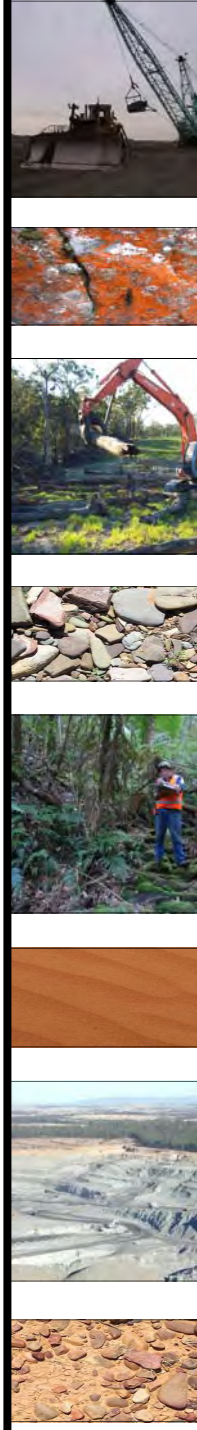
Rehabilitation and Decommissioning Strategy (GSSE 2011)



APPENDIX J

WHITEHAVEN COAL LIMITED

Rocglen Coal Mine Extension Project

Part 3A of the *EP&A Act 1979*

Environmental Assessment:-

Rehabilitation and Decommissioning Strategy

January 2011

WHM01-005

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

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1.0 INTRODUCTION

1.1 Background

GSS Environmental (GSSE) was commissioned by Whitehaven Coal Limited (Whitehaven) to prepare an Environmental Assessment (EA) to accompany a new Project Application under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the proposed expansion of operations at the Rocglen Coal Mine ('Rocglen') in the Gunnedah coalfields of New South Wales (NSW). This *Rehabilitation and Decommissioning Strategy* forms part of the EA.

Rocglen (formally known as Belmont Coal Project) was originally approved by the Minister on the 15 April 2008 under Project Approval (PA) 06_0198. It was classified as a Major Project in accordance with the *State Environmental Planning Policy (Major Projects) 2005* and, subsequently, was determined under Part 3A of the EP&A Act. Coal production at Rocglen commenced in late 2008.

Following further drilling and definition of the local geological features, as well as additional reviews of the mine plan, Whitehaven now propose to expand operations at Rocglen in order to maximise coal recovery and allow for improved mine progression. This includes, but is not limited to, an expansion of the open cut pit and the provision of additional out-of-pit emplacement area and volume.

Rocglen is located on Wean Road approximately 25 kilometres (km) north of Gunnedah and 23 km south-east of Boggabri in northwest NSW, shown on **Figure 1**. The Project Site covers approximately 460 hectares within the Parish of Tulcumba, County of Nandewar and Local Government Area (LGA) of Gunnedah. It incorporates all or part of the following land parcels:-

- Lot 1 in DP 787417;
- Lots 1 and 4 in DP 1120601; and
- Public roads and road reserves.

All of the freehold land within the Project Site, being Lot 1 in DP 787414 and Lots 1 and 4 in DP 1120601, is owned by Whitehaven.

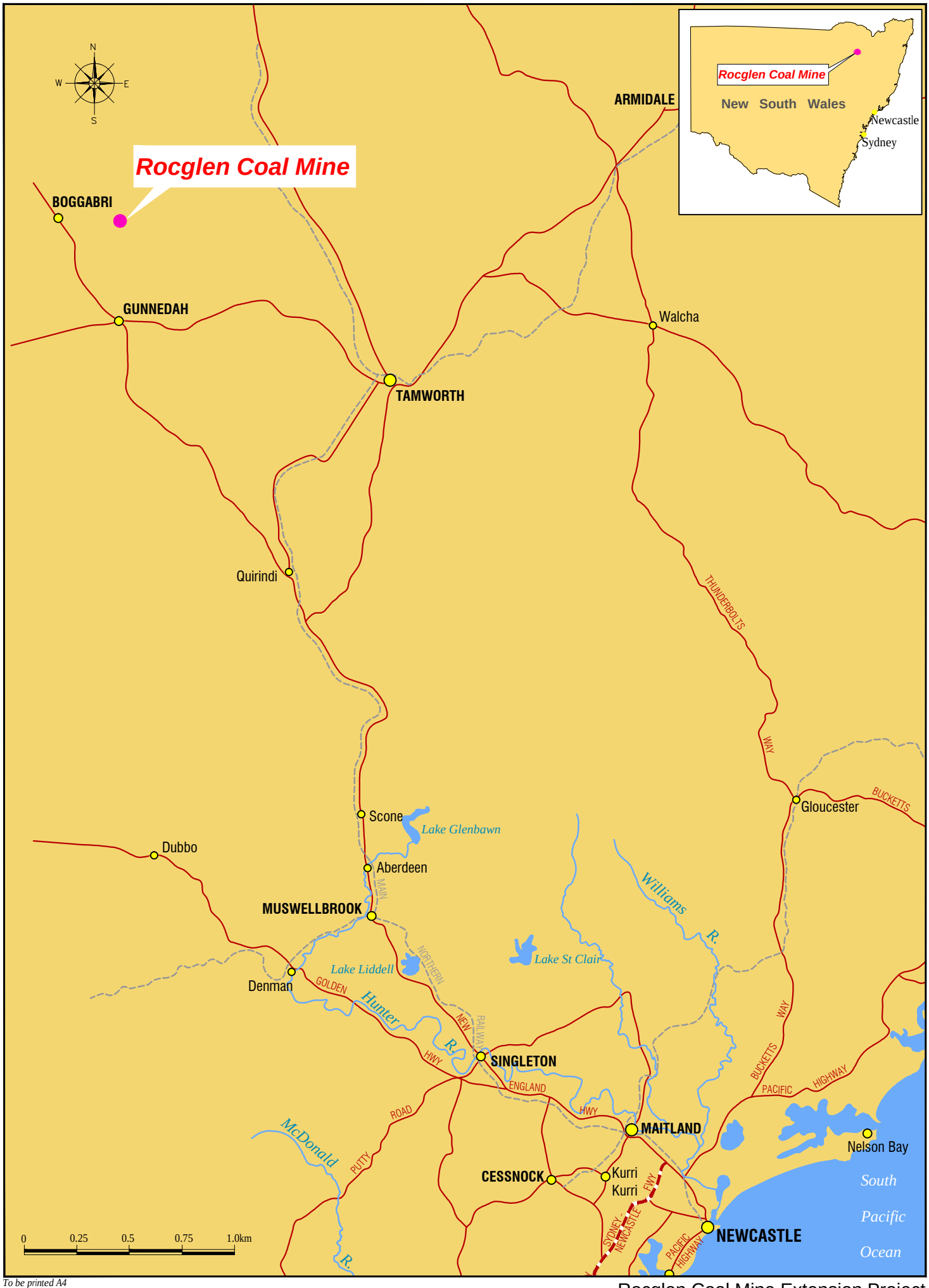
1.2 Objectives of the Rehabilitation and Mine Closure Strategy

Planning for mine closure includes integrating the closure design for the entire mine site, identifying the timing of the planning process, considering issues that relate to specific rehabilitation methods and economical and community objectives, as well as making sure adequate financial provisions have been set aside.

The principal objectives of mine closure planning, incorporated into this *Rehabilitation and Decommissioning Strategy*, include:-

To provide an overall framework for mine closure, including rehabilitation and decommissioning strategies. In this regard, a mine closure plan should be considered a template on which future activities should be based;

- To ensure that adequate financial provision is made available to cover the cost of decommissioning, final rehabilitation and any other post closure costs related to the closure of the mine site;
- To establish clear and agreed criteria with relevant stakeholders that can be used to provide the standard to which the final mine rehabilitation and post mining land use can be assessed against;



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Rocglen Coal Mine Extension Project
Locality Plan

FIGURE 1

- To reduce or eliminate adverse environmental effects once the mine ceases operation;
- To ensure closure is completed in accordance with good industry practice and meets the statutory requirements that may be applicable; and
- To ensure the closed mine does not pose an unacceptable risk to public health and safety.

The most effective rehabilitation and decommissioning strategies are those that are integrated with the long term operational plans of the mine and are subject to regular review to accommodate regulatory, technological, social and economic change.

1.3 Current Infrastructure, Mining and Rehabilitation Activities at Rocglen

As stated above, Rocglen was originally approved by the Minister on the 15 April 2008 under PA 06_0198. It was classified as a Major Project in accordance with the *State Environmental Planning Policy (Major Projects) 2005* and, subsequently, was determined under Part 3A of the EP&A Act. Whitehaven commenced coal production at Rocglen in late 2008.

The key activities approved, in summary, are:-

(a) **Coal Mining by Open Cut Mining Methods** – extraction of coal by open cut mining methods within an area of approximately 114 hectares. This involves the extraction of three separate coal seams with a combined thickness of up to 17 metres, at an approved production rate of 1.5 million tonnes per annum (Mtpa). The pit extensions approved for stabilisation works under PA 06_0198 MOD 1 have a combined area of approximately 2.05 hectares; giving a total approved open cut area of approximately 116.05 hectares.

(b) **Open Cut Mining by Auger Mining –** extraction of additional coal reserves that are uneconomical to extract by open cut mining methods using auger mining techniques.

(c) **On-Site Coal Processing –** transfer of mined coal by haul truck to a coal handling and processing area located immediately south of the limit of open cut mining for crushing, screening and loading into B-Double trucks for transport off-site.

(d) **Transportation –** transportation of crushed and screened coal approximately 30 km to the Whitehaven CHPP, via a purpose built section of road between Rocglen and Hoad Lane, and from Hoad Lane via an established coal haulage route for selective washing, stockpiling and dispatch by both rail and road. A proportion of the coarse and fine reject material from the CHPP is approved to be backloaded to Rocglen for placement in the mined-out areas of the open cut.

(e) **Relocation of Public Roads –** relocation of sections of Wean Road (not yet undertaken) and Jaeger Lane (completed) to allow for open-cut mining activities and infrastructure within these areas.

(f) **Biodiversity Offset Strategy –** offsetting of the disturbance to remnant native vegetation through the protection and rehabilitation of approximately 195.3 hectares of land, comprising 44.9 hectares of remnant woodland, enhancement planting and rehabilitation to 90.4 hectares and an additional 60 hectares within the Whitehaven Regional BioBank Site.

(g) **Rehabilitation –** progressive use of out-of-pit and in-pit overburden emplacements to shape and recreate the landform comparable to that of the pre-mining environment. Under the current approval, approximately 84 hectares of the final landform is planned for long-term nature conservation, with the remaining area planned to be returned for agricultural use.

Based on the open cut reserves at the time of approval and a maximum production rate of 1.5 Mtpa, the Rocglen Coal Mine was anticipated to have a production life for coal extraction of between *seven to ten years.*

1.4 Proposed Infrastructure, Mining and Rehabilitation Activities at Rocglen

Following further drilling and definition of the local geological features, as well as additional reviews of the mine plan, Whitehaven proposes to expand operations at the Rocglen Coal Mine in order to maximise coal recovery and allow for improved mine progression.

The objectives of the Rocglen Coal Mine Extension Project are to:

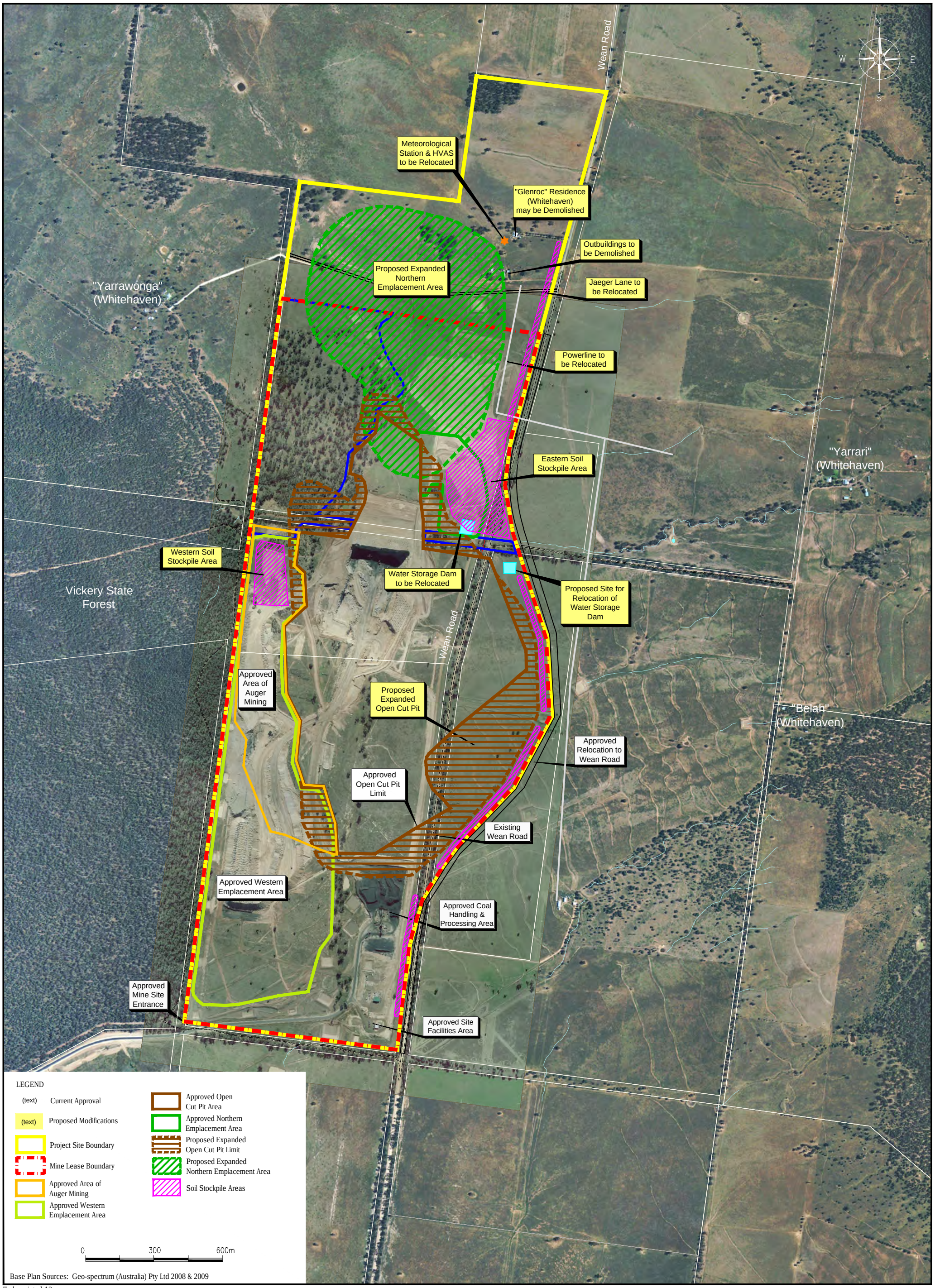
- Develop the on-going open cut operations with a focus on:
  - maximising resource recovery and maintaining continuity of coal production from the existing Rocglen Coal Mine beyond the currently projected life of mine;
  - maximising the use of existing infrastructure; and
  - securing on-going employment opportunities and socio-economic flow-on benefits;
- Provide additional out-of-pit emplacement area to accommodate overburden material from the existing operations and proposed pit expansion; and
- Continue to conduct mining at Rocglen in an environmental responsible manner to ensure the potential for adverse impact is minimised.

The primary components of the Project, over and above the current operations, to be assessed and determined under Part 3A are summarised in the below dot-points. It is intended that the Rocglen Extension Project will be fully integrated with the remaining operational life of the current approved Rocglen mine, which will enable Whitehaven to operate under a single Project Approval over the life of the Project. **Figure 2** illustrates the layout of the Project Site as proposed under the Rocglen Extension Project.

- **Expansion of Open Cut Pit –** expansion of the open cut pit design limit in order to access up to an additional 5 Mt of coal not previously considered in the life of mine plan. This will increase coal recovery at Rocglen by close to 30 percent. The footprint of the open cut pit will increase by approximately 50 hectares to a total open cut mined area of approximately 164 hectares. Coal will continue to be extracted from the expanded pit at the approved production rate of 1.5 Mtpa and using the open cut mining methods approved at Rocglen.

- **Extension to Life of Mine –** it is anticipated that coal extraction activities will occur for approximately 11 years following the issue of Project Approval and the subsequent issue of a new or amended mining lease. This represents an increase to the projected life of mine, for coal extraction, of up to four years.

- **Expansion of Northern Emplacement Area -** expansion in the footprint and height of the out-of-pit Northern Emplacement Area in order to accommodate a maximum of 12 million bank cubic meters (Mbcm), or 15 million loose cubic metres (Mlcm) accounting for swell, of overburden from the current operations and proposed pit expansion. The maximum design height of the expanded Northern Emplacement Area will be 50 metres above pre-mining landform, which is the approximate height of the adjacent ridge to the west of the Project Site at 340 metres Australian Height Datum (AHD). Early re-profiling and revegetation of the external batter slopes of the emplacement area will be undertaken to minimise visual impacts and limit erosion and downstream sedimentation.



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Rocglen Coal Mine Extension Project
Project Layout
FIGURE 2

- **Replacement of Soil Stockpile Areas –** the soil stockpiling areas identified as the Northern and Southern Soil Stockpile Areas will be replaced by the proposed Eastern and Western Soil Stockpile Areas to cater for the expanded open cut pit and Northern Emplacement Area. While all of the topsoil currently in the Northern Stockpile Area will be relocated, the majority of subsoil in this area will remain and will be covered with overburden due to sufficient soil material being available for rehabilitation from the expanded operation. The material to be relocated will be placed in either proposed new designated soil stockpile areas or placed directly onto areas available for rehabilitation.

- **Revised Rehabilitation and Mine Closure** - Whitehaven will continue to adopt a progressive approach to rehabilitation throughout the life of the mine. The rehabilitation and mine closure methodologies will essentially remain as currently approved under PA 06_0198, with the primary differences being the configuration of the final landform and final land use. Of the total anticipated disturbed area of approximately 358 hectares, it is proposed to restore approximately 206 hectares as rehabilitated bushland (58 percent), 147 hectares as rehabilitated pasture (41 percent), with the remaining 5 hectares comprising the retained highwall of the final void (1 percent).

- **Revised Biodiversity Offset Strategy –** A revised *Biodiversity Offset Strategy* has been prepared to compensate for the Project impacts and the impacts to the previously approved offset areas (i.e. cumulative impacts) on a 'like for like' basis with the equivalent of over 525 hectares of vegetation to be offset within the Whitehaven Regional BioBank Site. The *Strategy* will provide an offset to impact ratio of 4.75:1. The Whitehaven Regional BioBank Site is in the final stages of registration by the DECCW as a BioBank Site under Part 7A of the Threatened Species Conservation Act 1995 (TSC Act). It will be actively managed via a BioBanking Management Plan with in-perpetuity management funding, and will have the highest level of conservation status outside of National Parks (via a BioBanking Agreement registered on the land title in-perpetuity).

- **Other Minor Project Related Works:**
  - Altered surface water management to effectively cater for the expanded operations;
  - Relocation of the Mine Water Dam to cater for the expanded open cut pit;
  - Relocation of a section of Jaeger Lane (that has already been relocated under PA 06_0198) to cater for the expanded Northern Emplacement Area;
  - Removal of the building improvements within the "Glenroc" property, which is owned by Whitehaven, to cater for the expanded Northern Emplacement Area;
  - Relocation of the meteorological station and high volume air sampler (HVAS) used to monitor the concentration of particulate matter less then 10 micrometres (PM_{10}) located within the "Glenroc" property to elsewhere within or adjacent to the Project Site to ensure adequate separation from the expanded Northern Emplacement Area and optimal operation; and
  - Realignment of an existing overhead powerline, owned by Country Energy, to ensure adequate separation distances from the expanded Northern Emplacement Area and Eastern Soil Stockpile Area. .

The Project does not involve any change to the coal production rate, methods of coal extraction, hours of operation, coal handling and processing techniques, site servicing, general waste management or employment. The only change to the current mine fleet will be the addition of one 1250 excavator in the pit to enable cleaner mining (smaller machine).

1.5 Structure of Rehabilitation and Decommissioning Strategy

This *Rehabilitation and Decommissioning Strategy* comprises the following primary sections and information:-

Section 2.0 - Rehabilitation Management Strategy

- Conceptual final landform design, including discussion of the proposed post mining land use;
- Short and long term objectives for the rehabilitation of Rocglen;
- Details on the implementation of an effective revegetation program;
- Details of an effective monitoring program to assess performance of the rehabilitated areas; and
- Objectives and preliminary success criteria for mine closure.

Section 3.0 - Decommissioning and Mine Closure

- Details on the conceptual mine closure strategy for the Rocglen Extension Project; and
- Proposed measures to manage the environmental impacts of mine closure.

Section 4.0 - Final Void Management Plan

- Nature of the final void that will remain following cessation of mining;
- Details on the final stability and rehabilitation of the void;
- Summarises actions to address long term void water quality; and
- Post closure safety and final land use options for the void.

2.0 REHABILITATION MANAGEMENT STRATEGY

Whitehaven is committed to ensuring progressive rehabilitation of areas of disturbance (and sequencing activities to enable earliest revegetation consistent with operational requirements) within the Project Site in order to minimise the areas of exposure and hence reduce the potential air quality impacts, erosion and sedimentation, and the visibility of mining operations from surrounding residences and publically available vantage points.

Rehabilitation of disturbed areas will involve the re-profiling of the landform, top dressing (including subsoils) application consistent with the desired post-mining land capability and land use, installation of appropriate water management works and establishment of areas of native vegetation and pasture species.

Rehabilitated bushland areas along the western fringe of the site will be linked to existing bushland to the west. This will create a connection with the surrounding environment. A corridor from the rehabilitated bushland will extend east just south of the Northern Emplacement Area. Again, this will connect the rehabilitated bushland on the site with remnant vegetation to the east and create a wildlife corridor. Strategically placed bushland tree lots will also be established within grassland areas to act as wildlife refuges.

Central and eastern areas of the final landform will be established with rehabilitated pasture, including the areas directly surrounding the final void. This rehabilitated pasture will tie in with the existing surrounding grassland areas of the locality.

Along the eastern boundary of the site, adjacent to Wean Road, a strip of rehabilitated bushland will be established to improve the overall visual amenity of the site and reduce the visual impacts of the final void, as well as provide vegetation connectivity north-south on the eastern side of the final void.

As stated above, the revised *Biodiversity Offset Strategy* proposes to compensate for the Project impacts and the impacts to the previously approved offset areas (i.e. cumulative impacts) on a 'like for like' basis with the equivalent of over 525 hectares of vegetation within the Whitehaven Regional BioBank Site. The *Strategy* will provide an offset to impact ratio of 4.75:1. The Whitehaven Regional BioBank Site is in the final stages of registration by the DECCW as a BioBank Site under Part 7A of the TSC Act. It will be actively managed via a BioBanking Management Plan with in-perpetuity management funding, and will have the highest level of conservation status outside of National Parks (via a BioBanking Agreement registered on the land title in-perpetuity). The improvements in conservation values at the Whitehaven Regional Biobank Site (through the cessation of current grazing and implementation of conservation management practices, including enhancement tree and shrub planting and weed control) will lead to an 'improve and maintain' conservation outcome.

In the long term, upon mine completion, the primary rehabilitation objective will be to provide a low maintenance, stable and safe landform that blends in with the surrounding topography and provides a mixture of rehabilitated bushland with areas of grazing consistent with the pre-mining conditions.

2.1 General Principles of the Rehabilitation Strategy

All areas significantly disturbed by mining activities will be rehabilitated to a stable landform with a self-sustaining vegetation cover. This will be achieved by the early establishment of a ground cover and appropriately positioned tree and shrub plantings.

Short term rehabilitation objectives include:-

- Minimise clearing/vegetation disturbance consistent with operational requirements;

- Schedule operations including overburden/interburden emplacement and shaping and revegetation to minimise visual exposure;
- Rehabilitate areas of disturbance no longer required for mining-related operations;
- Apply appropriate soil material (topsoil/subsoil) to the final landform based on material availability and post-mining land use;
- Stabilise all earthworks, drainage lines and disturbed areas in order to minimise erosion and sedimentation; and
- Control vermin, feral animals and noxious weeds.

The overall long term mine rehabilitation objective is to provide a low maintenance, geotechnically stable and safe landform that blends in with the surrounding topography and provides a mixture of rehabilitated bushland with areas of grazing consistent with the pre-mining conditions. Specific long-term objectives include:

- Re-establishing land to either pasture or bushland over the areas disturbed by the mine;
- Increasing the area of land allocated to bushland/woodland through the revegetation of those areas disturbed by the mine and the long-term conservation of remnant and degraded native vegetation and/or habitat corridors on the mine site;
- Provide habitat for fauna and corridors for fauna movement within the final landform;
- Develop and implement a long-term and regionally integrated *Biodiversity Offset Strategy*; and
- Monitor rehabilitation success in terms of physical and biological parameters.

2.2 Conceptual Final Rehabilitated Landform

Rehabilitation planning will ensure the total area of disturbance at any one time is minimised to reduce the potential for wind-blown dust, visual impacts and increased sediment-laden run-off.

The rehabilitation should generally be designed to achieve a stable final landform compatible with the surrounding environment. This involves the reshaping of the majority of overburden emplacement slopes to 10 degrees or less using large dozers. Should slopes exceed 10 degrees, additional drainage and revegetation works should be carried out to ensure sediment and erosion control and groundcover establishment is achieved.

The major features of the final landform proposed at Rocglen include the following:-

- An elevated landform to the north of the final void (Northern Emplacement Area). The maximum design height of this knoll will be approximately 50 metres above the pre-mining landform, which is the approximate height of the adjacent ridge to the west of the Project Site at around 340 metres AHD. Reshaping will ensure that final slopes around the margin of the knoll will not exceed 10 degrees (1H:6V).
- Coal extraction will leave an open pit void (final void) at mine closure covering an area of around 65 hectares in the eastern and southern extents of the open cut pit. It will have a maximum depth of around 65 metres below the natural surface, with elevations ranging between 220 and 285 metres AHD. The northern, western and part of the eastern slopes of the final void will be shaped to achieve between 10 and a maximum of 18 degree batter angles (1V:6H to 1V:3H) depending on the location of the slope within the extent of the void. The highwall on the south eastern margin of the final void will be battered to approximately 45 degrees (1V:1H) through blasting.

- An elevated ridgeline extending southwards adjacent to the Vickery State Forest along the western boundary of the Project Site, being the approved Western Emplacement Area. The maximum design height of this ridgeline will, again, be approximately 50 metres above pre-mining landform, which is the approximate height of the adjacent ridge immediately to the west at 340 metres AHD. Reshaping will ensure that final slopes will generally be 10 degrees (1H:6V). In the northern section the eastern batters of this ridgeline will graduate to the gently sloping landform north of the final void, while in the middle section the ridgeline batters will blend with those of the final void. In the section extent, the eastward and south facing batters of the ridgeline will blend into the undisturbed landform.
- The runoff from the Northern Emplacement Area and Western Emplacement Area will be managed by contour banks and rock drop structures conveying water off the relatively steep rehabilitated areas to the gentle surrounding slopes. Runoff from the Northern Emplacement Area will be directed to Dams A, B, C and E and discharged from the site into Driggle Draggle Creek. Runoff from the southern extent of the site, including the Western Emplacement Area, will flow southwards through Dam D to the east of the Western Emplacement Area and a series of small sediment dams to the west of the Western Emplacement Area before entering Dam SB 19. Overflows from Dam SB 19 will enter Dam SD 3 prior to leaving the site via an existing drainage line that eventually drains into the Namoi River approximately 10 kilometres from the Project Site. Rehabilitation of this drainage line, and others within the Project Site, will seek to reinstate the natural hydraulic functions and provide a revegetated riparian corridor in accordance with the *Blue Book* (LandCom, 2004 and DECC, 2008) and the *Guidelines for Controlled Activities – In-Stream Works* (DWE, 2008).
- An additional Dam F will be constructed to the north of the final void to assist with the prevention of surface water runoff entering into the void. Dam F will be sufficiently large (in the order of 15 megalitres) to capture large storm events (for example, 10 year Annual Recurrence Interval events) and allow this water to be used for stock watering purposes and evaporated to minimise discharges to the final void. A low flow pipe will be installed (below the primary spillway) to safely convey dam overflows to the base of the final void. Extreme rainfall events will result in flows over the spillway and into the final void.

The final landform would also incorporate contour/graded banks installed progressively as part of the rehabilitation program. The spacing and ultimate dimensions of these structures would be a function of the final slope and catchment area and, consequently, would be determined at the time of installation. On the steeper slopes, bank spacing should generally range between 50 and 80 metres.

Other mine-related features forming part of the final landform within the Project Site will be rock drop structures, water storage dams and sediment basins used for surface water management and erosion and sediment control.

Unless otherwise directed by Gunnedah Shire Council, the upgraded section of Shannon Harbour Road would be retained, with maintenance responsibilities passing to Council. However, if instructed, Whitehaven will remove the entire bitumen pavement, any emplaced construction materials and water management structures, and re-profile, topsoil and seed the land to its pre-development landform.

2.2.1 Conceptual Post-Mining Land Use

Of the total anticipated disturbed area of approximately 358 hectares, it is proposed to restore approximately 206 hectares as rehabilitated bushland (58 percent), 147 hectares as rehabilitated pasture (41 percent), with the remaining 5 hectares comprising the retained highwall of the final void (1 percent). Furthermore, there will be retained areas of existing remnant vegetation within the Project Site.

The section of the Project Site which falls on the "Roseberry" property would be predominately returned to rehabilitated pasture, with grazing able to recommence once a stable vegetative cover is established. The western area of the property will be restored as rehabilitated bushland to link in with the existing remnant bushland to the west (Vickery State Forest) and create a viable connection with the surrounding environment.

The area of the Project Site formally known as the "Belmont" property will be established predominantly with rehabilitated bushland, with a small proportion of the south-eastern corner of the property returned to rehabilitated pasture. A corridor from the western rehabilitated bushland will extend between the Northern Emplacement Area and the final void to connect with remnant vegetation to the east of the Project Site and create a wildlife corridor.

The western slopes of the Northern Emplacement Area within the "Glenroc" property will be restored to rehabilitated bushland, which will connect to and enhance the existing areas of remnant native vegetation that are to remain undisturbed. The remaining sections of the property will be rehabilitated to pasture, potentially allowing for the re-commencement of some grazing activities.

Along the eastern boundary of the Project Site, adjacent to the realigned Wean Road, a strip of rehabilitated bushland will be established to screen the view of the final void and generally improve the visual amenity from Wean Road, as well as provide vegetation connectivity north-south on the eastern side of the final void.

The large area proposed to be returned to rehabilitated bushland, which includes the western slopes of the Northern and Western Emplacement Areas, will blend in well with the retained remnant vegetation areas within the Project Site and within the adjacent Vickery State Forest and "Yarrawonga" property. Furthermore, strategically placed bushland tree lots to be established within rehabilitated pasture areas will break-up the landform and act as wildlife refuges and linkages.

2.3 Progressive Rehabilitation

Whitehaven will adopt a progressive approach to the rehabilitation of disturbed areas within the Project Site to ensure that, where practicable, areas where mining or overburden placement are completed are quickly shaped, topsoiled and vegetated to provide a stable landform. The progressive formation of the post-mining landform and the establishment of a vegetative cover will reduce the amount of disturbed land at any one time and also reduce the visibility of mine-related activities from surrounding properties and roads. Early reprofiling and revegetation of the external batter slopes of the emplacement areas is particularly important and has been targeted as a priority.

It is proposed that progressive rehabilitation be undertaken on the site, with disturbed areas generally undergoing rehabilitation within one year of overburden placement and subsequently being re-profiled to the final landform.

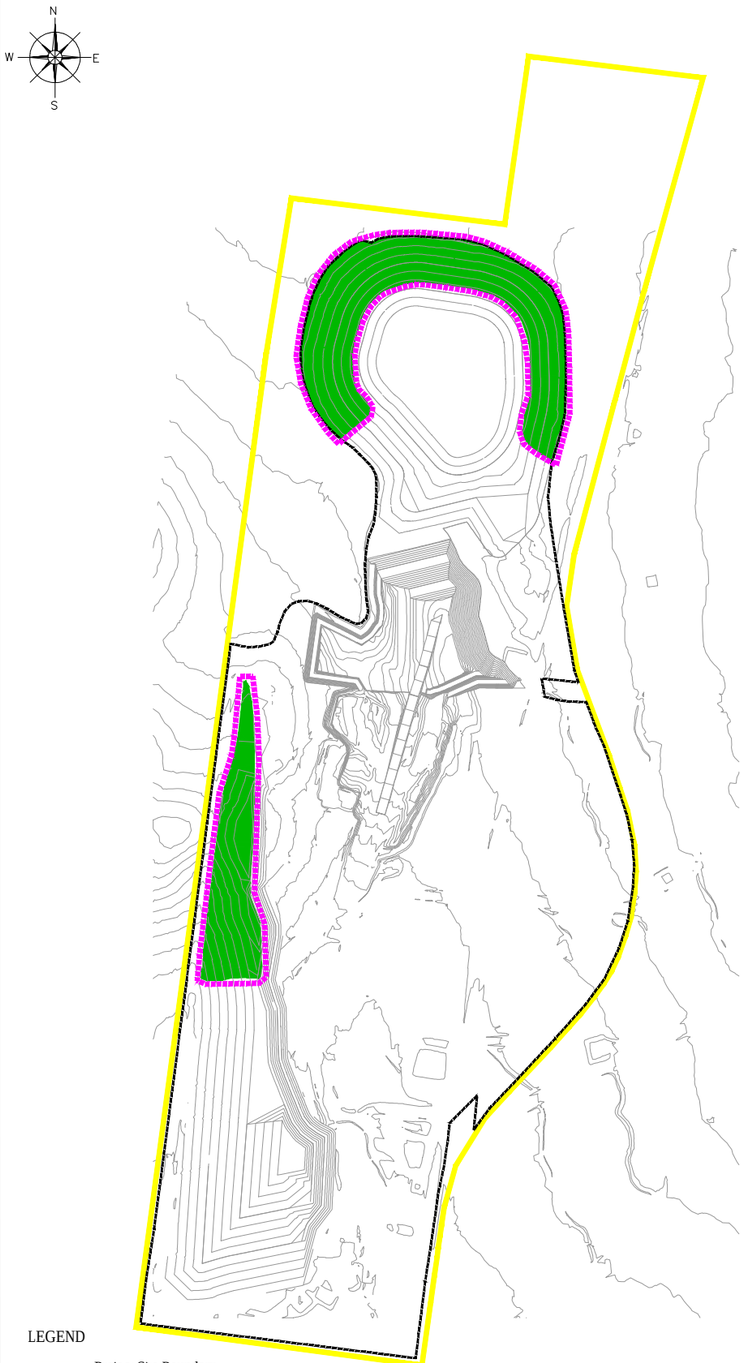
Table 1 outlines the progressive site rehabilitation for the Life of Mine (LOM), detailing the year in which rehabilitation is likely to be completed and the total area (hectares) to be rehabilitated.

Table 1 – Indicative Rehabilitation Schedule for the Life of the Mine

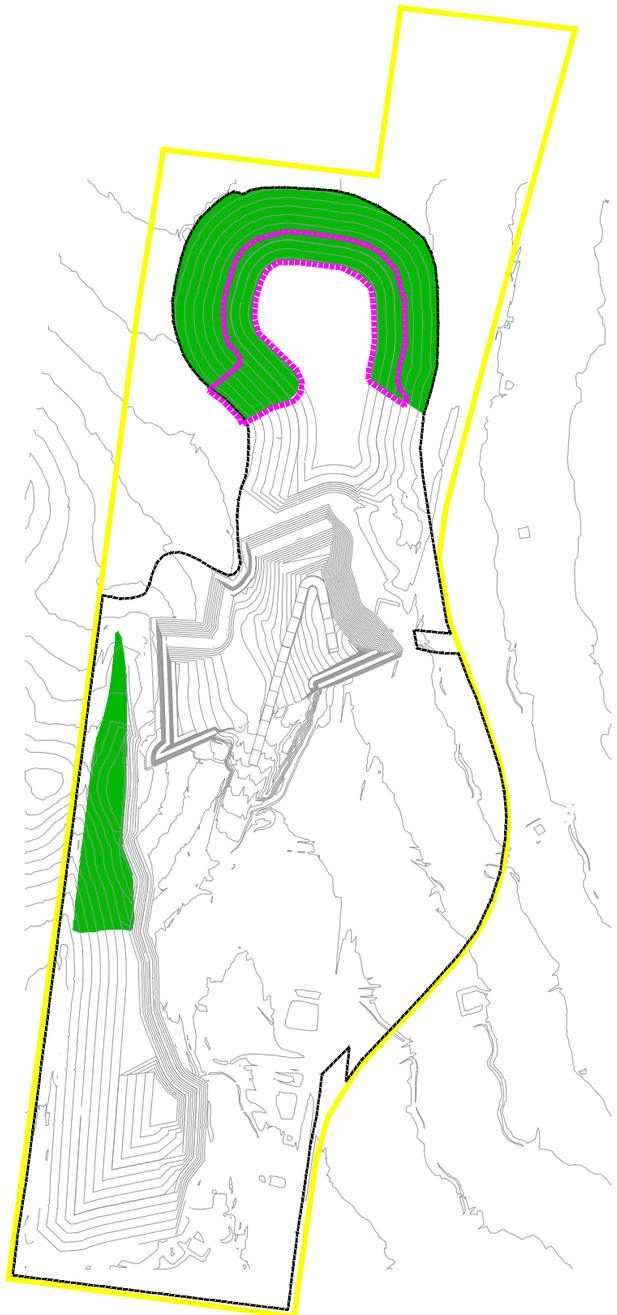
Year Rehabilitation to be Undertaken	Area (ha)
Year 1 of Expanded Operation	Rehabilitation Commences
Year 2 of Expanded Operation	33
Year 3 of Expanded Operation	14
Year 4 of Expanded Operation	11
Year 5 of Expanded Operation	14
Year 6 of Expanded Operation	26
Year 7 of Expanded Operation	13
Year 8 of Expanded Operation	26
Year 9 of Expanded Operation	11
Year 10 of Expanded Operation	25
Year 11 of Expanded Operation	11
End of Mine Life	174
Total	**358**

Figures 3 to **6** illustrate the progressive rehabilitation of the site on an annual basis. The following is a brief description of the annual rehabilitation sequencing:-

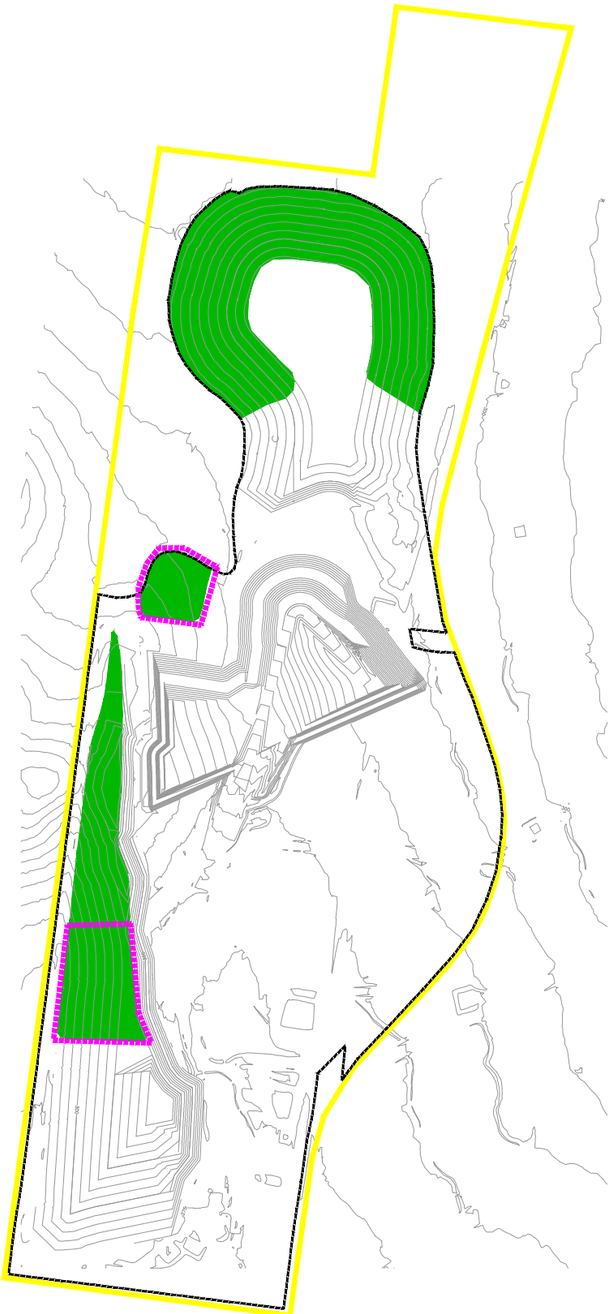
- **Year 1 of Expanded Operation** – no rehabilitation to occur in Year 1.
- **Year 2 of Expanded Operation** - rehabilitation of approximately 24 hectares on the lower slopes of the Northern Emplacement Area to the east, west and north, and approximately 9 hectares on the northern section of the Western Emplacement Area. Topsoil utilised for this rehabilitation will be obtained from stripped and stockpiled sources.
- **Year 3 of Expanded Operation** – rehabilitation of approximately 14 hectares on the central slopes of the Northern Emplacement Area to the east, west and north, utilising topsoil from stripped and stockpiled sources.
- **Year 4 of Expanded Operation** – rehabilitation of approximately 3 hectares within the mine pit and approximately 8 hectares at the southern end of the Western Emplacement Area. Topsoil utilised for this rehabilitation will be obtained from stripped and stockpiled sources.
- **Year 5 of Expanded Operation** – rehabilitation of approximately 14 hectares on the lower slopes of the Northern Emplacement Area to the south, using stripped and stockpiled topsoil.
- **Year 6 of Expanded Operation** – rehabilitation of approximately 17 hectares on the upper slopes of the Northern Emplacement Area and approximately 9 hectares on the southern end of the Western Emplacement Area. Topsoil utilised for this rehabilitation will be obtained from stripped and stockpiled sources.
- **Year 7 of Expanded Operation** – rehabilitation of approximately 13 hectares within the northern area of the mine pit, utilising stripped and stockpiled topsoil.
- **Year 8 of Expanded Operation** - rehabilitation of approximately 26 hectares in the northern and central areas of the mine pit, utilising stripped and stockpiled topsoil.
- **Year 9 of Expanded Operation** - rehabilitation of approximately 5 hectares in the central area of the mine pit and approximately 6 hectares on the southern end of the Western Emplacement Area. Topsoil utilised for this rehabilitation will be obtained from stripped and stockpiled sources.



Rehabilitated Areas - Year 2



Rehabilitated Areas - Year 3



Rehabilitated Areas - Year 4

LEGEND

- Project Site Boundary
- Total Rehabilitated Area
- Rehabilitated Area - This Annual Period
- Total Potential Disturbance Area

0 400 800m

Base Plan Source: MMG Civil P/L

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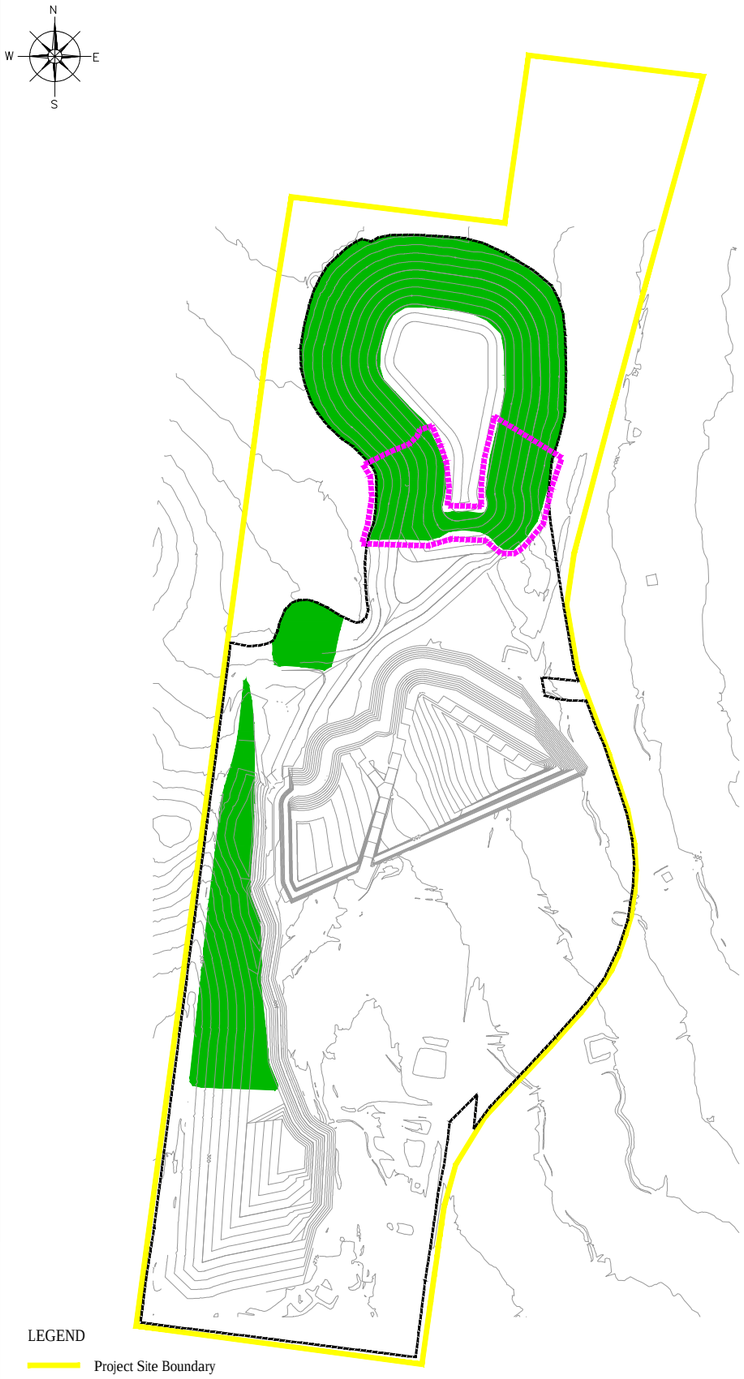
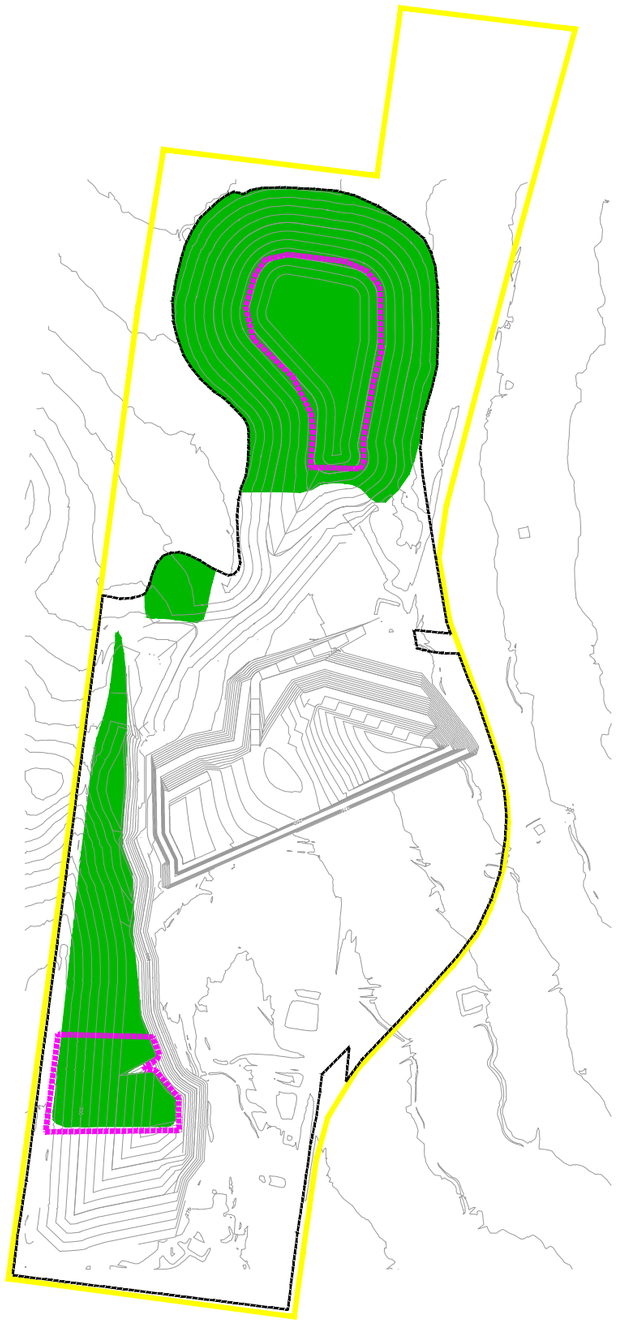
Rocglen Coal Mine Extension Project
Progressive Rehabilitation Years 2 - 4

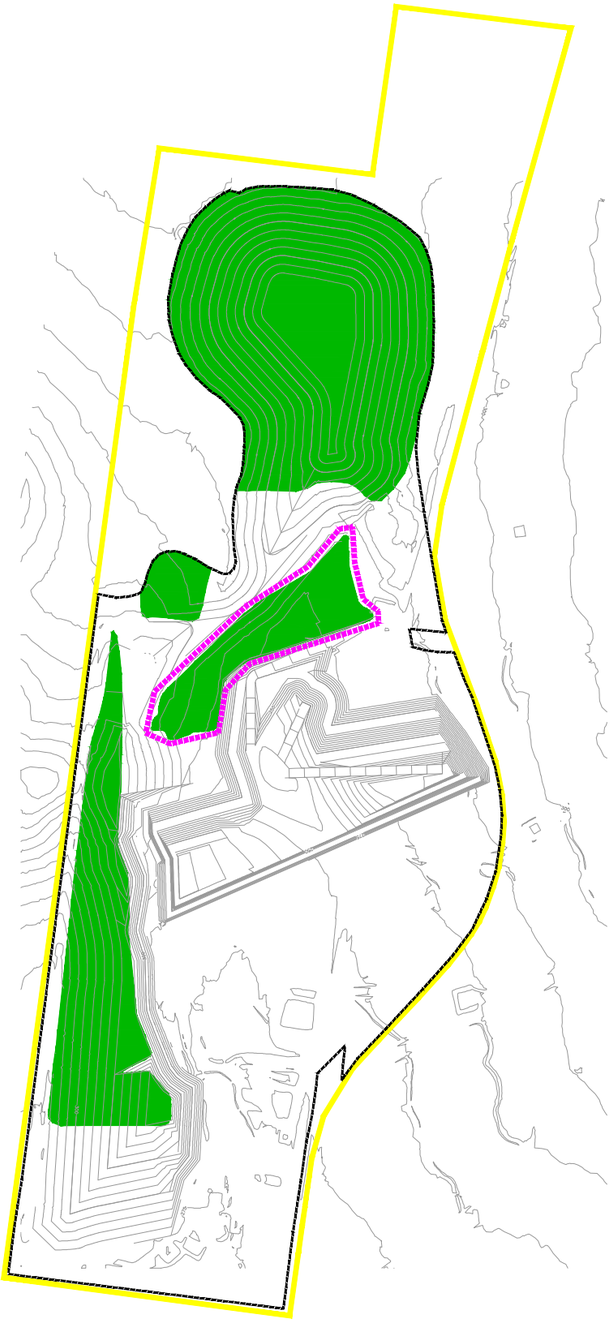
FIGURE 3



Rehabilitated Areas - Year 5



Rehabilitated Areas - Year 6



Rehabilitated Areas - Year 7

LEGEND

- Project Site Boundary
- Total Rehabilitated Area
- Rehabilitated Area - This Annual Period
- Total Potential Disturbance Area

0 400 800m

Base Plan Source: MMG Civil P/L

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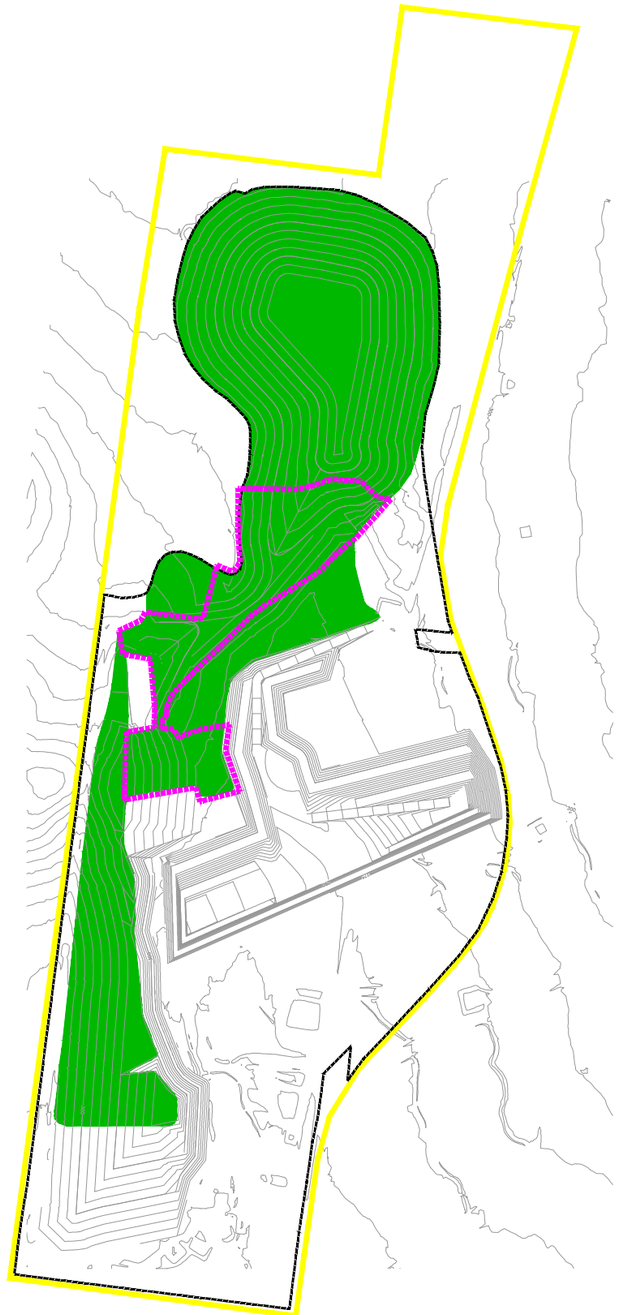
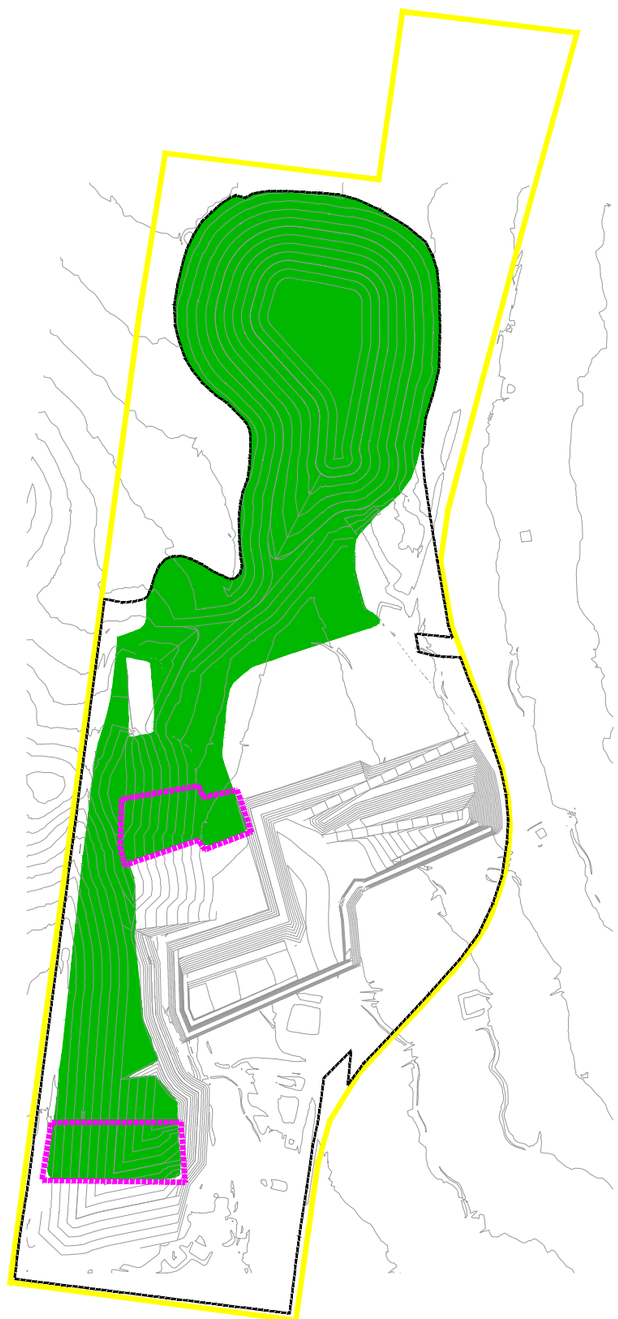
Rocglen Coal Mine Extension Project
Progressive Rehabilitation Years 5 - 7

FIGURE 4



Rehabilitated Areas - Year 8



5Rehabilitated Areas - Year 9

LEGEND

- Project Site Boundary
- Total Rehabilitated Area
- Rehabilitated Area - This Annual Period
- Total Potential Disturbance Area

0 400 800m

Base Plan Source: MMG Civil P/L

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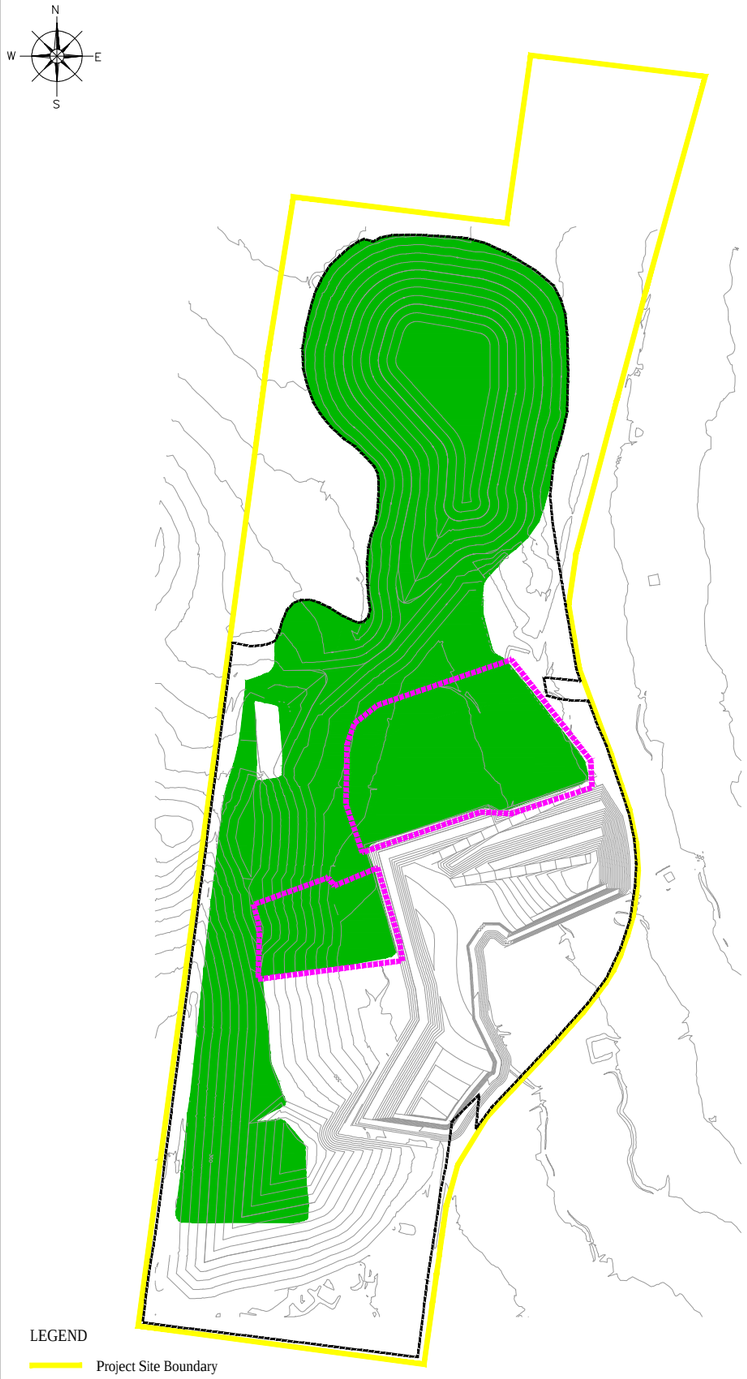
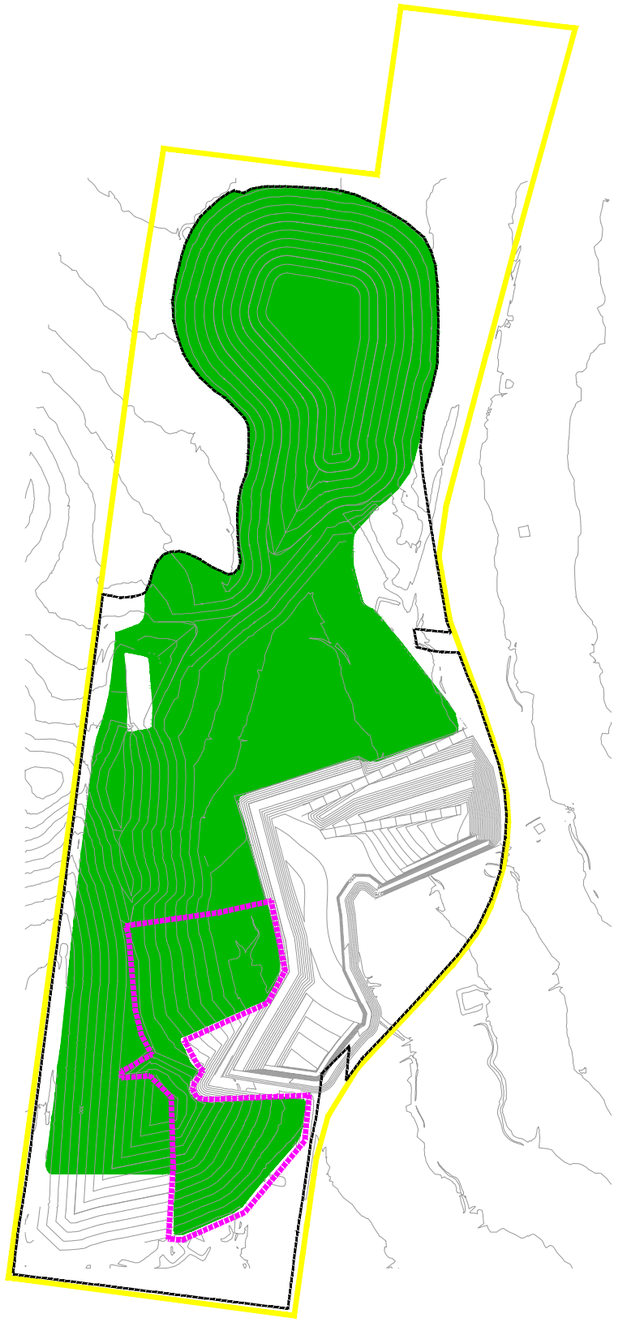
Rocglen Coal Mine Extension Project
Progressive Rehabilitation Years 8 - 9

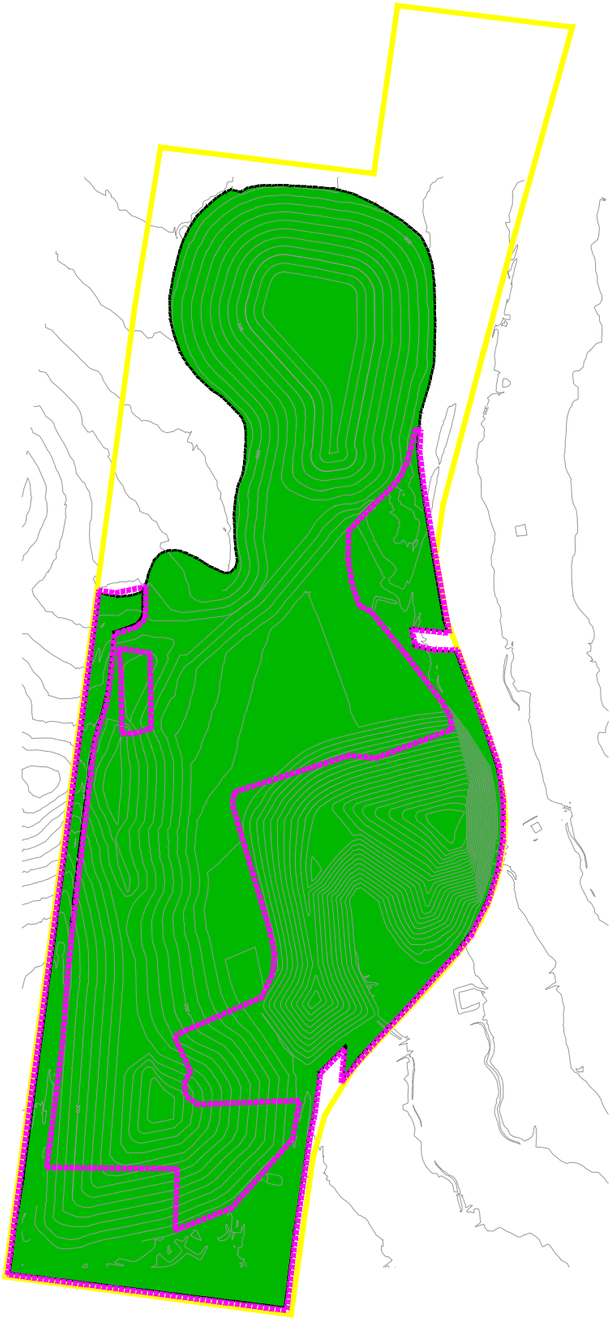
FIGURE 5



Rehabilitated Areas - Year 10



Rehabilitated Areas - Year 11



Rehabilitated Areas - End Of Mine Life

LEGEND

- Project Site Boundary
- Total Rehabilitated Area
- Rehabilitated Area - This Annual Period
- Total Potential Disturbance Area

0 400 800m

Base Plan Source: MMG Civil P/L

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Rocglen Coal Mine Extension Project Progressive Rehabilitation Year 10 - End of Mine Life

FIGURE 6

- **Year 10 of Expanded Operation** – rehabilitation of two areas within the northern and central areas of the mine pit, totalling approximately 25 hectares. Topsoil utilised for this rehabilitation will be obtained from stripped and stockpiled sources.
- **Year 11 of Expanded Operation** – rehabilitation of approximately 11 hectares at the southern end of the Western Emplacement Area, utilising stripped and stockpiled topsoil.
- **End of Mine Life** – rehabilitation of the remaining 174 hectares, utilising stripped and stockpiled topsoil.

2.4 Revegetation

The following sub-sections outline the rehabilitation procedures that will be adopted for each component area within the Project Site. These procedures are generally based on the successful rehabilitation already undertaken at Rocglen and other Whitehaven mines, with additional site specific input obtained from flora, fauna, soil and surface water consultants.

Whitehaven will routinely liaise with offices of the local Soil Conservation Service (SCS), DECCW and Gunnedah Shire Council when planning and/or undertaking rehabilitation activities.

2.4.1 Implementation of an Effective Revegetation Program

Rehabilitation of areas disturbed as a result of mining or overburden placement activities will be undertaken in the following five stages:

Stage 1: Overburden Placement and Shaping

Placement and shaping of overburden to create slopes with gradients around 10 degrees will be undertaken in a manner which, wherever practicable, ensures that any friable or weathered materials are placed below the subsoil and topsoil layers in order to provide a cover of more competent material and avoid the exposure of large rocks on the final surface. Any coarse rejects placed in the mine void would be covered with at least 3 metres of overburden material.

An initial assessment of interburden materials did not identify any risk of acid generation or soluble salt formation, and as such no specific handling or storage requirements are considered necessary.

Stage 2: Subsoil and Topsoil Replacement

Whitehaven's adopted general practice of including an intermediate layer of subsoil between the overburden material and the topdressing, which improves the water holding capacity of the rehabilitated landform and reinstates a more natural soil profile, will continue.

Whitehaven may reduce or remove subsoil replacement in targeted areas of woodland rehabilitation as a means of investigating impacts of different soil regimes on woodland development.

Where resources allow, topsoil and subsoil will each be spread to a nominal depth of between 100 to 150 mm, giving a combined depth of soil material on the rehabilitated landform of between 200 and 300 mm. The subsoil layer will be spread on an even but roughened surface that has been ripped along the line of the contour to break any compacted and/or smooth surfaces. Ripping will also assist the keying of subsoil into the overburden, which will, in turn, assist in the prevention of land slip and can help vegetation penetrate deep into the soil profile, encourage ingress of water and minimise erosion.

Tree trunks and branches less than 300 mm diameter and other smaller vegetative debris removed during clearing activities will be spread over those areas to be restored as rehabilitated bushland where practical.

Stage 3: Drainage Installation

Surface water management structures will be progressively installed on the rehabilitated landform. The heights (effective depths) and cross-sectional areas of the individual banks will be determined on the basis of individual sub-catchment areas, but will typically be less than 0.7 metres and 3.0 square metres (m^2), respectively. Rock-lined drains will be used, where required, to convey water safely from the rehabilitated landform into the surface water management system that takes water from the site.

Stage 4: Agricultural Land Pasture Sowing

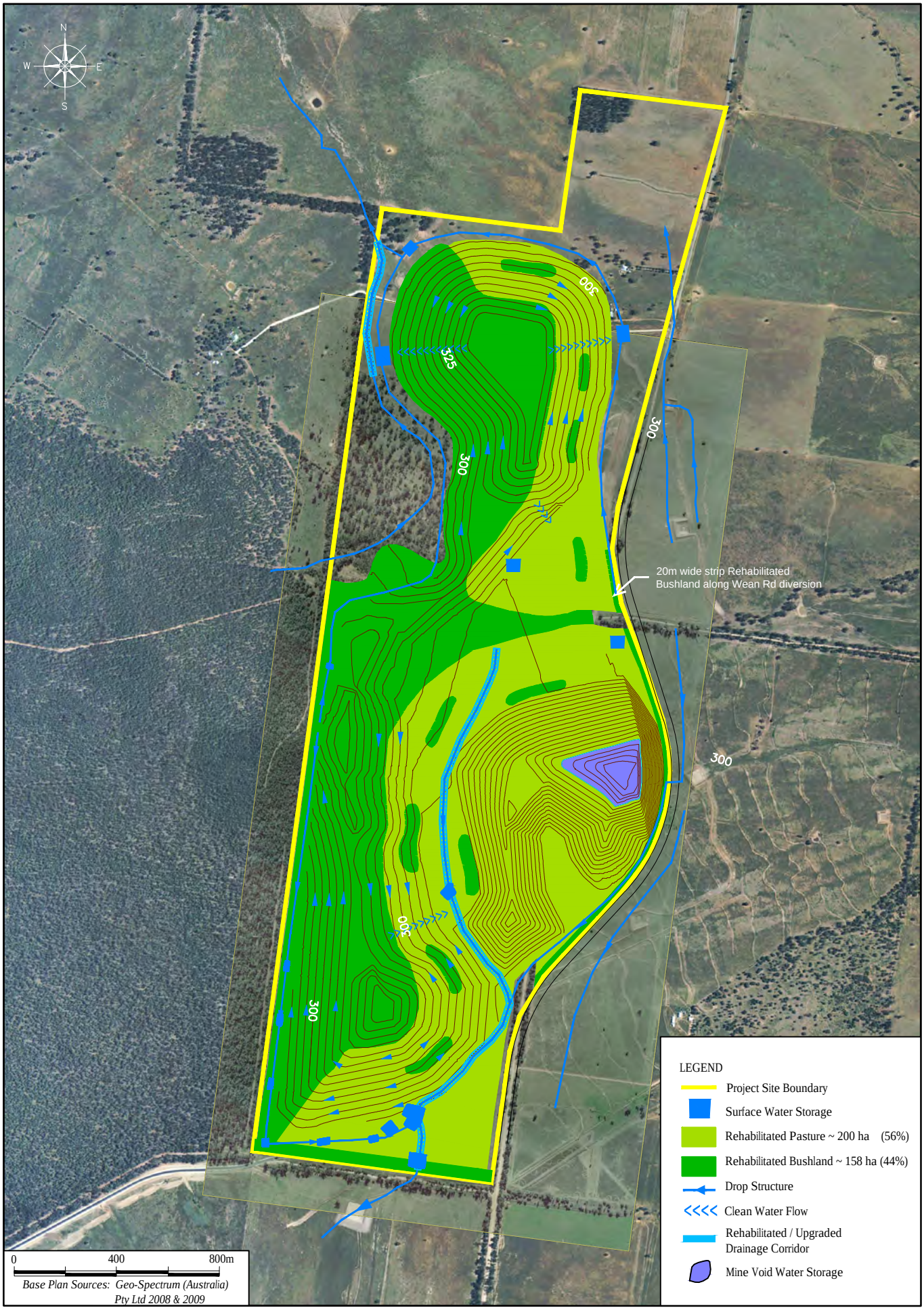
The topsoiled surface of those areas designated for a post-mining agricultural (grazing) land use will be sown with a mixture of pasture species appropriate for the season. The seed mixture will include fast growing, short-lived species and perennial grasses and legumes. A proposed pasture mix for cool and warm seasons is presented in **Table 2**. Following establishment of these areas, it is anticipated rotational cropping of pasture and suitable crops will be undertaken at the discretion of the landowner. Refer to **Figure 7** for the conceptual final land use.

Table 2 – Pasture Species Seed Mix

Pasture Species	Rate (kg/ha)	Fertiliser
Warm Season Grasses		
Bombatsi Panic	1 – 2	250kg/ha
Green Panic *2	2 – 4	Di-ammonium Phosphate (DAP)
Rhodes Grass*2	1 – 2	
Purple Pigeon Grass	1 – 2	
Annual Legumes		
Subterranean Clover	4 - 5	
Cool Season Legumes*1		
Barrel (Sephi) medic	2 – 4	
Snail (sava) medic *2	3 – 5	
Woolly Pod Vetch	4 – 6	
Serradella (Elgara)	1 – 2	
Lucerne	0.5	
Cool Season Grasses		
Phalaris (Sirolan or Holdfast)	1 -2	
Wallaby Grass	0.3 - 1	
*1 Inoculated with appropriate rhizobia *2 Specific Soil Conservation Application		

Stage 5: Native Vegetation Establishment

The topsoiled surfaces of those areas designated to be restored as rehabilitated bushland will be initially stabilised with a non-persistent cover crop followed by planting of a selection of locally occurring trees. **Table 3** lists recommended tree and shrub species for the re-establishment the bushland within the Project Site.



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Rocglen Coal Mine Extension Project
Post-Mining Landform and Land Use

FIGURE 7

Table 3 – Recommended Tree and Shrub Species

Common Name	Scientific Name
Trees	
Narrow-leaf ironbark	*Eucalyptus crebra*
Pilliga Grey Box	*Eucalyptus pilligaensis*
White Box	*Eucalyptus albens*
Blakely's Red Gum	*Eucalyptus blakelyi*
Yellow Box	*Eucalyptus melliodora*
Rosewood	*Alectryon oleifolius*
Bull Oak	*Allocasuarina luehmannii*
Bimble Box	*Eucalyptus populnea*
Brigalow *Acacia*	*harpophylla*
Wilga	*Geijera parviflora*
Belah	*Casuarina cristata*
Wild Orange	*Capparis mitchellii*
White Cypress Pine	*Callitris glaucophylla*
Shrubs	
Western Golden Wattle	*Acacia decora*
Amulla	*Myoporum debile*
Sandalwood	*Santalum lanceolatum*
Eastern Cottonbush	*Maireana microphylla*
Native Jasmine	*Jasminum lineare*
Gargaloo	*Parsonsia eucalyptophylla*
Yellow Berry Bush	*Maytenus cunninghamii*
Wild Lemon	*Canthium oleifolium*
Wild Orange	*Capparis mitchellii*
Hopbush	*Dodonaea* spp.
Emubush	*Eremophila longifolia*
Native Olive	*Notelaea macrocarpa*
Butterbush	*Pittosporum angustifolium*
Cough Bush	*Cassinia laevis*

The species will encourage the re-establishment of the pre-agricultural vegetation communities and, in the medium to longer term, create habitat and corridors for native fauna. Tubestock will generally be propagated from locally-collected seed through Whitehaven's seed collection program. Tubestock will be used in strategic landscape planting around the site for visual mitigation. Large areas will be seeded by direct seeding methods if site conditions allow, and will require the purchase of bulk seed mixes.

All areas identified for bushland and pasture re-establishment will be fenced and have stock excluded until it can be demonstrated that the vegetation is stable and self-sustaining, and that grazing will not impact upon its establishment.

2.4.2 Rehabilitation Maintenance

A commitment to effective rehabilitation involves an ongoing monitoring and maintenance program throughout and beyond the operation of the mine. Areas being rehabilitated should be regularly inspected and assessed against the long and short term rehabilitation objectives outlined in **Section 2.1**. During regular inspections, aspects of rehabilitation to be monitored should include:-

- Evidence of any erosion or sedimentation from areas with establishing vegetation cover;
- Success of initial grass cover establishment;
- Success of tree and shrub plantings;
- Adequacy of drainage controls;
- Presence/absence of weeds; and
- General stability of the rehabilitation site.

Where the rehabilitation success appears limited, maintenance activities should be initiated. These may include re-seeding and where necessary, re-topsoiling and/or the application of specialised treatments such as composted mulch to areas with poor vegetation establishment. Tree guards will be placed around tube stock if grazing by native animals is found to be excessive.

If drainage controls are found to be inadequate for their intended purpose or compromised by grazing stock or wildlife, these should be repaired and/or temporary fences installed to exclude animals. Should areas of excessive erosion and sedimentation be identified, remedial works such as importation of additional fill, subsoil or topsoil material and/or the redesigning of water management structures to address erosion should be undertaken.

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

No time limit has been placed on post-mining rehabilitation monitoring and maintenance. Rather, maintenance should continue until such time as the objectives are met, although it is generally accepted that is will be at least five (5) years beyond closure.

2.4.3 Topsoil Management

Whitehaven recognises that appropriate soil identification, stripping and management practices are important in terms of achieving successful rehabilitation and the desired post mining land use(s). The *Soil Survey and Land Resource Impact Assessment* (GSS Environmental, 2010) prepared for the Project identifies and recommends effective soil management practices.

Stripping of Topsoil and Subsoil

Careful planning and supervision of topsoil stripping activities is critical in ensuring all suitable material is recovered, while avoiding unsuitable materials such as dispersive or sodic subsoil. Where practicable, topsoil from the bushland and pasture areas will be preferentially stripped and stockpiled separately so that it can be placed in designated areas in accordance with the revegetation types on the site.

Some subsoils will be stripped to be used as a topsoil substitute or to establish a more natural soil profile over the reshaped overburden.

A detailed description of the appropriate soil stripping methodologies is included in the Soil Survey and Land Resource Impact Assessment prepared by GSS Environmental (2010).

Minimise Handling of Topsoil

Topsoil will generally be stripped ahead of the mining activities, transported and re-spread using a scraper. Direct placement is always the best management option as it reduces soil degradation and minimises later compaction. Where direct placement is not possible stockpiling will be necessary.

Stockpiling

Ideally, where possible, topsoil should not be stockpiled. However, difficulties associated with mining and rehabilitation sequencing typically necessitate stockpiling. Stockpiles should be constructed to minimise deterioration of seed, nutrients and soil biota by avoiding topsoil collection when saturated following rainfall, thus avoiding composting and compaction, and by forming stockpiles to a suitable height. It is recommended that topsoil stockpiles be no higher than 3 metres. There is generally no requirement for limiting the height of subsoil stockpiles, however, if there is adequate available stockpiling area, 3 metres is good practice. Clayey soils should be stored in lower stockpiles for shorter periods of time compared to sandier soils (GSS Environmental, 2010).

The duration of stockpiling should be minimised (where possible), as periods longer than about 6 to 12 months may cause structural degradation and death of seeds and micro-organisms, especially when soil moisture content is high. Seeding of the stockpile with an appropriate grass/legume mixture will minimise erosion, enhance weed control and reduce the loss of beneficial micro-organisms. Stockpiles should be placed outside of drainage areas where water is likely to be backed up. Where stockpiles become weed infested, the top 150 mm should be scalped off and discarded prior to the remaining material being utilised for rehabilitation.

It is recommended that Whitehaven investigate the mulching of trees to be removed to make way for the expanded operation in order to incorporate this material into the topsoil prior to spreading over the areas to be restored to bushland.

A detailed list of appropriate soil stripping and stockpiling methodologies is included in the Soil Survey and Land Resource Impact Assessment (GSS Environmental, 2010).

2.4.4 Weed Management

The presence of weed species has the potential to have a major impact on revegetation and regeneration outcomes. In addition to this, the presence of weed species within the surrounding land has the potential to significantly impact on the biodiversity value of rehabilitated areas. Weed management will be a critical component of mine rehabilitation and landscaping activities.

Whitehaven is conscious of the potential problem of noxious weed infestation and will take the necessary precautions to prevent the excessive development of weeds within the rehabilitated areas. When appropriate, this should include campaign weed spraying prior to the stripping of topsoil. The appropriate noxious weed control or eradication methods and programs should be undertaken in consultation with the Department of Industry and Investment (I&I NSW) and/or the local Noxious Weeds Inspector.

Recommended weed control measures include:-

- Hosing down equipment in an approved wash down area before entry to site;
- Herbicide spraying or scalping weeds off topsoil stockpiles prior to re-spreading;
- Rehabilitation inspection to identify potential weed infestations; and

- Identifying and spraying existing weed populations on-site together with on-going weed spraying over the life of the mine.

The monitoring and control of weed populations using herbicides, particularly in the areas to be stripped and on topsoil stockpiles, will also assist.

Weed control, if required, should be undertaken in a manner that will minimise soil disturbance. Any use of herbicides should be carried out in accordance with I&I NSW and Department of Environment, Climate Change and Water (DECCW) requirements. Records should be maintained of weed infestations and control programs implemented according to best management practice for the weed species concerned.

2.4.5 Rehabilitation Monitoring

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

Monitoring should be conducted periodically by independent, suitably skilled and qualified persons at locations that are representative of the range of conditions on the rehabilitating areas. Annual reviews should be conducted of monitoring data to assess trends and monitoring program effectiveness. The outcome of these reviews should be included in each AEMR.

In developing the rehabilitation monitoring program, the following aspects should be taken into consideration:

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

Figure 8 shows the monitoring plot design recommended to be adopted for the monitoring of an area revegetated with trees.

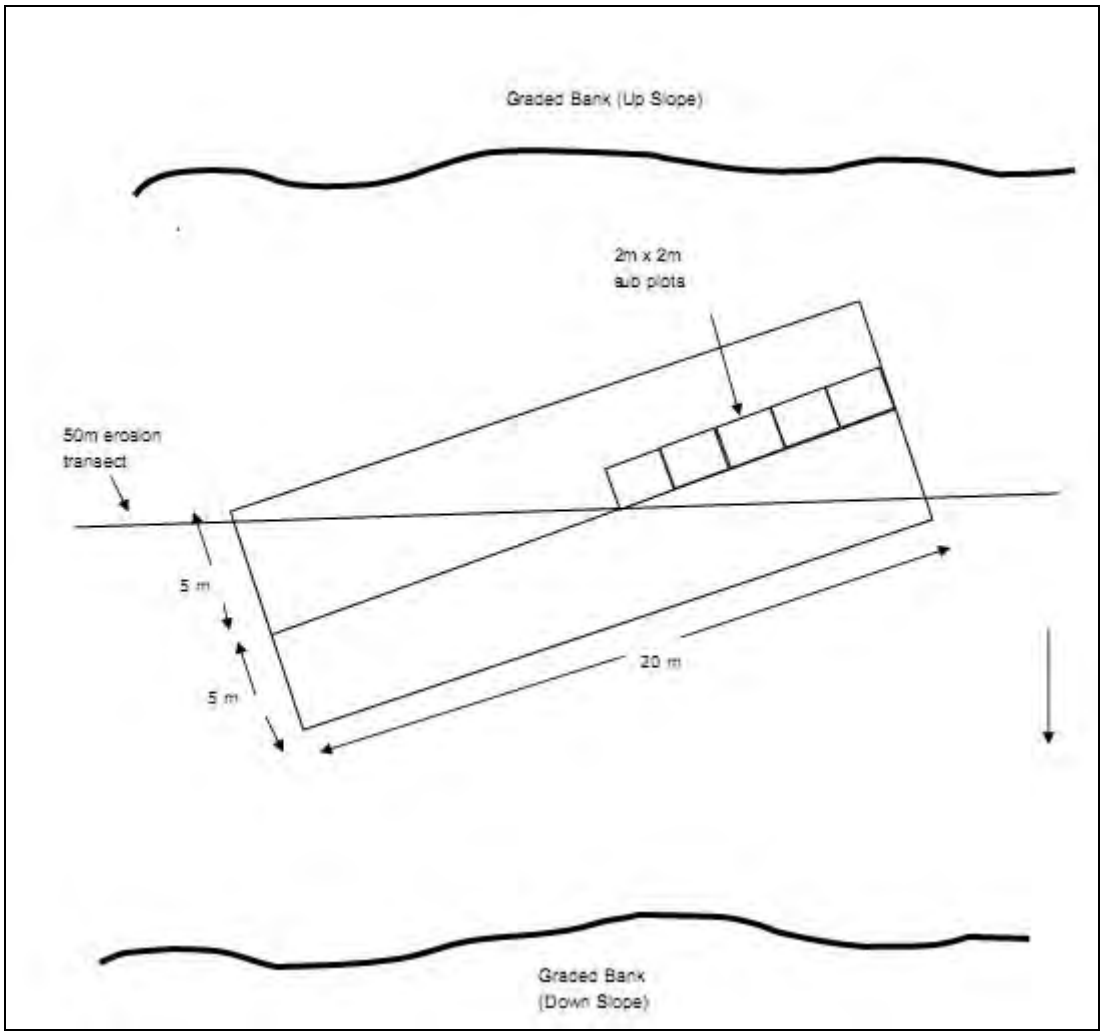


Figure 8 – Typical Monitoring Plot Design (Areas Revegetated to Bushland)

For the areas rehabilitated as pasture, it is proposed that a 100 metre transect be established across a 'typical' section of rehabilitation at the site and monitored for:

- Grass cover in 2 metre by 2 metre (4 square metres) plots every 20 metres;
- Pasture species present;
- Weed species present and percentage area noted;
- Percentage of bare ground; and
- Extent and type of erosion.

Along the 100 metre transect general comments such as rocks present, presence/absence of topsoil and other factors likely to influence rehabilitation development should be noted.

Rehabilitation methods will be improved as additional knowledge develops from monitoring data collected through these programs.

More specifically, monitoring of the elements in **Table 4** should be undertaken to determine the level of achievement of success criteria.

Table 4 – Recommended Rehabilitation Monitoring Program

Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
Ecosystem Establishment		
General Description	• Describe the vegetation in general terms, e.g. mixed eucalypt woodland with grass understorey and scattered shrubs, dense Acacia scrub, etc.	12 months after establishment and then every 2 years
2m x 2m Quadrats	• Count the number of plants of all species, excluding grass • Measure live vegetation cover for understorey and grasses (separately) using a line intercept method • Record details of ground cover (litter, logs, rocks etc.)	12 months after establishment and then every 2 years
20m x 10m Plots	• Count, by species, all trees >1.6m tall. • Tag and measure DBH of trees >1.6m tall, to a maximum of 10 for any one species. • Record canopy cover over the whole 20m centreline when trees are tall enough • Subjectively describe tree health, by species if relevant, noting signs of drought stress, nutrient deficiencies, disease and severe insect attack. Where health problems are noted, record the percentage of unhealthy trees. • Record any new plant species not present in the smaller plots, including any problem and declared noxious weeds • Take five surface soil samples (e.g. at approx. 5m intervals along the centreline) and bulk these for analyses of: pH, EC, chloride and sulfate; exchangeable Ca/Mg/K/Na; cation exchange capacity; particle size analysis and R1 dispersion index; 15 bar and field capacity moisture content; organic carbon; total and nitrate nitrogen; total and extractable phosphorus; Cu, Mn and Zn.	12 months after establishment and then every 2 years
50m Transect	• Along the 50m erosion monitoring transect, record the location, number and dimension of all gullies >30cm wide and/or 30cm deep. • Erosion pins should be established in plots located in newer rehabilitation to record sheet erosion if present	12 months after establishment and then every 2 years
Rehabilitation in General	• When traversing between monitoring plots, note the presence of species of interest not previously recorded (e.g. key functional or structural species, protected species, noxious weeds), as well as obvious problems including any extensive bare areas (e.g. those greater than 0.1ha). • Observations such as this can provide useful, broad scale information on rehabilitation success and problems.	12 months after establishment and then every 2 years
Photographic Record	• For each 20m x 10m plot, a photograph should be taken at each end of the plot, along the centreline looking in.	12 months after establishment and then every 2 years
Habitat	• General observations relating to the availability and variety of food sources (e.g. flowering/fruiting trees, presence of invertebrates etc). • Availability and variety of shelter (e.g. depth of leaf litter, presence of logs, hollows etc). • Presence/absence of free water in the rehabilitated areas	12 months after establishment and then every 2 years
Fauna	• General observations of vertebrate species (including species of conservation significance). • Detailed fauna surveys including presence and approximate	After rehabilitation is three years old undertake monitoring biennially in both

Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
	abundance and distribution of vertebrate species (focussing on species of conservation significance).	Autumn and Spring
Weeds and Pests	• Species identity. • Approximate numbers/level of infestation. • Observations of impact on rehabilitation (if any).	Quarterly during the first two years and biennially after that. Inspections should be opportunistic after significant rainfall events.
Geotechnical Stability		
	• Assessment of the stability of batters and also looking at surface settlements (sink holes). In particular where these features could impact on the performance of any surface water management system. • Surface integrity of landform cover/capping (measurement of extent of integrity failure). • Presence / absence of landform slumping.	Annually
Surface and Groundwater		
	• Groundwater quality and depth. • Efficiency of landform surface water drainage systems (integrity of banks and drains) • Water quality including pH, EC and total suspended solids of water in water storages, and pits, sedimentation dams.	Quarterly or following rainfall events Monitoring of receiving waters

2.5 Preliminary Rehabilitation Success Criteria

Rehabilitation planning criteria for the mine site as presented in this section have been taken from *Strategic Framework for Mine Closure* (ANZMEC, 2000) to ensure the most appropriate and efficient rehabilitation techniques are applied. It is also recommended that Whitehaven seek advice from representatives of I&I NSW, DoP, DECCW and specialist consultants regarding any additional actions that may need to be adopted.

The following is a list of the ANZMEC Rehabilitation Criteria:

- Rehabilitation and rehabilitation outcomes consistent with the Environmental Assessment which formed the basis of approval.
- Based on mine closure criteria and rehabilitation outcomes developed through stakeholder consultation.
- Integrates rehabilitated native vegetation with undisturbed native vegetation to provide larger areas and wildlife corridors.
- Suitable for an agreed subsequent land use as far as possible compatible with the surrounding land fabric and land use requirements.
- Addresses limitations on the use of rehabilitated land.
- Sustainable in terms of that land use.
- Stable and permanent landforms, with soils, hydrology, and ecosystems with maintenance needs no greater than those of surrounding land (may include waste emplacements, voids, pits and water-bodies providing that they are part of the accepted final outcome).
- Securely and safely contain waste substances that have the potential to affect land use or result in pollution.
- Not present a hazard to persons, stock or native fauna.

- Addresses threatened species issues.
- Addresses heritage issues.
- Clean and tidy, and free of rubbish, metal and derelict equipment/structures, except for heritage and other agreed features.
- Free from unacceptable air and water pollution, and other environmental effect outside the disturbed area.

Key performance outcomes for rehabilitation

- Clearing/vegetation disturbance and rehabilitation progress consistent with the Mining Operation Plan (MOP);
- Successful establishment of vegetation on the final landform consistent with the MOP;
- Progressive achievement of landform and land use objectives;
- Achievement of the objectives with respect to flora and fauna, soil resources and land capability, erosion and sediment control, and air quality;
- Verification of achievements through monitoring;
- A legally binding arrangement to secure the long-term security of the biodiversity offset areas; and
- Performance reporting in the AEMR.

The preliminary success criteria (or closure criteria as they are often referred to) for the rehabilitation areas are identified in **Table 5**. 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 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 a mosaic of native woodland, open grasslands with selective grazing opportunities.

For each element, standards that define rehabilitation success at mine closure are provided. Based on the generic indicators in **Table 5**, each criterion will be further developed to be specific, measurable, achievable, realistic and outcome based, and to reflect the principle of sustainable development. This will be based on results of further research and ongoing monitoring of the progressive rehabilitation areas. The success criteria should be reviewed every three to five years with stakeholder participation to ensure the nominated success criteria remain realistic and achievable.

Decommissioning and rehabilitation of mine site components (other than the rehabilitation areas) are detailed further in **Section 3**.

Table 5 – Preliminary Rehabilitation Success Criteria

Rehabilitation Element	Indicator	Criteria
1. Inpit Overburden		
Landform stability	*Slope gradient*	No less than 75% of the area has overall slopes ≤3H:1V. Where the slopes are steeper, additional water management structures will be utilised (as required).
	Erosion control	Erosion control structures are installed at intervals commensurate with the slope of the landform.
		Average soil loss per annum is <40 tonnes/ha/yr (sheet erosion).
		Dimensions and frequency of occurrence of erosion rills and gullies are generally no greater than that in reference sites that exhibit similar landform characteristics.
	Surface Water Drainage	Use of contour banks and diversion drains to direct water into stable areas or sediment control basins.
		All landforms will be free draining except where specific structures (ie dams) have been constructed for the storage of water as required for sediment and erosion control or some post mining land use.
Water quality	*Water Quality*	Ensure receiving waters affected by surface water runoff have contaminant limits within an acceptable range.
Topsoil	*Salinity (electrical conductivity)*	Soil salinity content is <0.6 dS/m.
	pH	Soil pH is between 5.5 and 8.5.
	Sodium content	Soil Exchange Sodium Percentage (ESP) is <15%.
	Nutrient cycling	Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micro-nutrients are present.
Vegetation	*Land use*	Area accomplishes and remains as a healthy stand of shrubs, trees and grass species.
		The site can be managed for its designated landuse without any greater management inputs than other land in the area being for a similar purpose.
	Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 m^2 in area or >10 m in length down slope.
	Species composition	Subject to proposed land use, comprise a mixture of native trees, shrubs and grasses representative of regionally occurring vegetation where possible.
		Vegetation communities should be developed to attract and support the re-colonisation by native flora and fauna species found in the area.
	Resilience to disturbance	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species.
	Sustainability	Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of shrub and understorey species. Vegetation develops and maintains a litter layer evidenced by a consistent mass and depth of litter over subsequent seasons. More than 75% of shrubs and/or trees are healthy when ranked healthy,

Rehabilitation Element	Indicator	Criteria
		sick or dead.
Fauna	*Vertebrate species*	Representation of a range of species characteristics from each faunal assemblage group (e.g. reptiles, birds, mammals), present in the ecosystem type, based on pre-mine fauna lists and sighted within the three-year period preceding mine closure. The number of vertebrate species does not show a decrease over a number of successive seasons prior to mine closure.
	Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.
	Habitat structure	Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including: a variety of food plants; evidence of active use of habitat provided during rehabilitation such as nest boxes, and logs and signs of natural generation of shelter sources including leaf litter.
Visual	*Visual Amenity*	Long term visual impact should be minimised by creating acceptable landforms, preferably compatible with adjacent landscape
Safety	*Physical*	Excavations to be rendered safe
		All drill holes, pits, open cuts and other opening to be securely capped, filled or otherwise made safe
		Access to members of the public and livestock is to be restricted as appropriate to site conditions
		No rubbish should remain at the surface, or at risk of being exposed through erosion
2. Final Void (including Ramps)		
Landform stability	*Stability*	Inspection undertaken by a qualified Geotech engineer and there are no subsidence or slipping of the pit walls is present that is a threat to the long term stability of the pit abandonment bunds
Safety	*Risk Assessment*	Risk assessment has been undertaken in accordance with relevant guidelines and Australian Standards and risks reduced to levels agreed with the stakeholders.
	Physical	Excavations to be rendered safe
		All drill holes, pits, open cuts and other opening to be securely capped, filled or otherwise made safe
		Access to members of the public and livestock is to be restricted as appropriate to site conditions
		No rubbish should remain at the surface, or at risk of being exposed through erosion.
4. Mine Plant/Industrial Areas		
Landform stability	*Slope gradient*	Areas have gradients of <2°.
	Erosion control	Erosion mitigation measures have been applied. Average soil loss per annum per domain unit is <40 tonnes/ha/yr (sheet erosion).
	Surface Water Drainage	Use of contour banks and diversion drains to direct water into stable areas or sediment control basins.
Water quality	*Water Quality*	Ensure receiving waters affected by surface water runoff have contaminant limits within an acceptable range.
Topsoil	*Salinity (electrical conductivity)*	Soil salinity content is <0.6 dS/m.
	pH	Soil pH is between 5.5 and 8.5.

Rehabilitation Element	Indicator	Criteria
	Sodium content	Soil Exchange Sodium Percentage (ESP) is <15%.
	Nutrient cycling	Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micro-nutrients are present.
	Land use	Buildings, water storage, roads (except those used by the public) and other infrastructure have been removed unless stakeholders have entered into formal written agreements for their retention.
	Land use	Areas are readily accessible and conducive to safe management activities. Predicted economics and /or benefits have been defined and agreed by the stakeholders.
	Boreholes	Boreholes (except those retained for monitoring purposes) have been shutdown, bore casings removed and holes plugged or capped in accordance with regulatory standards
	Land use	Area accomplishes and remains as a healthy stand of shrubs, trees and grass species.
Infrastructure		The site can be managed for its designated landuse without any greater management inputs than other land in the area being for a similar purpose.
	Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 m^2 in area or >10 m in length down slope.
	Species composition	Subject to proposed land use, comprise a mixture of native trees, shrubs and grasses representative of regionally occurring vegetation where possible.
Vegetation	*Land use*	Area accomplishes and remains as a healthy stand of shrubs, trees and grass species.
		The site can be managed for its designated landuse without any greater management inputs than other land in the area being for a similar purpose.
	Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 m^2 in area or >10 m in length down slope.
	Species composition	Subject to proposed land use, comprise a mixture of native trees, shrubs and grasses representative of regionally occurring vegetation where possible.
		Vegetation communities should be developed to attract and support the re-colonisation by native flora and fauna species found in the area.
	Resilience to disturbance	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species.
	Sustainability	Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of shrub and understorey species. Vegetation develops and maintains a litter layer evidenced by a consistent mass and depth of litter over subsequent seasons. More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead.
		All surfaces should be regraded to the agreed landform on the ESIA and revegetated to a self-sustaining condition similar to vegetation in comparable local areas to a standard consistent with data obtained from pre-mining baseline environmental studies.

Rehabilitation Element	Indicator	Criteria
Fauna	*Vertebrate species*	Representation of a range of species characteristics from each faunal assemblage group (e.g. reptiles, birds, mammals), present in the ecosystem type, based on pre-mine fauna lists and sighted within the three-year period preceding mine closure. The number of vertebrate species does not show a decrease over a number of successive seasons prior to mine closure.
	Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.
	Habitat structure	Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including: a variety of food plants; evidence of active use of habitat provided during rehabilitation such as nest boxes, and logs and signs of natural generation of shelter sources including leaf litter.
Visual	*Visual Amenity*	Long term visual impact should be minimised by creating acceptable landforms, preferably compatible with adjacent landscape
Safety	*Physical*	Excavations and subsidence to be rendered safe
		All drill holes, pits, open cuts and other opening to be securely capped, filled or otherwise made safe
		Access to members of the public and livestock is to be restricted as appropriate to site conditions
		No rubbish should remain at the surface, or at risk of being exposed through erosion

2.6 Water Management in Rehabilitation Areas

Where practicable, water management structures such as contour banks and drains should be constructed with longitudinal gradients that permit the transfer of water at non-erosive velocities (e.g. 1:200 (V:H)). Consequently, specialised rehabilitation treatments should generally not be required. Similarly, rock lined drains constructed on the slopes of the emplacements and final void should be retained and allowed to revegetate naturally. However, in the event that unacceptable levels of erosion are observed, fast growing species indentified as having a particular soil conservation application and/or specialised treatments such as bitumen/jute meshing or rock lining should be established.

The planting of trees and other vegetation around the various water management structures can enhance the filtration ability of these structures and surrounding areas and minimise the potential for erosion, as well as encouraging their use by native fauna.

2.7 Revised Biodiversity Offset Strategy

The direct and indirect impacts to threatened species, populations and ecological communities and their habitats as a result of the Rocglen Extension Project are documented in the *Flora and Fauna Assessment* prepared by RPS (2010). While not all vegetation within the Project Site is likely to be cleared, the *Flora and Fauna Assessment* has been prepared on the assumption that all remaining vegetation will be cleared with the exception of approximately 30 hectares in the north-eastern corner of the Project Site encompassing a small area of Poplar Box Grassy Woodland. This approach has been adopted, regardless of whether the clearing/disturbance occurs, in order to allow more flexibility, if required, to site associated infrastructure and undertake site management in peripheral areas (for example, vehicle access and manoeuvring, surface water management and stockpiles). This approach will also provide flexibility if future geological exploration and economic modelling determine recoverable coal reserves within these peripheral areas, which, if approval was granted for extraction, would enable Whitehaven to further maximise coal recovery using existing infrastructure at an

approved operation and also maintain the on-going socio-economic benefits of the mine for a longer period of time.

The direct and indirect impacts of the Rocglen Extension Project comprise 95.44 hectares of vegetation consisting of 47.04 hectares of intact vegetation in moderate to good condition and 48.4 hectares of derived native grassland (DNG) in moderate condition.

To address and offset these impacts, Eco Logical Australia (ELA 2010) was engaged to prepare a revised *Biodiversity Offset Strategy* that meets the offset requirements for an approval under the EP&A Act and the *Environmental Protection and Biodiversity Conservation Act 1999 (*EPBC Act). ELA conducted a quantitative assessment of vegetation condition at the Project Site and adjoining properties ("Yarrawonga" and "Greenwood") utilising the BioBanking Assessment Methodology (DECC 2009) ('the BioBanking Methodology') from 20 to 22 October 2010. As recommended by DECCW, the BioBanking Methodology was used to 'inform' the 'improve or maintain' assessment and provide a 'quantum' of area required to offset the impacts of the Project.

The *Biodiversity Offset Strategy* proposed for the Rocglen Extension Project, including replacement of original offset areas, is to retire the full 4,859 credit requirement as calculated by ELA (2010) from the Whitehaven Regional BioBank Site, which is in the final stages of registration by the DECCW as a BioBank Site under Part 7A of the TSC Act. It will be actively managed via a BioBanking Management Plan with in-perpetuity management funding, and will have the highest level of conservation status outside of National Parks via a BioBanking Agreement registered on the land title in-perpetuity.

In summary, the proposed *Biodiversity Offset Strategy* compensates for the direct loss of 95.44 hectares of vegetation in various condition states (intact and DNG) and replacement offsets for impacts to 47.9 hectares of the 131.74 hectares of approved offsets on a 'like for like' basis with over 525 hectares of vegetation in the Whitehaven Regional Biobank Site. The *Biodiversity Offset Strategy* provides an offset (525 hectares) to impact (110.44 hectares comprising 95.44 hectares of impacts for mine extension and the equivalent of 15 hectares of original impacts which now needs a replacement offset) ratio of 4.75:1.

The improvements in conservation values at the Whitehaven Regional Biobank Site (through the cessation of current grazing and implementation of conservation management practices, including enhancement tree and shrub planting and weed control) will lead to an 'improve and maintain' conservation outcome.

3.0 DECOMMISSIONING AND MINE CLOSURE

3.1 Mine Closure Objectives

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

- Providing an overall framework for mine closure including rehabilitation and decommissioning strategies that are consistent with the current mine closure plan and I&I NSW expectations;
- Establishing clear and agreed criteria, which can be used to provide the standard against which the final mine rehabilitation and post mining land use can be assessed (refer to **Section 2.0**);
- Reducing or eliminating adverse environmental effects once the mine ceases operation;
- Ensuring closure is completed in accordance with good industry practice; and
- Ensuring the closed mine does not pose an unacceptable risk to public health and safety.

3.2 Closure Methodology – Decommissioning of Infrastructure, Plant and Buildings

The following sections summarise the key aspects related to the decommissioning and closure of the site. It assumes that all buildings and other infrastructure are demolished and removed from the site despite the potential for them being used after mining (subject to the landholder's requirements). It is considered likely that at least some aspects of the existing infrastructure will be used post mining; however they are not able to be identified at this time. These other options will be considered in greater detail during stakeholder engagement, which will be undertaken closer to final mine closure.

3.2.1 Site Services

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

3.2.2 Infrastructure and Buildings

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

All buildings, including the administration building, workshop, crushing equipment and fixed plant will 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 areas being backfilled if available at the time of closure. Prior to disposal, all wastes should be assessed and classified in accordance with the *Waste Classification Guidelines (DECC, 2008).*

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

All areas will then be reshaped, deep ripped, topsoiled and seeded in accordance with **Section 3.3.2** below.

3.2.3 Roadways, Car Parks and Hardstands

The bitumen roadways, car parks and hardstand areas around the workshop and administration areas should be ripped up and the inert waste material placed in the open cut void and buried.

All areas will then be reshaped, deep ripped, topsoiled and seeded in accordance with **Section 3.3.2** below.

3.2.4 Fuel Farms and Chemical Storage Areas

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

3.3 Closure Methodology – Bulk Earthworks and Rehabilitation of the Site

3.3.1 Storages and Surface Water Management

All sedimentation dams which assist in the water flow from the final rehabilitated surface will be retained following mine closure. All dams will be assessed for structural integrity and upgrade works completed if the dam is to be retained. Any of the remaining dams that are not required will be removed and the original drainage paths re-established wherever possible.

In general, drainage lines will be restored with adequate controls to minimise the erosion within the channel, along with controls to prevent the migration of any erosion upstream or downstream. Works within the restored drainage lines should be undertaken in accordance with Section 5.3.3 of the *Managing Urban Stormwater: Soils and Construction Vol 2E – Mines and Quarries* (DECC, 2008), the *Guidelines for Controlled Activities – Riparian Corridors* (DWE, 2008) and *Guidelines for Controlled Activities – In-Stream Works* (DWE, 2008). Some of the key design elements of the channel establishment works are as follows:-

- The channel should convey a 100 year Annual Recurrence Interval (ARI) storm event, assuming that the catchment is partially vegetated.
- For the minor first order drainage lines, the channels should be generally trapezoidal in shape with 3:1 (H:V) bank batters and a base width of 1 to 2 metres.
- For the second order section of drainage line, the channel would be at least 3 metres wide at the base to accommodate for the larger flows predicted.
- Natural meanders should be used instead of straight lines to reflect natural stream characteristics.
- Where there are high flows or steep grades the channel bed should be rock lined where required and constructed in accordance with the *Managing Urban Stormwater: Soils and Construction Vol 2E – Mines and Quarries* (DECC, 2008) (known as the *Blue Book)*, including the placement of appropriately sized rocks above a filter layer of suitable geotextile. Exposed earth bed and banks are not appropriate given the dispersive nature of the soils and would be avoided.
- Soil should be packed in between rocks to allow sedges and grasses to be established within the channel to provide for the long-term channel stability.

Following earthworks and channel establishment, a riparian corridor will be established with a minimum width of 10 metres, measured horizontally and at right angles to the flow from the top of both banks on the streams.

As a result of past and present disturbance within the Project Site, the drainage lines are in a highly modified condition. The rehabilitation program should seek to achieve a long-term enhancement of the ecological value of these drainage lines through the restoration of natural hydraulic conditions and the revegetation of appropriate vegetation.

3.3.2 Unshaped Mined Land

Generally the unshaped areas will undergo reshaping to ensure they meet the final landform criteria prior to final revegetation works commencing (see **Figure 7** showing final land form).

Once the reshaping has been completed, soil will be applied to a nominal depth of around 300 mm. The areas should be shallow ripped to assist in the preparation of a seed bed. Rock raking will generally be undertaken to remove all rock greater than 500 mm diameter. In the areas that are planned for trees, this rock can be pushed into small piles to provide habitat and roosting areas for the local fauna.

Structural soil conservation works will be established to ensure that water is directed into the site water management system. Such works may include the construction of waterways, drains, graded banks and check dams, as is current rehabilitation practice on the site.

At the completion of mining there will be large areas of land that are already successfully rehabilitated or undergoing rehabilitation. These areas will require on-going management and maintenance. Generally maintenance will include two applications of fertiliser and weed management over a five year period, although this may vary depending on the outcomes of monitoring described in **Section 2.5.5**.

3.3.3 Surrounding Lands

This land includes all unmined lands owned or managed by Whitehaven that are not used for purposes related to mining. It includes a significant proportion of the land immediately around the mine.

Apart from the Vickery State Forest, the surrounding land primarily comprises agricultural land that provides a buffer between the mine and surrounding residences. The key aspects include:

- Access roads/tracks that are not included within the mining area;
- Dams around the site; and
- Biodiversity offset areas.

These areas will be assessed in accordance with the proposed post-mining land use to ensure that they are free of weeds and the fences are sound. An assessment of the road network should be made and those required for the on-going management of these areas retained. All other roads should be ripped and rehabilitated.

The management of the biodiversity offset areas will be undertaken by Whitehaven whilst ever the company owns the land. Should Whitehaven sell the land (and subject to the nature of the long term security afforded to the areas), the new owner(s) will be required to manage the biodiversity areas in accordance with the requirements of the approvals.

3.4 Post-Mine Land Use

3.4.1 Land Capability

The pre-mining land capability classes within the Project Site consist of Class III, V and VI land based on topographic, climatic and soils factors. The post-mining *land capability* consists of Class III, IV, V, VI, VII and VIII. The extent of each class within the Project Site is summarised in **Table 7**.

Table 7 – Pre and Post-Mining Land Capability Areas

Land Capability Class	Pre-Mining Area		Post-Mining Area	
	ha	%	ha	%
I	0	0%	0	0%
II	0	0%	0	0%
III	265	58%	82	18%
IV	0	0%	57	12%
V	102	22%	29	6%
VI	93	20%	217	47%
VII	0	0%	68	15%
VIII	0	0%	7	2%
Totals	**460**	**100%**	**460**	**100%**

Source: *Soil Survey and Land Resource Impact Assessment (*GSS Environmental, 2010).

Pre-mining and post-mining land capability is shown on **Figure 9**.

3.4.2 Agricultural Suitability

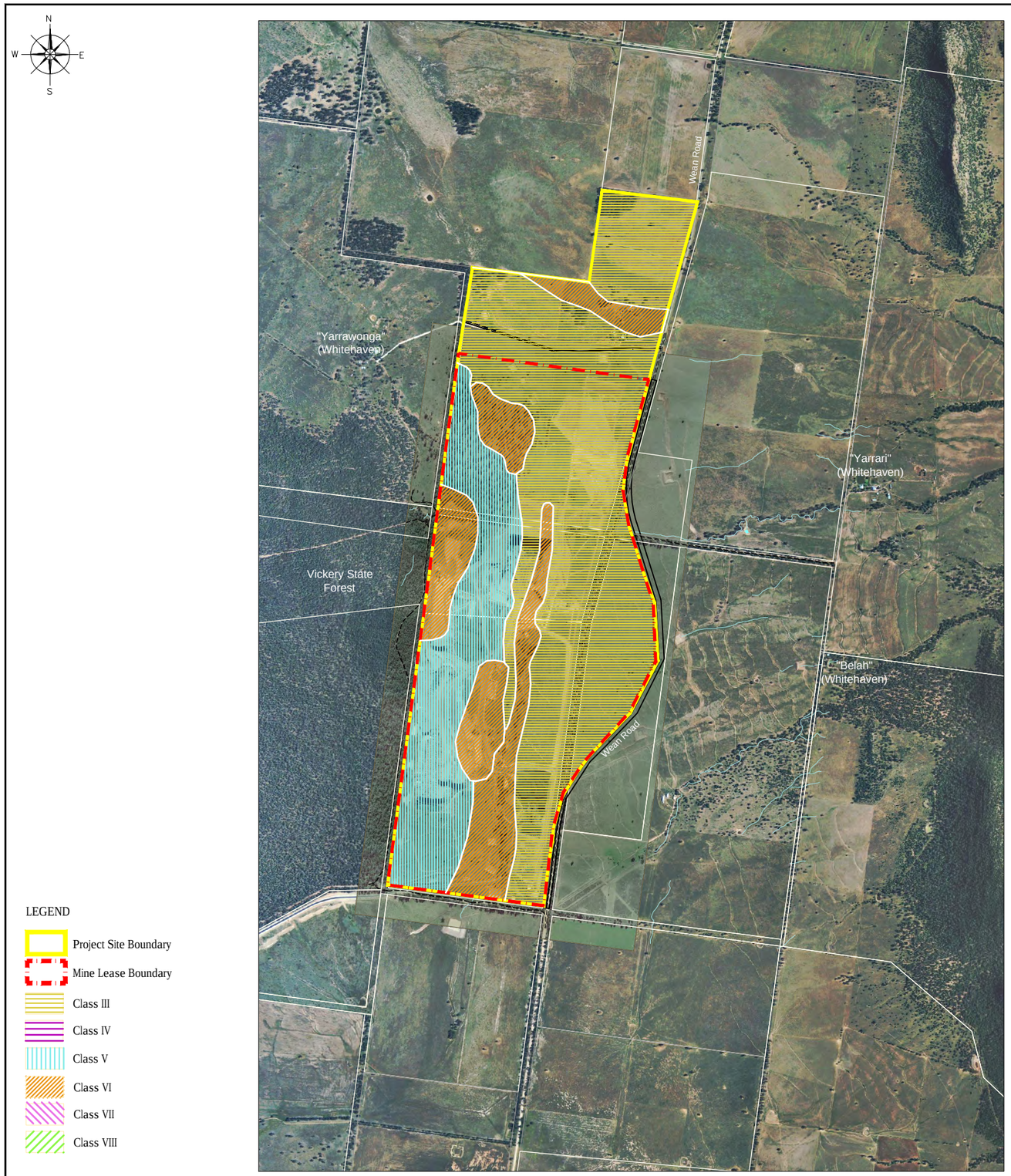
The pre-mining and post-mining agricultural suitability classes within the Project Site are summarised in **Table 8**.

Table 8 – Pre and Post-Mining Agricultural Suitability Areas

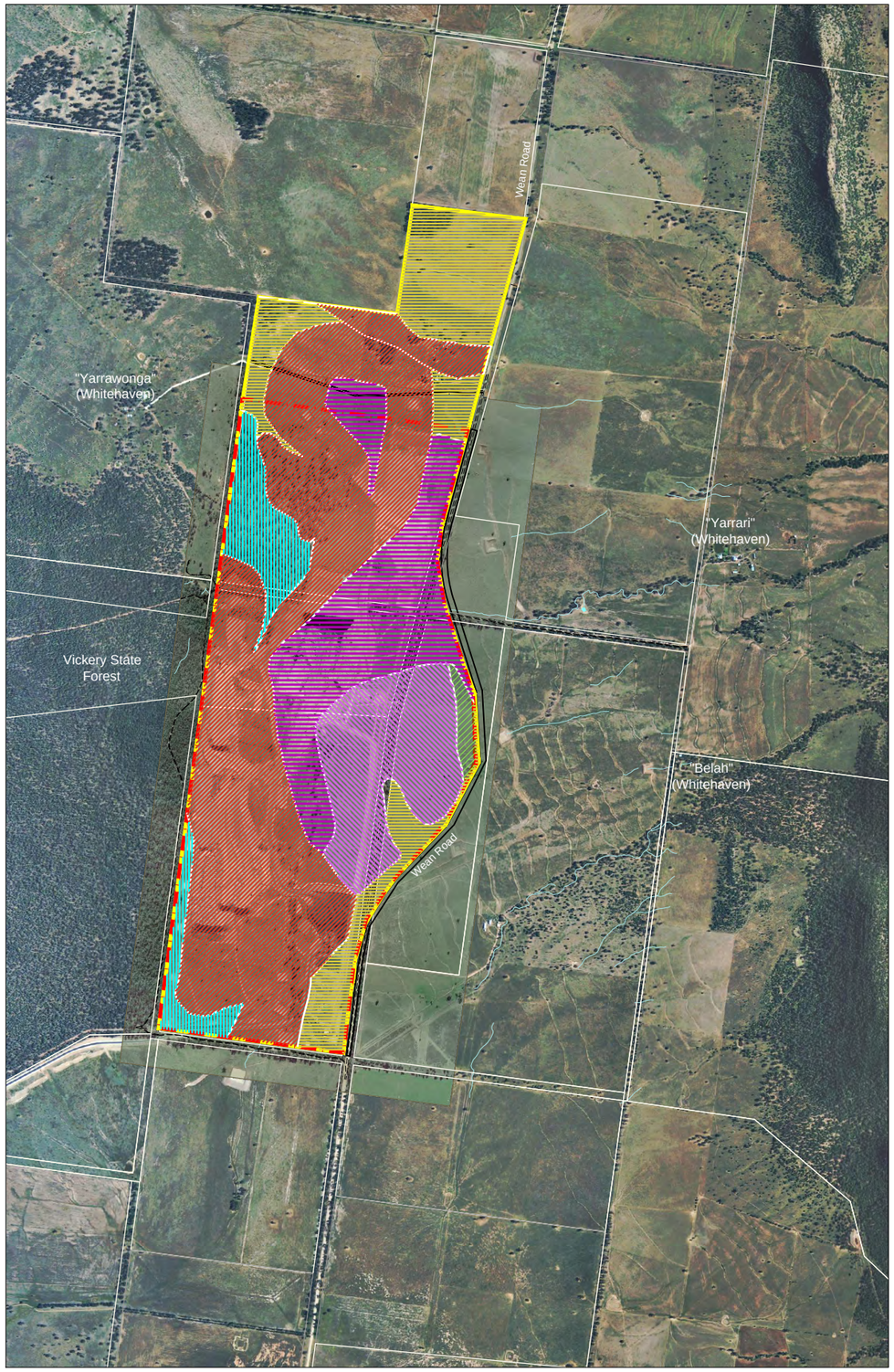
Agricultural Suitability Class	Pre-Mining Area		Post-Mining Area	
	ha	%	ha	%
1	0	0%	0	0%
2	0	0%	0	0%
3	348	76%	82	18%
4	112	24%	302	66%
5	0	0%	76	16%
Totals	**460**	**100%**	**460**	**100%**

Source: *Soil Survey and Land Resource Impact Assessment (*GSS Environmental, 2010).

Pre-mining and post-mining agricultural suitability is shown on **Figure 10**.



PRE-MINING



POST-MINING

Base Plan Sources: Geo-Spectrum (Australia) Pty Ltd. 2008 & 2009

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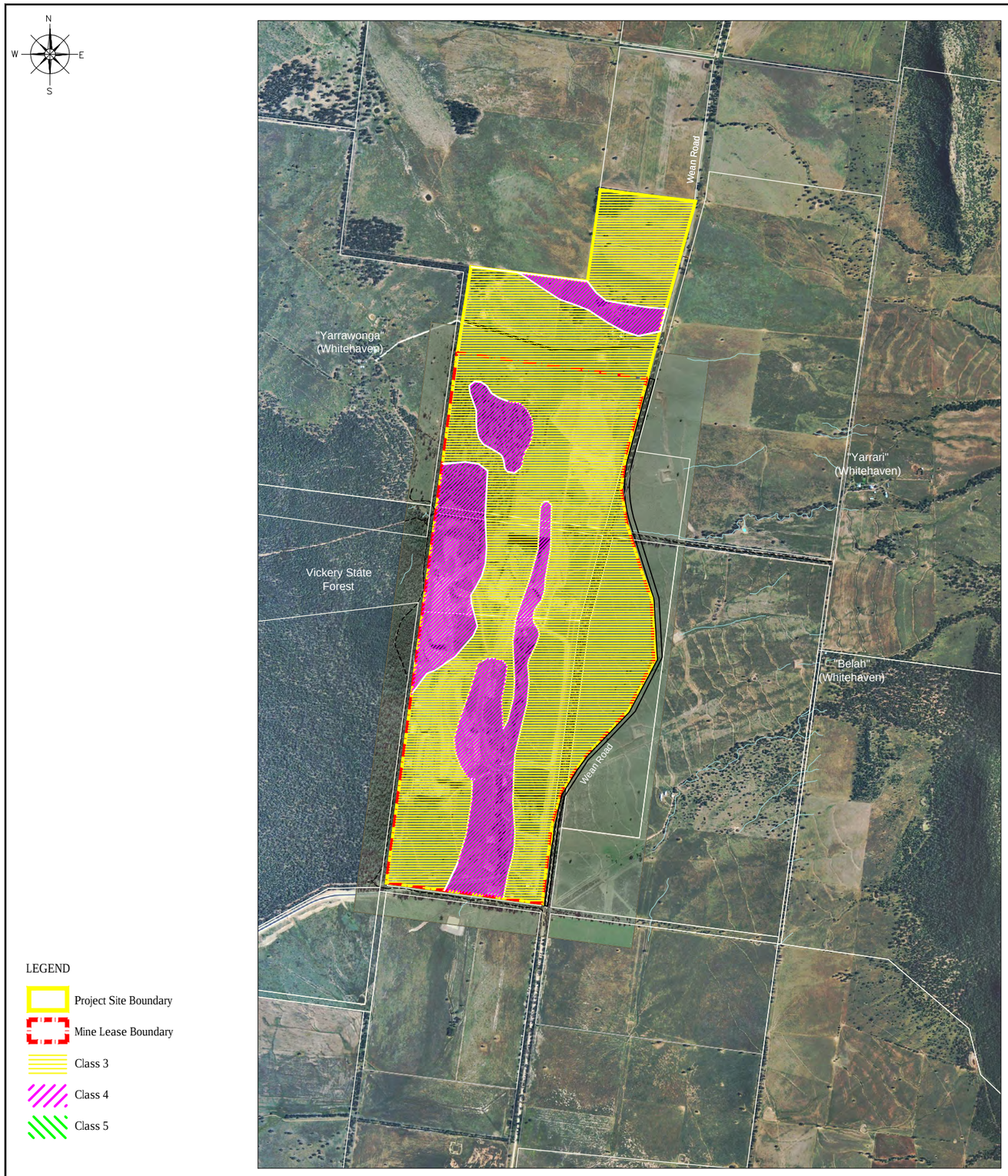
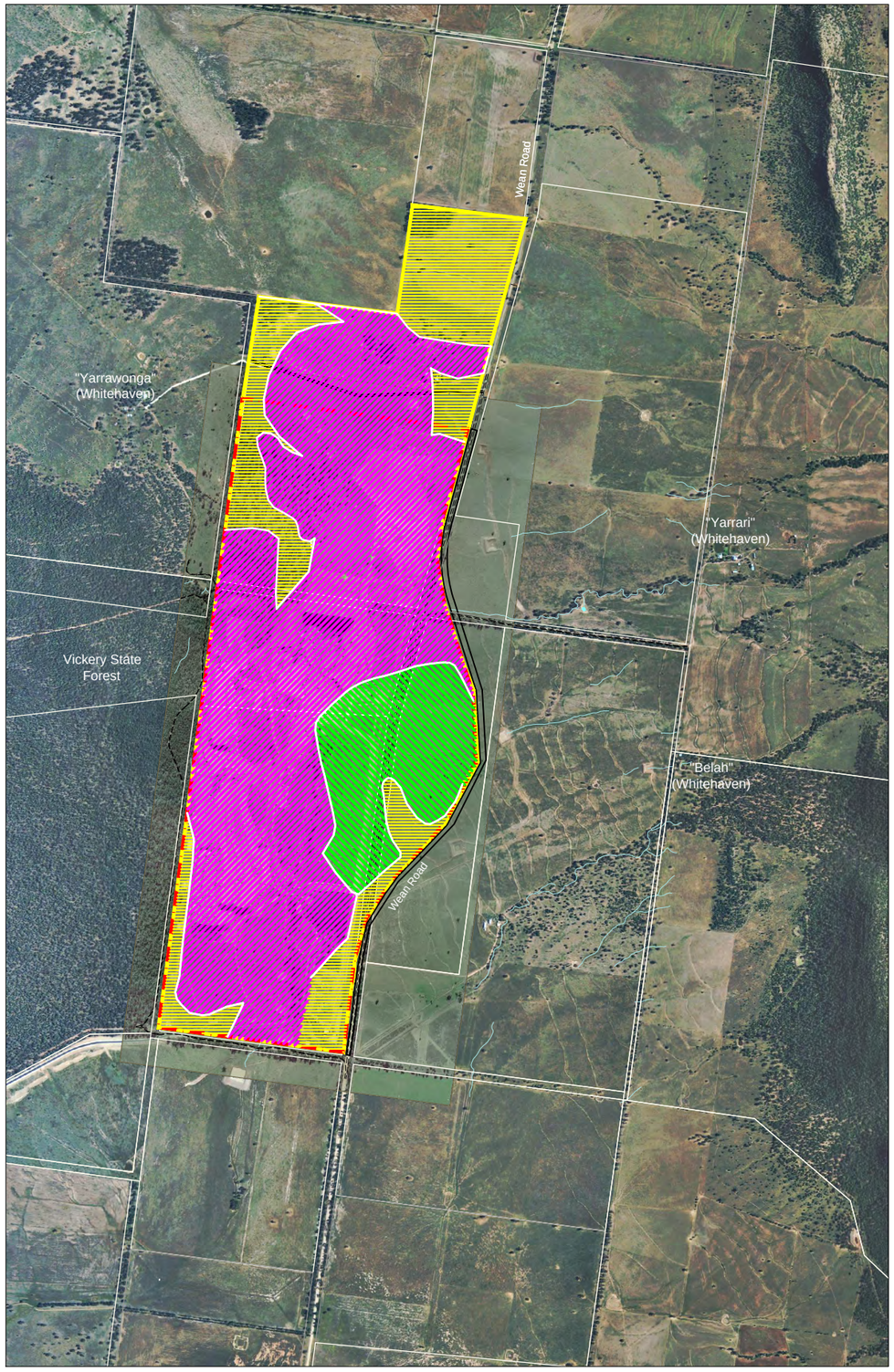
Rocglen Coal Mine Extension Project
Pre and Post-Mining Land Capability

FIGURE 9



PRE-MINING



POST-MINING

Base Plan Sources: Geo-Spectrum (Australia) Pty Ltd. 2008 & 2009

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Environmental, Land and Project Management Consultants

Rocglen Coal Mine Extension Project
Pre and Post-Mining Agricultural Suitability
FIGURE 10

The majority of the pre-mining area has an agricultural suitability of Class 3 (348 hectares), which means moderately productive lands suited to grazing and pasture improvement. The remaining 112 hectares is Class 4 land situated along minor drainage lines and hill slopes, which is marginal land not suitable for cultivation, however minimum till pasture improvement may be possible for grazing enterprises.

The post-mining land suitability assessment predicts Class 4 (302 hectares) land dominates the final landform, including all the rehabilitated overburden emplacements. The sections of Class 3 land (82 hectares) will be those areas untouched by mining activities or, if disturbed will be rehabilitated to a Class 3 level. The final void area will be Class 5 land, which is unsuitable for agriculture.

4.0 FINAL VOID MANAGEMENT

As evident on the final landform shown on **Figure 7,** coal extraction will leave an open pit void (final void) at mine closure covering an area of around 65 hectares in the southern extents of the open cut pit. It will have a maximum depth of around 65 metres below the natural surface, with elevations ranging between 220 and 285 metres AHD. The northern, western and parts of the eastern slopes of the final void will be shaped to achieve between 10 and a maximum of 18 degree batter angles (1V:6H to 1V:3H) depending on the location of the slope within the extent of the void. The highwall on the south eastern margin of the final void will be battered to approximately 45 degrees (1V:1H) through blasting. The final void has been designed to be suitable distance from the Wean Road deviation to ensure that the risk to the road as a result of any geotechnical instabilities is minimised, while also allowing for efficient mining of coal and minimising the area extent of the void.

There are several key environmental issues that have been considered for the long term management of the void following closure of the open cut. The issues are outlined below in **Section 4.2**.

4.1 Objectives

The primary objectives of the final void management section of this *Rehabilitation and Decommissioning Strategy* are to:

- Propose mitigation measures to minimise potential off-site impacts associated with the final void;
- Propose measures to be incorporated in the final landform which aim to minimise potential safety hazards to the general public; and
- Present options for the final land use of the void following the completion of mining at Rocglen.

4.2 Final Landuse Options (Final Void)

The options available for post-mining land use(s) of the final void are generally determined by the location and nature of the void, and although the options presented at this time are considered appropriate, there may be more appropriate options at mine closure. These will be considered further through on-going stakeholder consultation undertaken closer to the end of the economic life of the mine.

In terms of post-mining land use(s), the following preliminary potential options have been considered:

Backfilling with Overburden or Other Waste Material

During the life of the mine, emplacement of overburden and backloaded coal rejects (as approved under PA 06_0198) into the mined out areas will, to the extent practicable, be undertaken and seek to minimise the overall size of the remaining void. Any future proposals to use the void or part thereof for a long-term storage facility for overburden and/or coal rejects from other nearby mining operations will require consultation and approval from I&I NSW and DoP.

Post Closure Water Storage Area

As previously advised, Dam F will be constructed to the north of the final void to assist with the prevention of surface water runoff entering into the void. Dam F will be sufficiently large (in the order of 15 megalitres) to capture large storm events (for example, 10 year Annual Recurrence Interval events) and allow this water to be used for stock watering purposes and evaporated to minimise discharges to the final void.

A low flow pipe will be installed (below the primary spillway) to safely convey dam overflows to the base of the final void. Extreme rainfall events will result in flows over the spillway and into the final void.

It is further anticipated that once mining is complete, recharge of groundwater into the pit will result in the eventual formation of surface water in the southern part of the void with locally deeper final surface levels. Douglas Partners (2010) expects that the inflow to the void will be offset by evaporation from the area of surface water due to the majority of the void being partially backfilled to an elevation above 250 metres AHD, therefore being generally dry in average years.

Douglas Partners (2010) states that the existing groundwater in the Maules Creek Formation is generally brackish with total dissolved solids in the range 1,000 to 5,130 milligrams per litre (mg/L). In general, the pore water in the backfilled mine spoil is expected to become less saline over time due to the percolation of rainfall through the spoil pile. The exception to this will be in the area of surface water in the non-backfilled portion of the pit. In this location, the salinity is expected to increase over time as the evaporation leads to reduction in water volume and leaves the dissolved salt behind. The increase in concentration is expected to be generally isolated to the surface water in the locally deep area, with some minor mixing with the adjacent pore water in the mine spoil.

Consideration was given to raising the backfill levels such that surface water is never formed within the pit, thereby reducing evaporation and associated increase in salinity over time. Calculations indicate that a final fill level of about 275 metres AHD is required to prevent surface water ever occurring. This level is above the pre-development groundwater level because the mine spoil will be relatively permeable and porous, and recharge rates into the mine spoil will be substantially higher than for the surrounding undisturbed ground. Such a high final ground level, well above pre-development groundwater levels, is understood to be impractical from a mine spoil management perspective.

It is considered that, although the proposed final void form will, over time, lead to increasing salt concentrations in the localised area of surface water within the final void, this will be of minimal impact outside the final void for the following reasons:

- The final void will behave as a groundwater sink. Therefore any increases in salinity within the sink will not affect the surrounding groundwater quality as the flow will be towards the area of higher salinity and not away from it;
- The surface water level at equilibrium will be well below surrounding groundwater levels; and
- The surface water will be located within a small final void with relatively steep sloping sides. This small area will be unsuitable for alternative land uses which would be sensitive to the potential saline surface water

(Douglas Partners 2010).

Leaving the void as a stable landform with the possible additional use of a long-term water storage is, at this point in time, the preferred option. There may be additional appropriate land use options at mine closure, and in consultation with stakeholders at that time, any such options will need to be assessed as appropriate.

4.3 Final Void Rehabilitation

4.3.1 Void Slope Stability

Low Walls

For the purposes of this *Rehabilitation and Decommissioning Strategy*, the low wall is assumed to comprise mixed, disturbed and fragmented material. Stability of the low wall should be achieved in the following manner:

- The low wall will be battered back from the angle of repose to ensure the long term geotechnical stability of the face, with the determination of geotechnical stability and recommendations as to the final slope undertaken by a qualified geotechnical engineer on the basis of an assessment of the overburden material, the likely degree of settlement, and the degree of weathering expected in the long term. However it is expected that the low wall sides of the final void will be battered back to a maximum of 18 degrees with a goal of 10 degrees being optimal;
- Surface water drainage on and over the low wall will be minimised through the construction of drainage control structures, the construction of Dam F, and the aim of diverting as much of the catchment as possible away from the final void and back into the surface water system; and
- Erosion of the low wall will be controlled by limiting the length of slope through the use of contour and graded drains, minimising the slope, and by the establishment of suitable vegetation in accordance with the requirements described in **Section 2.5**.

All low wall areas should be revegetated in accordance with the requirements outlined in **Section 2.5** above.

Highwall

For the purposes of this document, the highwall is assumed to comprise undisturbed, solid material generally occurring above the economically lower-most limits of the mineable seam in the final void. Depending on the geology of the deposit, the high wall material may comprise a range of natural occurring soil or rock materials of varying strengths or states of weathering.

To ensure the safety of the final void, the surrounding final slopes should be left in a condition where the risk of slope failure is minimised. The highwall of the final void will be left at 45 degrees to ensure long term geotechnical stability. This will be assessed by a suitably qualified geotechnical engineer.

The following will be considered when assessing the geotechnical stability of the high wall:

- Long term final void water level;
- Height and inclination of slope and number and spacing of intermediate benches (as may be required to achieve the final slope);
- 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.

GE Holt & Associates (GHA 2010) prepared a geotechnical report assessing the stability of the eastern highwall adjacent to the approved Wean Road realignment. A copy of GHA's report is appended to the EA. The report discusses the issues involved in ensuring a safe and stable highwall design, analyses the likely stability of the final highwall adjacent to the road and provides recommendations to ensure the permanent integrity of Wean Road.

Generally the mine is developed on top of an anticline with the western limb steeper than the eastern. The eastern limb is interrupted by the Belmont Fault, which is a significant thrust fault. It tips the eastern dipping coal sequence up vertically, and has a deeply weathered fault breccia zone. In addition, there is a thick sequence of poorly consolidated clay and sand alluvials overlying the Permian coal measures.

The alluvials, deeply weathered rock and the Belmont fault zone will have a major influence on final wall stability. The location of the fault has been delineated more accurately by recent drilling, which has shown that the thrust is not a straight line from the northwest to southeast, rather it meanders along an irregular path in this direction and may have offshoots. It effectively cuts off the thick Belmont Seam so the pit limit has been set close to the fault structure.

GHA (2011) identifies that the open pit limits can be adjusted to ensure there is solid unmined ground to prevent instability collapsing the ground in a manner that could affect Wean Road as a result of the fault structures. Such adjustments will allow some flexibility if the fault structure changes location from that suspected at present. The stability recommendations to be adopted by Whitehaven are:

(a) When the Belmont Fault (or fault zone) is more than 150 metres from Wean Road, operations will mine through the Belmont Fault. The uppermost alluvial material and weathered rock on the eastern side of the fault will have individual face angles no steeper than 45 degrees;

(b) Benching will be adopted at a maximum interval of 25 metres in alluvial, weathered rock and brecciated rock;

(c) In fresh strata face angles will designed at 75 degrees to pit bottom. If in following the upturned Belmont Seam down to pit bottom the floor rock is strong and competent, then the face will be developed on the dip slope without the need for benches in rock beneath the Belmont Seam;

(d) When the top of the stable highwall reaches 50 metres from Wean Road (i.e. when the eastern limit of the Belmont Fault zone reaches 150 metres from Wean Road), the eastern end wall will be turned at right angles to the west. Once the turned highwall encounters sound rock, as it continues to the west, it can be turned again to develop parallel to the Belmont Fault until it reaches the planned pit limit;

(e) The turned highwall in the fault zone will be notched to achieve a stable face. This notch will not approach Wean Road any closer than 150 metres without geotechnical advice;

(f) A block of unmined ground will be left to contain the Belmont Fault zone and prevent it causing collapse back towards Wean Road. The size of this block of unmined ground will be determined by geotechnical investigation by the time a change in highwall direction is required; and

(g) If the highwall is free of faulting mining will resume southeast towards the currently planned pit limit. Such mining will cease when the pit crest reaches 50 metres from Wean Road. If additional faulting is detected in this advancing face then the relevance of such structure on highwall stability will be investigated before continuation of highwall development.

Alterations to a mine plan are not uncommon in any mining operation affected by geology and sufficient flexibility is needed in the mine plan (and approval process) to accommodate changes in geological conditions. GHA (2011) states that this can be achieved by including trigger points for action in the MOP. It will be some years before the pit crest approaches within 150 metres of the realigned Wean Road providing time to monitor and amend highwall design should any other stability issues arise, without affecting land beyond the proposed pit shell. It is on this basis that Whitehaven will commit to undertaking progressive stability reviews and monitoring of geological conditions once the pit moves within 250 metres of the realigned Wean Road to ensure geotechnical stability and safe conditions. If any unfavourable conditions are observed or detected, a detailed assessment will be undertaken by a suitably qualified geotechnical engineer before mining is allowed to continue towards Wean Road.

4.3.2 Spontaneous Combustion

While spontaneous combustion is not known to occur at the Rocglen Coal Mine, it has been included in this document for reference as it is often an issue associated with final voids, particularly where coal seams (and other carbonaceous materials) are left exposed (i.e. not capped or covered). There is also the possibility that a bushfire post closure could ignite any exposed seams if they are in close proximity to the surface.

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

- Accumulations of coal, coarse rejects and other carbonaceous material, particularly if it is known to contain pyritic material, will be buried under a minimum of 3 metres of inert overburden material; and
- Should any outbreaks of spontaneous combustion occur during mining operation, the details on the materials involved, presence of pyrites, location, date, time and climatic conditions should be recorded on surveyed plans. These areas will be assessed at closure to ensure appropriate mitigation measures are in place to minimise the likelihood of spontaneous combustion occurring post mine closure. These areas should also be included as part of the ongoing inspection and monitoring that will be required following closure of the mine and before final lease relinquishment.

4.3.3 Control of Surface Water Inflow

The control of surface water 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 highwalls.

Surface water is a possible cause of slope deterioration and ultimate failure. Drainage has been directed away from the highwall face (where ever possible) 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.

Drainage over the low wall will be minimised through constructing surface water diversions and the construction of Dam F. The drainage on the low wall will be limited and controlled to reduce the erosion potential. The catchment area of the final void will be minimised by the installation of diversion drains.

4.3.4 Public Safety Considerations

At mine closure, one of the main priorities for the final void will be to render it safe in terms of access by humans, livestock and wildlife. In order to achieve this, the following key activities should be considered:

- Instability of the low wall can induce failures or mass movement. To ensure the stability of the low walls, they will be battered back;
- Instability of the highwall can also induce failures and mass movement. To ensure the stability of the highwall to be retained post closure, an appropriately qualified geotechnical engineer will be consulted on final highwall design (see **Section 4.3.1**);
- Where possible, the exposed coal seams will be covered with inert material to prevent ignition either from spontaneous combustion, bushfires or human interference;
- Suitable signs, clearly stating the risk to public safety and prohibiting public access, will be erected at 50 metre intervals along the entire length of the fence;

- A physical barrier will be constructed at a safe distance from the perimeter of the void to prevent human access. The highwall areas should be secured by the construction of a trench and a 2 metre safety berm. Additional security measures will be installed as required by I&I NSW. This is to provide an engineered barrier between the pit and the surrounding area. The trench and berm should be constructed in such a way that will physically stop most vehicles;
- Surface runoff from land surrounding the void will be diverted so as to prevent any potential development of instability of the void walls; and
- Where practicable, grasses and shrubs / trees selected to conform to the agreed post-mining rehabilitation criteria and land use will be planted along the outside edge of the bund wall to lessen any visual impact of the wall.

5.0 STRATEGY REVIEW STRATEGY

This Rehabilitation and Decommissioning Mine Closure Strategy is to be a dynamic document. While it has initially been prepared for this EA, it will be continually reviewed and updated throughout the life of the project. Five years prior to mine closure, a more detailed *Rehabilitation and Decommissioning Strategy* will be prepared. Throughout the life of the Project, the key strategy review triggers will include, but not be limited to, the following:

- Issue of the Project Approval (i.e. amendments to reflect any additional requirements that might be included in the approval);
- Changes in legislation or policy that applies to the operation; and
- Progressively throughout the life of the project (in particular when there is a major shift in the operation direction away from what this preliminary strategy has been based).

6.0 REFERENCES

ANZMEC (2000) *Strategic Framework for Mine Closure*.

DECC (2008) *Managing Urban Stormwater: Soils and Construction Vol 2E – Mines and Quarries*.

DECC (2008) *Waste Classification Guidelines*.

DMR (1999) *Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley*.

Douglas Partners (2010) *Hydrological Assessment*, Rocglen Coal Mine Extension Project.

Eco Logical Australia (2010) *Rocglen Coal Mine Extension Project Biodiversity Offset Strategy*

DWE (2008) *Guidelines for Controlled Activities – Riparian Corridors*.

DWE (2008) *Guidelines for Controlled Activities – In-Stream Works*.

GE Holt & Associates Pty Ltd (2011) *Short and Long Term Stability of the Eastern Highwall*

GSS Environmental (2010) *Soil Survey and Land Resource Impact Assessment,* Rocglen Mine Extension Project.

GSS Environmental (2010) *Surface Water Assessment*, Rocglen Mine Extension Project.

Landcom (2004) *Soils and Construction - Managing Urban Stormwater*.

RPS (2010) *Flora and Fauna Assessment for Proposed Rocglen Coal Mine Extension Project*

R.W. Corkery & Co. Pty Limited (2007) *Environmental Assessment of the Belmont Coal Project, via Gunnedah*.

R.W. Corkery & Co. Pty Limited (2008) *Mining Operations Plan for the Rocglen Coal Mine, via Gunnedah*.