and water management concepts).

Rehabilitation at the SCM currently includes some 182 ha of rehabilitation to pasture and 13 ha rehabilitation to woodland. Photographs of the SCM rehabilitation shown on Plate 5-2 provide an indication of what the DCM could look like following the implementation of the rehabilitation strategies described in this section.

Table 5-1
Short-term, Medium-term and Long-term Rehabilitation Objectives

Short-term Objectives	Medium-term Objectives	Long-term Objectives
• Minimisation of disturbance areas. • Conservation of sufficient soil resources for rehabilitation via appropriate soil management. • Provision of sediment control measures. • Rapid stabilisation of newly constructed infrastructure by topsoiling, seeding and fertilising. • Appropriate waste rock management including delineation and controlled placement of rock wastes on the basis of acid forming potential. • Recovery of items suitable for providing alternative habitat for displaced fauna (e.g. tree hollows). • Progressive backfilling of the open pit. • Direct placement of topsoil resources where areas on the waste rock emplacement are available for topsoil application.	• Creation of landforms which are geotechnically stable and visually consistent with the surrounding environment. • Minimisation of erosion through the design and construction of contour drainage and additional sediment control dams. • Appropriate selection of tree and pasture species for progressive rehabilitation. • Encouragement of seed propagation through placement of topsoil, utilisation of soil ameliorants as required (e.g. gypsum, lime), seeding and fertilising. • Evaluation of availability of soil resources for rehabilitation completion by routinely calculating a soil balance. • Improvement of habitat in rehabilitated areas through noxious weed management, feral animal control and restriction of cattle and vehicle access. • Revegetation monitoring with remediation where monitoring indicates the need.	• Creation of landforms which are geotechnically stable and visually consistent with the surrounding environment. • Creation of final land use of grazing and woodland habitat. • Reconstruction of Coal Shaft Creek using design principles which provide for long-term stability including a stable vegetative covering. • Management of cattle through fencing to allow controlled grazing within particular rehabilitated areas. • Provision of access tracks for light vehicles, tractors, etc. • Retention of water management infrastructure for use as agreed with the relevant landholders. • Decommissioning of sediment control structures if they are no longer serving an ancillary purpose (e.g. stock watering). • Gradual removal and decommissioning of redundant site infrastructure. • Maintenance of the quality of surface water runoff to appropriate standards. • Revegetation monitoring with remediation where monitoring indicates the need.

Source: After Appendix N.

5.2 REHABILITATION OF THE PROJECT

This section summarises the rehabilitation concepts for mine landforms described in Appendix N. At the completion of mining the key final landforms and features at the DCM would include the following:

- Weismantel Extension and Clareval North West open pit voids;
- integrated in-pit and out-of-pit waste rock emplacement landform;
- reconstructed Coal Shaft Creek;
- water management infrastructure; and
- site infrastructure areas (e.g. administration and workshop buildings).

The following sub-sections describe the rehabilitation concepts for key mine landforms, and the details of the planned rehabilitation concepts for each landform.

5.2.1 Weismantel Extension and Clareval North West Open Pits

As discussed in Section 2.9, at the cessation of mining, final voids would remain in the Clareval North West and Weismantel Extension open pits. The approximate depths and areas of the final voids are provided in Table 2-2 and the location of the two voids is shown on Figure 5-1.

Following cessation of Weismantel Extension open pit mining activities, the remaining final void would be used to store mine water. Following the completion of mining activities at the DCM, it would be expected that the Weismantel Extension final void would continue to fill until an equilibrium level is reached. The filling behaviour of the Weismantel Extension final void is discussed below.

A Duralie Coal Mine Waste Rock Emplacement Revegetation Looking North-West

B Duralie Coal Mine Waste Rock Emplacement Looking North-East

C Duralie Coal Mine Waste Rock Emplacement Revegetation Looking North

D Duralie Coal Mine Waste Rock Emplacement Revegetation Looking West

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PLATE 5-1

Duralie Coal Mine Rehabilitation

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Stratford Coal Mine Rehabilitation -
Examples of Duralie Extension Project Rehabilitation Concepts


Stratford Waste Rock Emplacement Looking South-East - Rehabilitation to Grazing and Woodland


Stratford Eastern Emplacement Looking East South-East (Water Dam) - Rehabilitation to Grazing


Stratford Eastern Emplacement Looking North - Rehabilitation to Grazing


Stratford Waste Rock Emplacement Looking South - Rehabilitation to Grazing and Woodland


Stratford Waste Rock Emplacement - Rehabilitation to Woodland


Stratford Waste Rock Emplacement - Rehabilitation to Grazing and Woodland

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PLATE 5-2

Stratford Coal Mine Rehabilitation

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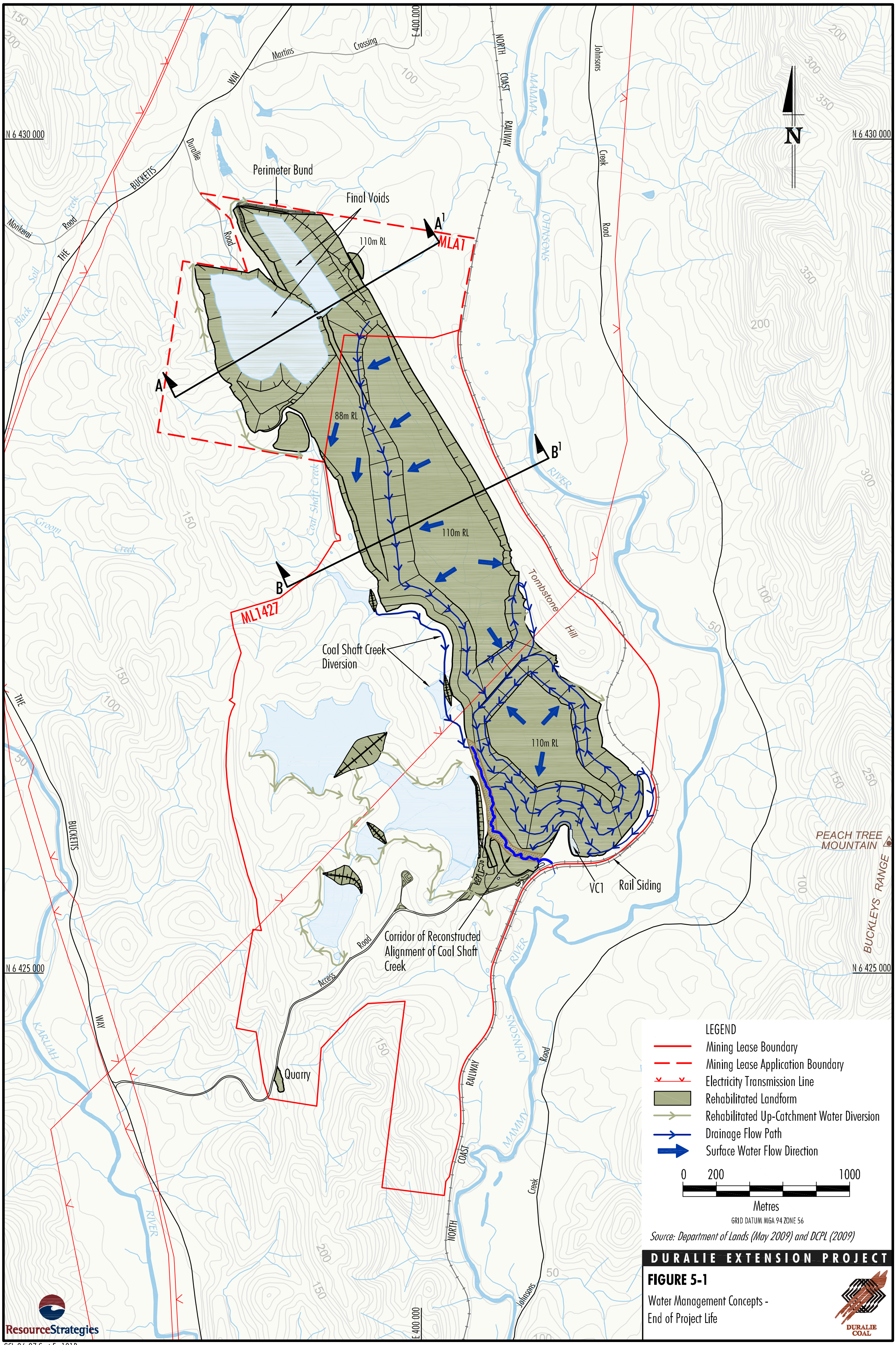

Source: Department of Lands (May 2009) and DCPL (2009)

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FIGURE 5-1

Water Management Concepts - End of Project Life

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In addition to the mining of the Weismantel Extension open pit, the Project would also include mining of the Clareval North West open pit. Development of the Clareval North West open pit would commence by approximately in Year 2 of the Project and would occupy the western portion of MLA 1 (Figure 2-5).

Similar to the Weismantel open pit, the Clareval North West open pit would be progressively backfilled with waste rock as the open pit is developed, with a final void remaining to the north. The integrated final rehabilitated landform is shown on Figure 5-1 and comprises the abovementioned final voids, and the rehabilitated backfilled open pits integrated with rehabilitated out-of-pit waste rock emplacements.

Inflows to the final voids would comprise incident rainfall, runoff and groundwater (including waste rock emplacement infiltration).

The surface catchment of the final voids would be reduced to a minimum by the use of upslope diversions and contour drains around their perimeter. A final void water balance model was developed in Appendix A for the combined final voids to predict the long-term behaviour of the final void pit lake.

The results of the water balance for the final voids indicate that the voids would slowly fill over time and would become an integrated pit lake approximately 40 years post-mining. Water levels would continue to rise for up to 120 years post-mining before reaching an equilibrium level at approximately RL 80 m (Appendix A).

Appendix B indicates that the pit lake would act as a flow-though system. To the east of the mine footprint, natural groundwater flow would be restored to a dominant southerly direction. Within the mine disturbance areas, preferential flow would occur in a south-southeast direction. There would be no deleterious effect on the groundwater resource or on the quality of groundwater, because water quality in the surrounding groundwater is in many cases of a poorer quality than what is predicted from the final void (Appendix B). Therefore it is not predicted that groundwater quality would be impacted by final void water quality after mining.

Figure 5-2 shows a cross-section through the Clareval North West open pit and the Weismantel Extension open pit final voids.

The following rehabilitation activities would be undertaken for the final voids:

- restriction of access via perimeter bunding, fencing and installation of signage;
- a geotechnical assessment would be undertaken to assess geotechnical stability and provide recommendations for the reshaping of final highwalls and endwalls; and
- vegetation screens would be established at strategic locations to provide visual screening and additional access control.

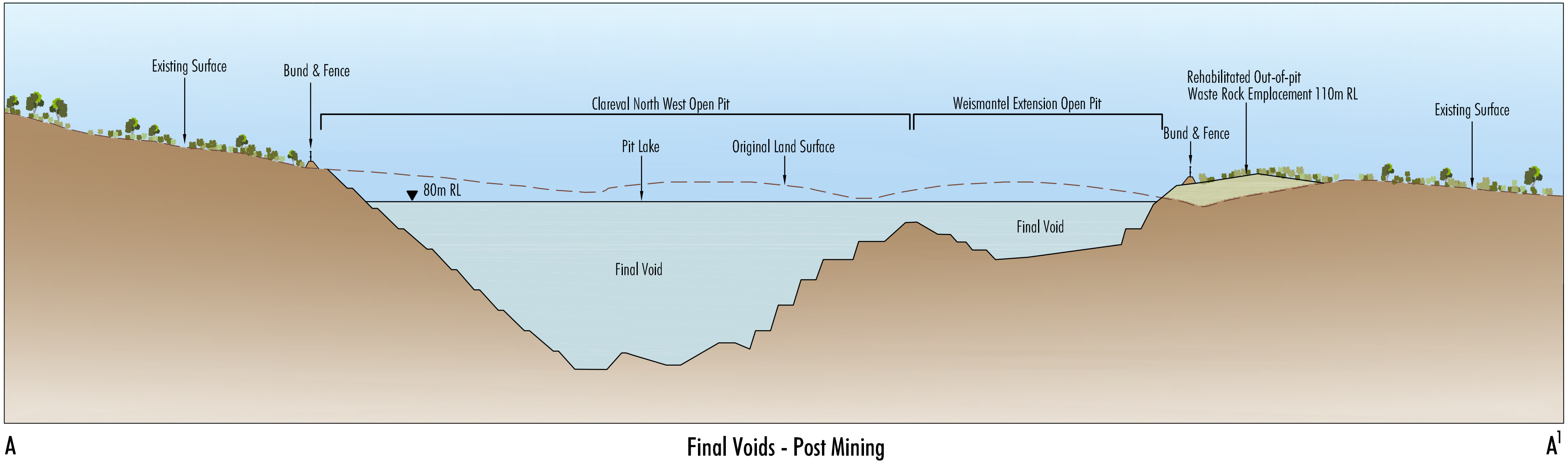
5.2.2 Waste Rock Emplacement

As described in Section 2.1.4, mined waste rock at the existing DCM is placed in the waste rock emplacement. The waste rock emplacement would continue to be developed for the Project. Similar to the existing situation, Project waste rock would be predominantly NAF, with some PAF material located mainly near the coal seam (Appendix I). The existing waste rock management methods would continue to apply for the Project (Section 2.7.2).

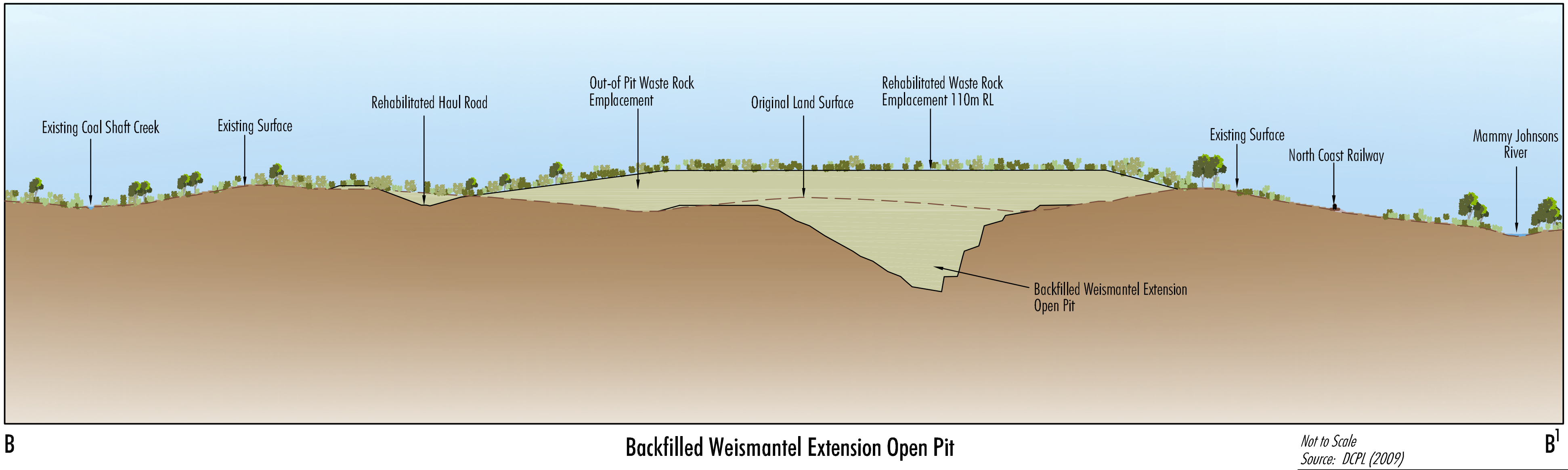
The final landform would consist of integrated in-pit and out-of-pit waste rock emplacements. The maximum height of the existing/approved waste rock emplacement of RL 110 m would be unchanged. The final landform would be of a similar scale to the existing Tombstone Hill. Figure 5-2 provides a cross-section showing the integration of the backfilled Weismantel Extension open pit and out-of pit waste rock emplacement.

The closure concept and rehabilitation strategy for the waste rock emplacement for the Project involves:

- management of PAF material in accordance with existing site practices (i.e. encapsulation within cells of low permeability material or placement of PAF material below the post-mining groundwater table);
- grading the final surface of the waste rock emplacement to blend in with the natural topography of the area, with an overall outer batter slope of 1V:4H;
- maintenance of operational erosion and sediment controls until establishment of stable final landforms;



Final Voids - Post Mining



Backfilled Weismantel Extension Open Pit

Not to Scale
Source: DCPL (2009)

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FIGURE 5-2

Typical Cross-Sections - Final Voids and Backfilled Open Pit

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- installation of drainage works (i.e. contour drains with a longitudinal grade 1% flattening to 0.6%) and ponds to channel runoff safely to constructed outlet areas; and
- progressive rehabilitation of outer batters.

Water Management

The post-mining water management strategy presented in the Duralie Coal EIS proposed re-establishing Coal Shaft Creek which would incorporate the final void as a permanent lake and construction of a channel linking the void to the river (Woodward-Clyde, 1996b). The currently proposed post-mining water management strategy is shown on Figure 5-1.

The top surface of the waste rock emplacement would be designed as an extension of Tombstone Hill and would generally drain towards the south to Coal Shaft Creek. Rock-lined channels would be installed along the edge of the top surface to provide a stable means for surface water runoff to drain from the top of the waste rock emplacement (Woodward-Clyde, 1996b).

Consistent with the Duralie Coal EIS (Woodward-Clyde, 1996b), on the batters of the waste rock emplacement, surface water runoff would flow perpendicularly down the slope to the toe of each batter where it would be re-directed by contour drains. The contour drains would be grass-lined, and would flow to the natural ground surface. Hydraulic control structures would be constructed to minimise erosion potential down the slope to the existing ground level (Woodward-Clyde, 1996b).

As part of development of the waste rock emplacement, waste rock would be placed against the Tombstone Hill ridgeline to the east of the waste rock emplacement area (Figure 2-8). In the northern portion of the waste rock emplacement, drainage from the eastern batter of the waste rock emplacement (total batter area 0.4 km^2) would drain eastwards towards Mammy Johnsons River (Appendix A).

Rock-lined channels (or other appropriate erosion control treatment) would be used at the base of the waste rock emplacement to direct runoff into natural creek lines (e.g. Coal Shaft Creek).

The existing sediment dams (and any new sediment dams constructed as part of the Project) downstream of the waste rock emplacement would be retained until the revegetated surface of the waste rock emplacement is stable and the runoff water quality is similar to runoff from similar landforms outside the mining leases.

In the long-term, it is possible that seepage of groundwater may occur from the rehabilitated waste rock emplacement. To prevent movement of undiluted water to Mammy Johnsons River during the recession of runoff events, consistent with the Duralie Coal EIS (Woodward-Clyde, 1996b), clay cut-off walls would be constructed along the southern end of the toe of the waste rock emplacement at the invert of the original Coal Shaft Creek channel and the main drainage channel and its banks would be engineered to reduce direct seepage out of the waste rock emplacement to negligible levels. These works would be undertaken in conjunction with the reconstruction of Coal Shaft Creek.

Revegetation

Similar to the SCM, the revegetation objective for the waste rock emplacement would be to provide areas of woodland and pasture on the waste rock emplacement surface and batters. The woodland areas would be linked to a broader habitat enhancement strategy as discussed in Section 4.8.3. In addition, trees would be established around the perimeter of the reprofiled waste rock emplacement to facilitate screening of potential views of the Project. Plate 5-2 shows the current status of the SCM revegetation and provides an indication of how the DCM revegetation is likely to develop with time.

An irrigation system has been installed on the existing rehabilitated areas on the waste rock emplacement. This system would be extended as rehabilitation progresses to the north over the life of the Project. It is anticipated that irrigation would assist with the early establishment of sown pasture and trees on rehabilitated areas.

As vegetation on rehabilitated areas becomes mature, the irrigation would be managed to allow vegetation to adjust to the natural rainfall regime that it would encounter after the irrigation is ceased following mine closure. Replacement of trees and fertilisation of rehabilitated areas would be undertaken should vegetation monitoring indicate the need.

Similarly, prolonged irrigation of mine water has the potential to elevate salinity levels in the rehabilitated waste rock emplacement. An assessment of the suitability of mine water for irrigation was undertaken by Agricultural Water Management (2009) (Attachment AB of Appendix A).

Agricultural Water Management (2009) noted that the waste rock emplacement is likely to have a greater permeability than the *in-situ* soils of the area, and is therefore likely to have less potential for salinity impacts.

Vegetation monitoring would be undertaken to record any dieback or loss of vigour as a result of irrigation. Where effects such as these are recorded, appropriate management measures would be put in-place (e.g. soil rejuvenation by light cultivation).

5.2.3 Coal Shaft Creek

The proposed design for the post-mining alignment of Coal Shaft Creek would comprise a reworked section of the existing Coal Shaft Creek Diversion channel, a drop-down section outside the in-pit waste rock emplacement, and a reconstruction of the creek within a corridor over the in-pit waste rock emplacement at the southern end of the Weismantel open pit extent (Figure 5-1). Photographs of the existing Coal Shaft Creek Diversion are shown on Plate 5-3. An assessment of the environmental, hydrogeological, and geomorphic characteristics of the proposed final alignment of Coal Shaft Creek is provided in Appendix A.

Throughout the Project life, further analyses would be conducted into the geotechnical, hydrological and hydraulic design of the final alignment focussing on long-term stability, seepage management and the creation of habitat. The outcomes of these analyses would inform the final detailed design of the post-mining alignment and reconstruction of Coal Shaft Creek.

The final design of the post-mining alignment of the Coal Shaft Creek would be documented in a Coal Shaft Creek Reconstruction Plan as part of the overall site water management reporting process. A description of the components of the proposed design for the reconstructed Coal Shaft Creek is provided below.

The upper section of the Coal Shaft Creek Diversion would be retained as a primarily engineered structure, however sediments and vegetation (in addition to existing vegetation) would establish within the channel over time. The banks of the diversion would continue to be revegetated throughout the mine life and following the completion of mining to enhance stability and create fauna habitat.

A drop-down section, to lower the level of the diversion by approximately 20 m, would be constructed between the reworked section of the existing Coal Shaft Creek Diversion channel and the re-established alignment over the in-pit waste rock emplacement. The drop-down section would be constructed from the diversion channel through the ridgeline north of the existing MWD. The aim would be for excavation into hard rock to facilitate long-term stability and to minimise ongoing maintenance. Monitoring of the drop-down section would be conducted and where results indicate the need, relevant maintenance would be undertaken (Appendix A).

DCPL would undertake a study into the long-term geotechnical stability and maintenance requirements of the proposed drop-down section of the reconstructed Coal Shaft Creek. The results of this study would be incorporated into the final design and post-mining alignment of the reconstructed Coal Shaft Creek as a component of the Coal Shaft Creek Reconstruction Plan.

The final alignment of Coal Shaft Creek over the in-pit waste rock emplacement would be designed and constructed within the corridor shown on Figure 5-1. The creek would be designed with a meandering channel within a 50 m wide reconstruction corridor, which would generally replicate the original meandering geometry. In general accordance with *Maintenance of Geomorphic Processes in Bowen Basin River Diversions - Stage 1*, Australian Coal Association Research Program Project C8030 (ID&A Pty Ltd, 2000), the reconstructed creek design would aim to generally mimic pre-mining (surveyed) creek cross-sections and adopt a design with a “main” flow channel, with overbank areas for large flows, with the main channel sized similar to the pre-mining creek capacity (Figure 5-3).

The channel would include an engineered low permeability zone (e.g. clay liner) (Figure 5-3) which would restrict the movement of water between Coal Shaft Creek and the waste rock emplacement (Appendix A).

Coal Shaft Creek Diversion Looking Upstream

Coal Shaft Creek Diversion Looking Downstream

Coal Shaft Creek Diversion Looking Downstream to Dam 1

Coal Shaft Creek Diversion Looking Upstream from Haul Road Culvert

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PLATE 5-3

Existing Coal Shaft Creek Diversion (2009)

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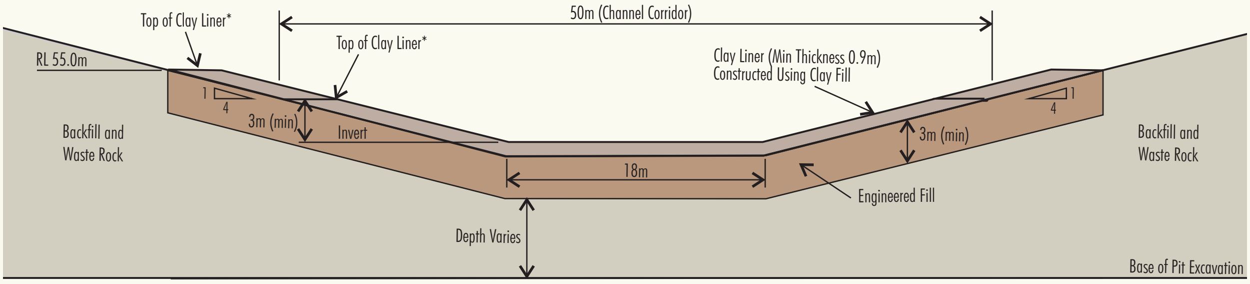
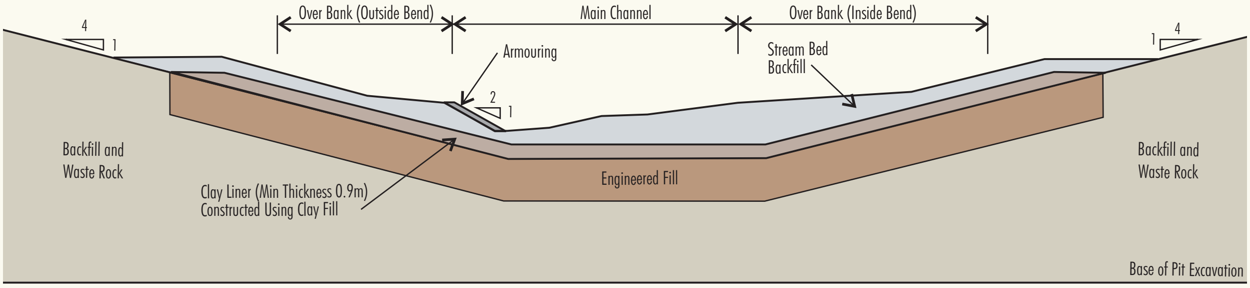
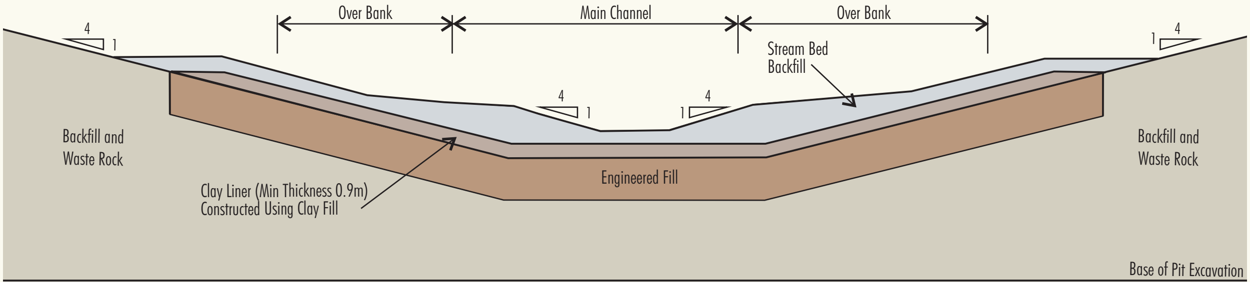


*Channel Corridor Clay Liner to extend up batters to RL 55m or
3m(min) vertically from corridor invert (whichever is greater).

Typical Channel Corridor Section



Typical Section - Reconstructed Creek (Bend)



Typical Section - Reconstructed Creek (Straight)

Source: Allan Watson Associates (2006)

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FIGURE 5-3

Coal Shaft Creek Reconstruction
(Typical Sections)

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Whilst the design concepts for the re-establishment of the creek over the in-pit waste emplacement are based on mimicking the natural creek, the reconstructed creek is expected to be dynamic and would evolve into a more natural system over time. This would inevitably result in preferential erosion and deposition in some sections which may (depending on the pattern of flows experienced post-commissioning) be initially greater than might be expected in the natural creek. Selection of final form and alignment would be subject to a detailed hydraulic analysis, as part of final design, together with an assessment of the likelihood of bed/bank erosion on the outside of bends under a range of flow conditions (Appendix A).

The conceptual longitudinal channel profile would also include habitat creation initiatives such as the provision of irregular pool and riffle sequences, use of material recovered from the existing channel or some other suitable source, placement of large boulders and/or timber to form pools upstream and promote aquatic habitat and planting of riverine vegetation on banks to enhance stability (Appendix A).

Examples of habitat in the existing Coal Shaft Creek Diversion are shown on Plate 5-3.

The channel would be formed progressively from south to north and creek flows would not be reinstated until the completion of mining and/or when vegetation was well established throughout. In concept, the creek would be constructed by (Appendix A):

- forming the 50 m wide reconstruction corridor in the waste rock material;
- constructing the clay liner to control leakage from the reconstructed creek to the waste rock and seepage from the waste rock emplacement to the creek;
- forming the channel and banks using material recovered from the existing channel or some other suitable source;
- placement of large boulders and/or timber to form pools upstream and promote aquatic habitat; and
- planting of riverine vegetation on the banks to enhance stability.

5.2.4 Water Management Infrastructure

In consultation with the regulatory authorities and the community, and considering future local and regional water infrastructure needs, site water dams (e.g. MWD, Auxiliary Dams) and accompanying upstream diversion structures may be retained for future use. The final uses of the water storages would be addressed through the MREMP framework (i.e. MOP and AEMR). Examples of retained dams for stock watering exist at the SCM and are shown on Plate 5-2.

Sediment dams would remain pending long-term acceptable water quality and may be kept for stockwater if suitable.

Irrigation infrastructure owned by DCPL would be decommissioned and sold, unless used for post-mining agricultural use.

5.2.5 Site Infrastructure

The existing infrastructure and services at the DCM would continue to be utilised throughout the life of the Project, with minor additions, upgrades and maintenance works undertaken as required.

Infrastructure located at the DCM that would be removed at the end of the Project life would include:

- workshop buildings and stores[1];
- heavy vehicle servicing, parking and washdown facilities;
- sewage treatment facilities; and
- dangerous goods storage facilities.

During the decommissioning phase, the priority would be to dismantle fixed equipment and infrastructure for removal from site and re-use at another location or recycling. Non-salvageable/non-recyclable and non-contaminated infrastructure would be disposed of at suitable off-site disposal areas (or on-site subject to relevant approvals being obtained).

[1] Some buildings and stores may be retained if required for post-mine land use.

Once all the equipment and infrastructure components have been removed from an area it would be deep ripped, topsoiled and seeded. Land contamination assessments would be conducted and contaminated soil would be remediated in accordance with the relevant guidelines (including guidelines under section 145C of the EP&A Act and the NSW *Contaminated Land Management Act, 1997* [CLM Act]).

Some concrete hardstands, administration and ablution buildings, site access roads, sheds, buildings and sediment dams may be retained for alternate post-mining uses. Electricity transmission infrastructure would be retained for future use by landholders unless it is no longer required, in which case it would be decommissioned and removed. The rail siding may also be retained for future infrastructure use if required by relevant stakeholders and if appropriate approvals are obtained.

It is anticipated that some of the internal roads would be retained for use by landholders following the cessation of mining, although this would be subject to consultation with relevant landholders during closure planning.

5.3 INTEGRATION WITH THE PROJECT OFFSET STRATEGY

DCPL proposes an offset area which is located on freehold DCPL-owned land to the south and east of the Project area (Section 4.8.3). The integration of the offset area with Project rehabilitation areas is shown on Figure 5-4. DCPL currently utilises the proposed offset area land for pastoral purposes.

The offset area is located directly adjacent to DCPL's existing offset area which was proposed as part of the DCM June 2009 modification (DCPL, 2009a). DCPL's existing offset area directly adjoins land which has a conservation agreement included in its conditions of tenure.

Table 5-2 provides a summary of the proposed offset. While approximately 87 ha of natural vegetation communities and 109 ha of derived grassland would be cleared for the Project, it is proposed that significant areas of existing native vegetation communities would be enhanced (approximately 214 ha) and areas of derived grasslands would be revegetated (approximately 230 ha), including enhancement and revegetation of the Mammy Johnsons River riparian corridor for an approximate 1.7 km reach of the river.

Table 5-2
Summary of the Offset Proposal

Area	Description	Size (ha)
Enhancement Area	Enhancement of existing areas of native vegetation communities through natural regeneration and management for conservation.	214
Revegetation Area	Re-establishment of woodland in derived grasslands by selective planting and fencing for natural regeneration.	230
Total Area Conserved (ha)		444

Source: Appendix E.

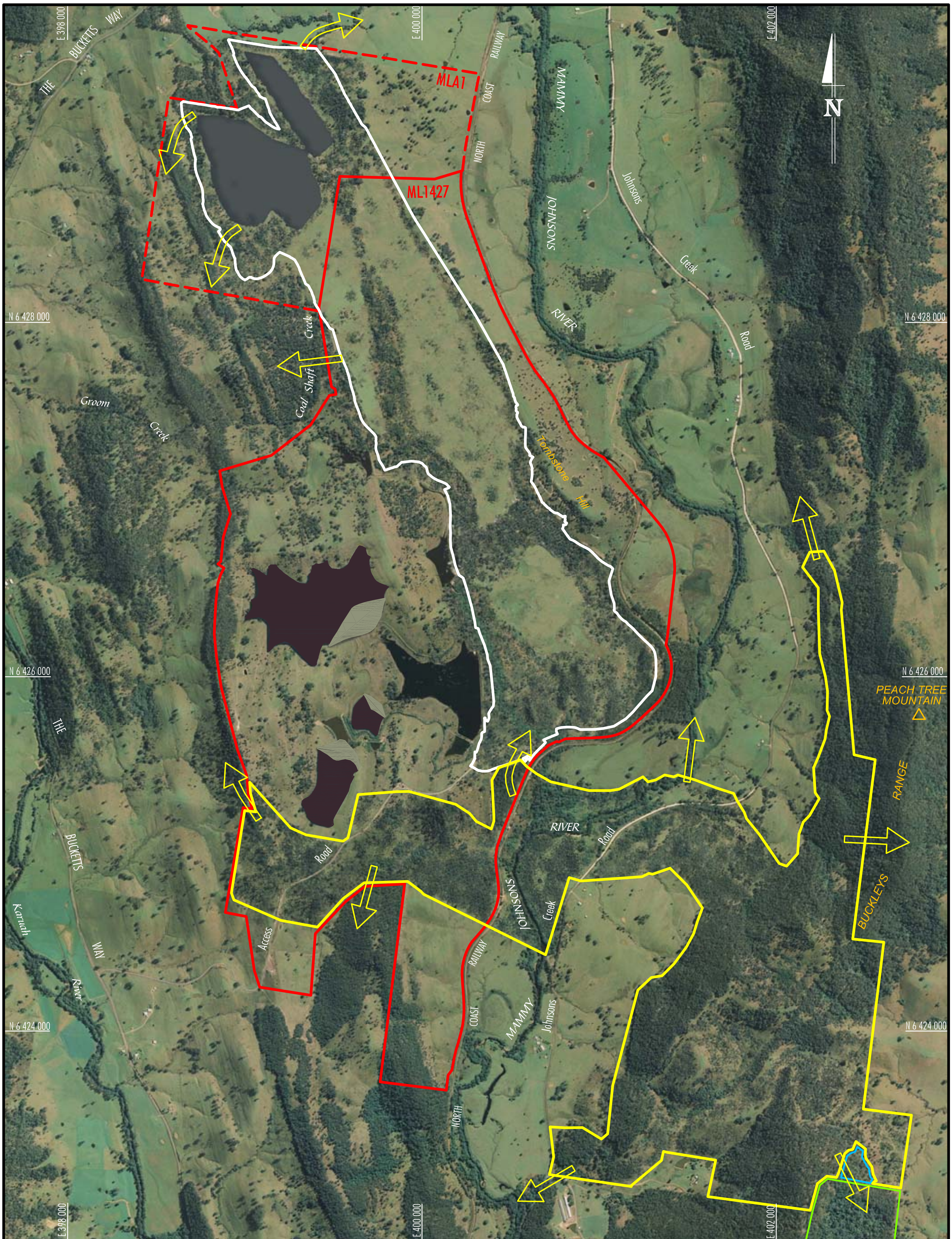
The conservation of the proposed offset areas would be secured in perpetuity, and this would occur through a voluntary conservation agreement with the NSW Minister for the Environment. A voluntary conservation agreement provides permanent protection as it is registered on the title of the land (Section 4.8.3).

The proposed offset area traverses two roads and the North Coast Railway. Canopy bridges would be installed to facilitate the crossing of arboreal mammals where there is not existing substantial canopy connection.

5.4 GENERAL REHABILITATION PRACTICES AND MEASURES

The following sub-sections summarise the rehabilitation practices and measures that would be implemented at the Project.

The success of the existing rehabilitation activities would continue to be evaluated throughout the Project and would be used to inform future rehabilitation initiatives.



Source: AAHatch- Aerial Photography flown November 2007 and April 2009

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FIGURE 5-4

Conceptual Final Landform Rehabilitation and Proposed Offset Areas

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5.4.1 Vegetation Clearing Measures

As described in Section 4.8.3, a Vegetation Clearance Protocol (DCPL, 2002b) has been developed to minimise the impact of vegetation clearance on flora and fauna. Throughout the life of the Project, the Vegetation Clearance Protocol would be implemented during all clearing required to facilitate Project mining operations (primarily for the development of the Weismantel Extension open pit and the Clareval North West open pit).

5.4.2 Soil Stripping Areas and Handling Measures

Soil stripping and storage is currently undertaken in accordance with the Topsoil Stripping Management Plan (DCPL, 2003b). Disturbance areas are stripped progressively (i.e. only as required) so as to reduce erosion and sediment generation, to reduce the extent of soil stockpiles and to utilise stripped soil as soon as possible for rehabilitation.

In accordance with *Leading Practice Sustainable Development Program for the Mining Industry - Mine Rehabilitation* (Department of Industry, Tourism and Resources, 2006a), stripped soil is directly placed on mine rehabilitation areas where areas on the waste rock emplacement are available for topsoil application. Where stockpiling is necessary, soil stockpiles are managed to maximise long-term viability through implementation of the following practices:

- the surface of the completed stockpiles are left in a "rough" condition to help promote water infiltration and minimise erosion prior to vegetation establishment;
- soil stockpiles have a maximum height of 3 m in order to limit the potential for anaerobic conditions to develop within the soil stockpile;
- soil stockpiles have an embankment grade of approximately 1V:4H (to limit the potential for erosion of the outer pile face);
- soil stockpiles are seeded and fertilised; and
- soil rejuvenation practices (e.g. fertiliser addition) are undertaken (if required) prior to respreading as part of rehabilitation works.

These management measures would continue to be implemented for the Project.

The existing Topsoil Stripping Management Plan (DCPL, 2003b) would be reviewed and revised to incorporate Project disturbance areas. Annual soil stripping and stockpiling volumes would continue to be reported within the AEMR.

Soil Reserves

A preliminary material balance calculation was conducted to determine the quantity of soil available for rehabilitation (Appendix N). The results of these calculations are summarised in Table 5-3. The preliminary material balance demonstrates that there would be sufficient soil available to meet the rehabilitation concepts described in this document (Appendix N). Surplus soil would be dedicated to forming deeper soil profiles within the reconstructed alignment of Coal Shaft Creek over the waste rock emplacement.

Table 5-3
Preliminary Duralie Coal Mine Soil Balance

Soil Accounting	Volume (m^3)
Existing soil stockpiles (to June 2009)	128,500
Additional soil to be stockpiled[1]	176,948
Total Available Soil Volume	**305,448**
Soil required for rehabilitation[2]	263,327
Net Soil Surplus	**42,121**

Source: Appendix N.
[1] Assuming an average stripping depth of 7 cm.
[2] Assuming an average cover depth of 12 cm.
m^3 = cubic metres.

As described in Section 4.2.1, given the continuity of geological formations into the additional Project disturbance areas, it is considered likely that the *in-situ* soil resource availability and soil chemistry of the additional disturbance areas for the Project would be similar to the soils encountered at the existing DCM to date.

Detail with respect to the quantification of soil resources, stripping and reapplication schedules and stockpiling inventories would be included as part of the MOP and would be reported in the AEMR.

5.4.3 Plant Species Selection

Endemic plant species would be used for revegetation and would predominantly comprise those listed in Table 5-4 below. Species listed in Table 5-4 would continue to be selectively trialled and, based on performance, used within revegetation areas. Annual cover crops would be utilised to provide short-term stabilisation to revegetation areas.

Table 5-4
Indicative Species Proposed for Native Revegetation

Scientific Name	Common Name	Growth Form
Acacia fulva	Velvet Wattle	Erect Shrub/ Tree
Allocasuarina torulosa	Forest Oak	Tree
Dodonaea megazyga	-	Erect Shrub/ Tree
D. rhombifolia	Broad-leaf Hop-bush	Erect Shrub
Eucalyptus canaliculata	Grey Gum	Tree
E. glaucina	Slaty Red Gum	Tree
E. largeana	Craven Grey Box	Tree
E. punctata	Grey Gum	Tree
E. rudderi	Rudder's Box	Tree
E. tereticornis	Forest Red Gum	Tree
Corymbia maculata	Spotted Gum	Tree
E. crebra	Narrow-leaved Ironbark	Tree
E. tereticornis	Forest Red Gum	Tree
E. paniculata	Grey Ironbark	Tree
E. eugenioides	Thin-leaved Stringybark	Tree
E. moluccana	Grey Box	Tree
Acacia irrorata	Green Wattle	Erect Shrub/ Tree
Acacia ulicifolia	Prickly Moses	Erect Shrub
Themeda australis	Kangaroo Grass	Grass

Source: Appendix N.

Selection of tree and pasture species would include consideration of the abutting vegetation type, site features (i.e. slope, anticipated ground conditions, availability of water), sowing season and prevailing weather conditions, seed availability, advice from seed suppliers and success or otherwise of earlier sowings.

5.4.4 Erosion and Sediment Control Works

The existing ESCP (DCPL, 2002a) would be revised to include erosion and sediment control strategies applicable to the Project.

Erosion control would be achieved by the development and implementation of land stabilisation procedures and protocols. Examples of the protocols and procedures that may be implemented during rehabilitation include:

- the use of stabilising techniques such as meshing, hydromulching and the application of approved rapid germinating pasture grasses in drainage channels; and
- the use of constructed rip-rap and gabion baskets at critical sites such as drainage confluences and outfalls to natural or existing drainage lines.

5.4.5 Weeds and Pest Control

Weed control at the DCM is undertaken subject to seasonal factors, weather, scale of infestation and availability of chemical applicator(s). Weeds declared as noxious by the GLC are targeted for control (GLC, 2009a).

The likelihood of natural control of weeds by competition, grazing and the anticipated follow-up germination rate is taken into account when selecting the most appropriate means of weed management.

The requirement for pest control is assessed on the basis of the significance of the pest threat, in terms of species, population size and likely consequence of pest presence. If controls are required, available control methods are assessed and the method deemed to be most appropriate are be utilised (e.g. baiting programmes).

The existing weed and pest control management measures at the DCM would continue to apply for the Project.

5.4.6 Bushfire Management

Bushfire management measures are described in Section 4.2.3.

5.5 REHABILITATION AND REVEGETATION MONITORING

Ongoing monitoring and maintenance of rehabilitation areas at the DCM is conducted to assess:

- progression of rehabilitated land; and
- effectiveness of rehabilitation techniques used (including soil erosion controls, water quality within and outside ML 1427 and revegetation methods).

Monitoring of rehabilitation activities at the DCM is currently undertaken through the implementation of monitoring programmes outlined in the Rehabilitation Management Plan (DCPL, 2007a) and the AEMR. Rehabilitation monitoring at the DCM includes the following:

- evaluating spread topsoil profile thickness and quality prior to sowing;
- observing drains and assessment of water quality to determine whether substantial silting of inverts and/or any localised failure of the drain embankment has occurred;
- observing recently topsoiled areas after rain events (particularly on sloping ground) to determine if any significant rilling or loss of topsoil has occurred;
- assessing germination success (diversity and abundance);
- evaluating the behaviour of placed topsoil;
- assessing the degree of vegetative ground coverage achieved over time;
- assessing the survival rate for sown species by type and location;
- recording information on observations (by photographic record, file notation, etc.); and
- evaluating threats posed to rehabilitated areas posed by weed infestation, feral animals, cattle, etc.

Water quality and geomorphic monitoring would also be conducted to monitor the performance of the reconstructed Coal Shaft Creek (Section 5.2.3).

The performance of rehabilitation and revegetation areas would be monitored using LFA or a similar systems-based approach. LFA is a CSIRO developed method used to provide indicators of rehabilitation success and allows the assessment of landscape processes. LFA aims to measure the progression of rehabilitation towards a self-sustaining ecosystem through the assessment of landscape function.

Key completion criteria are proposed in Table 5-5. These criteria have been developed with regard to *Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on the Coal Mines in the Hunter Valley,* Australian Coal Association Research Program Project C13048 (Australian Centre for Minerals Extension and Research, 2005).

Key completion criteria would be reviewed and refined as part of the MREMP.

A meteorological station would be maintained to provide data on climatic conditions such as temperature and rainfall.

The parameters monitored during rehabilitation would be determined in consultation with the DII-Minerals & Energy and documented in the MOP and AEMR. They would be used as indicators of rehabilitation performance.

The Rehabilitation Management Plan (DCPL, 2007a) would be updated to include monitoring programmes designed to assess the performance of the rehabilitation areas applicable to the Project. Monitoring results along with monitoring site locations, parameters and frequencies would be reviewed annually through the AEMR process. Where deficiencies are observed within rehabilitated areas which require remedial works, such works would be undertaken at the earliest possible opportunity, subject to resource availability, season, ground condition and access considerations.

Table 5-5
Key Completion Criteria

Project Component	Key Completion Criteria
Final Landforms	• Safe, stable, adequately drained post-mining landforms consistent with the surrounding landscape as evidenced by comparative photography, water quality monitoring and geotechnical surveys. • Geomorphic stability of drainage features comparable to existing natural drainage features as evidenced by cross-section and long-section surveys and monitoring of erosion.
Final Voids	• Surface water inflows to the final voids minimised through appropriate landforming as evidenced by revision of the water balance based on final as-built mine landforms. • Final voids profiled for long-term stability as evidenced by geotechnical surveys of high walls/end walls. • Perimeter bunding formed.
Rehabilitation and Revegetation Areas	• Woodland/riparian areas on trajectory toward self-sustaining ecosystem[1] and/or measures of ecosystem function (e.g. vegetation cover, landform stability, species diversity) equivalent to reference sites.
Grazing Areas	• Stocking rates of between 1.5 and 4.0 dry sheep equivalents (DSE) per hectare (average 2.8 DSE) in accordance with *Beef Stocking Rates and Farm Size - Hunter Region* (DPI, 2006) (Native unimproved pasture – moderate fertility [no seed or fertiliser added]) as evidenced by monitoring of grazing productivity.

Source: Appendix N.

1 As measured by LFA or a similar systems-based approach.

5.6 LONG-TERM PROTECTION AND MANAGEMENT MEASURES

The Rehabilitation and Landscape Management Strategy described in Appendix N provides objectives for the long-term protection of the site (Section 5.1). These objectives aim to provide a stable landform that facilitates a land use consistent with the expectation of relevant stakeholders.

There are no relevant strategic land use planning or resource management plans or policies in the Great Lakes or Gloucester Shire LGAs that would apply to the Project. Should any such plans or policies become available, DCPL would review these against the existing rehabilitation strategies and objectives for consistency.

In general accordance with *Leading Practice Sustainable Development Program for the Mining Industry - Mine Closure and Completion* (Department of Industry, Tourism and Resources, 2006b), a comprehensive monitoring regime would be established to track the progress of rehabilitation initiatives towards the fulfilment of these objectives.

Upon cessation of mining operations, it would be expected that tenure of ML 1427 and MLA 1 would be maintained by DCPL until such time as the relevant statutory requirements are achieved (e.g. fulfilment of mining lease conditions). DCPL would then seek to relinquish the mining leases.

Central to lease relinquishment would be the confirmation of safety issues and the demonstrated application of adequate control measures to facilitate sustainable landscapes. Assessment of rehabilitation success (i.e. in accordance with established completion criteria) would be conducted in consultation with relevant authorities and stakeholders.