

Section 4

Environmental Features, Constraints, Safeguards and Impacts

4.1 SURFACE WATER RESOURCES

4.1.1 Introduction

The proposed modification to the Werris Creek Coal Mine has the potential to cause minor alterations to the flow paths and catchments on the mine site and its surrounds. The following sub-sections provide a summary of the pre-mining hydrological setting, identify the potential impacts on local surface water and constraints on the proposed modification, identify the operational safeguards and controls that would continue to be implemented by the Applicant and assess the impact of the proposed modification on surface water quality and/or quantity.

This section has been prepared with considerable reference to a Site Water Management Plan (SWMP) prepared for the Werris Creek Coal Mine by GSS Environmental in January 2009 (GSSE, 2009).

4.1.2 Hydrological Setting

4.1.2.1 Introduction

Prior to the development of the Werris Creek Coal Mine, surface water flows through and surrounding the mine site had been modified following many years of agricultural activity, as well as previous mining and quarrying operations, in the local area. However, despite the construction of numerous contour/diversion banks, drainage channels and dams, the general surface water flow patterns of the pre-agriculture environment remained intact. The following sub-sections place the mine site within this slightly modified local context, identify the existing surface water flows through the mine site with reference to specific catchments, describe the flooding potential on and surrounding the mine site and present information on the typical surface water quality in local streams.



4.1.2.2 Regional Drainage

The regional drainage is depicted on **Figure 4.1** which identifies the mine site within the Liverpool Plains catchment of the Namoi River Catchment of mid-northern NSW. The Namoi River Catchment covers an area of approximately 42 000 km² (DLWC, 2003) and is located within the Barwon-Darling River system in northwestern NSW. Major tributaries of the Namoi River include Coxs Creek and the Mooki, Peel, Cockburn, Manilla, and McDonald Rivers, all of which join the Namoi River upstream of Boggabri.

4.1.2.3 Local Drainage

Figure 4.1 also presents the local drainage network. The mine site is positioned between two creeks, namely Quipolly Creek in the south and Werris Creek to the north. Werris Creek flows into the Mooki River and then into the Namoi River. Quipolly Creek, while restricted by the Quipolly Dam located upstream of Quipolly Creek, flows into Quirindi Creek, the Mooki River and then into the Namoi River.

4.1.2.4 Pre-Mining Mine Site Drainage

The pre-mining drainage of the mine site is presented on **Figure 4.2**. The majority of the mine site (536ha), including the open cut area, Coal Processing Area and overburden emplacement, lie within the Quipolly Creek catchment. The remaining 143ha of the mine site, including the northern section of the rail load-out road and the Product Coal Storage Area and Rail Load-out Facility, lie within the Werris Creek catchment.

All drainage on the mine site is ephemeral and flows via several first order streams to either to Werris Creek or Quipolly Creek. Following heavy rainfall, all land within the mine site with the exception of the north-south trending ridge, has a tendency to become waterlogged due to its relatively flat slopes and clayey soils.

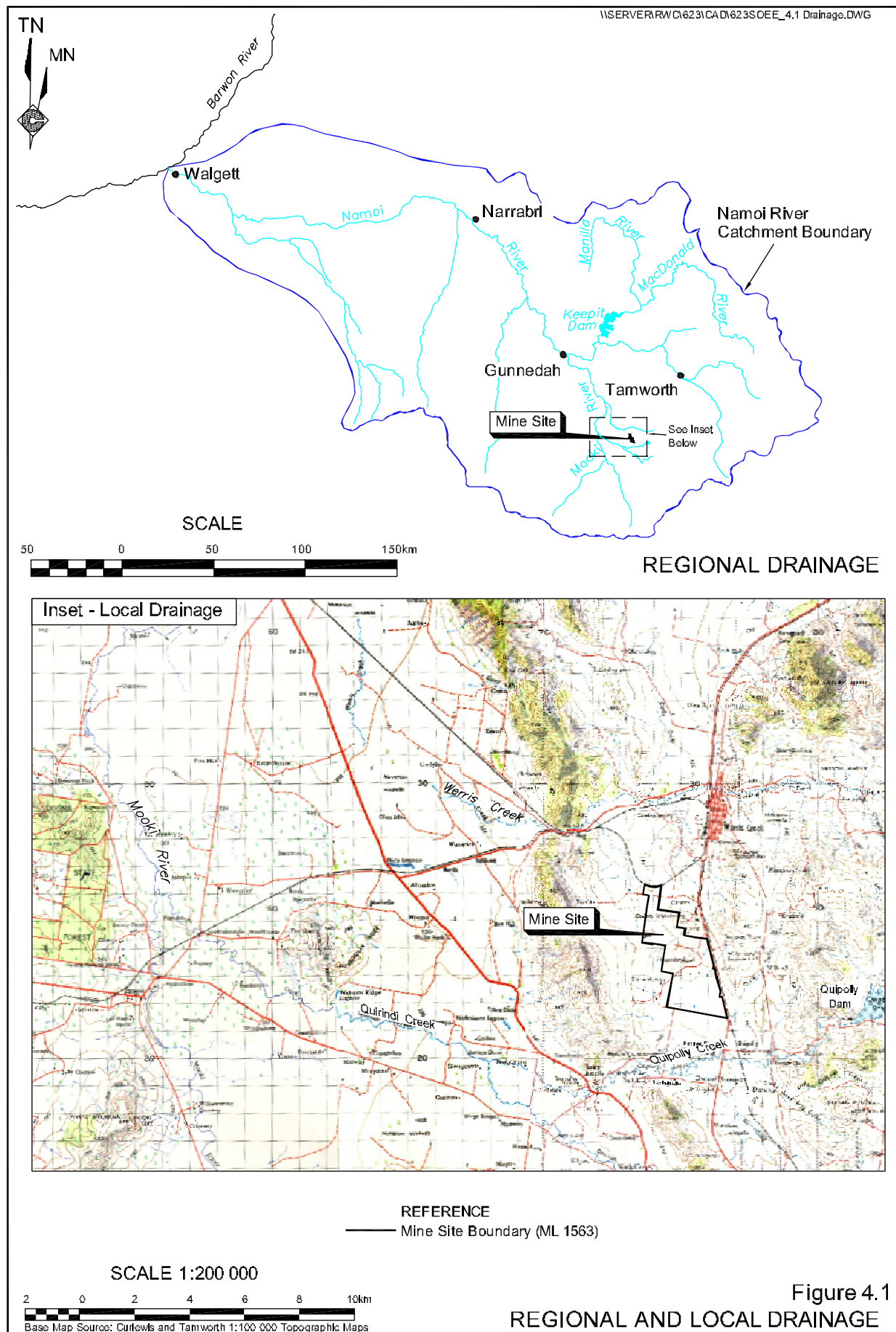
As noted in Section 4.1.2.1, the natural drainage patterns on the mine site have been modified through the installation of contour/diversion banks and dams which would reduce the run-off from the mine site to Werris and Quipolly Creeks. Prior to the commencement of the Werris Creek Coal Mine, a total of 11 dams were present on the mine site with a combined storage capacity of 13 350m³.

4.1.2.5 Surface Water Quality

Surface water was sampled from seven sites on and surrounding the mine site on 25 and 26 February 2004 (see **Figure 4.2**). With the exception of sampling site WCW1, an agricultural dam, the water sampled was flowing and followed a period of rainfall on February 23 to 26 yielding a rainfall of 78mm¹. The water sampled from these sites therefore provides an indication of pre-mining/natural chemistry and suspended sediment load of water running off the mine site. **Table 4.1** presents a description of each sampling location and a summary of the analytical results.

¹ 78mm was recorded at the Quirindi weather station approximately 11km south-southeast of the mine site





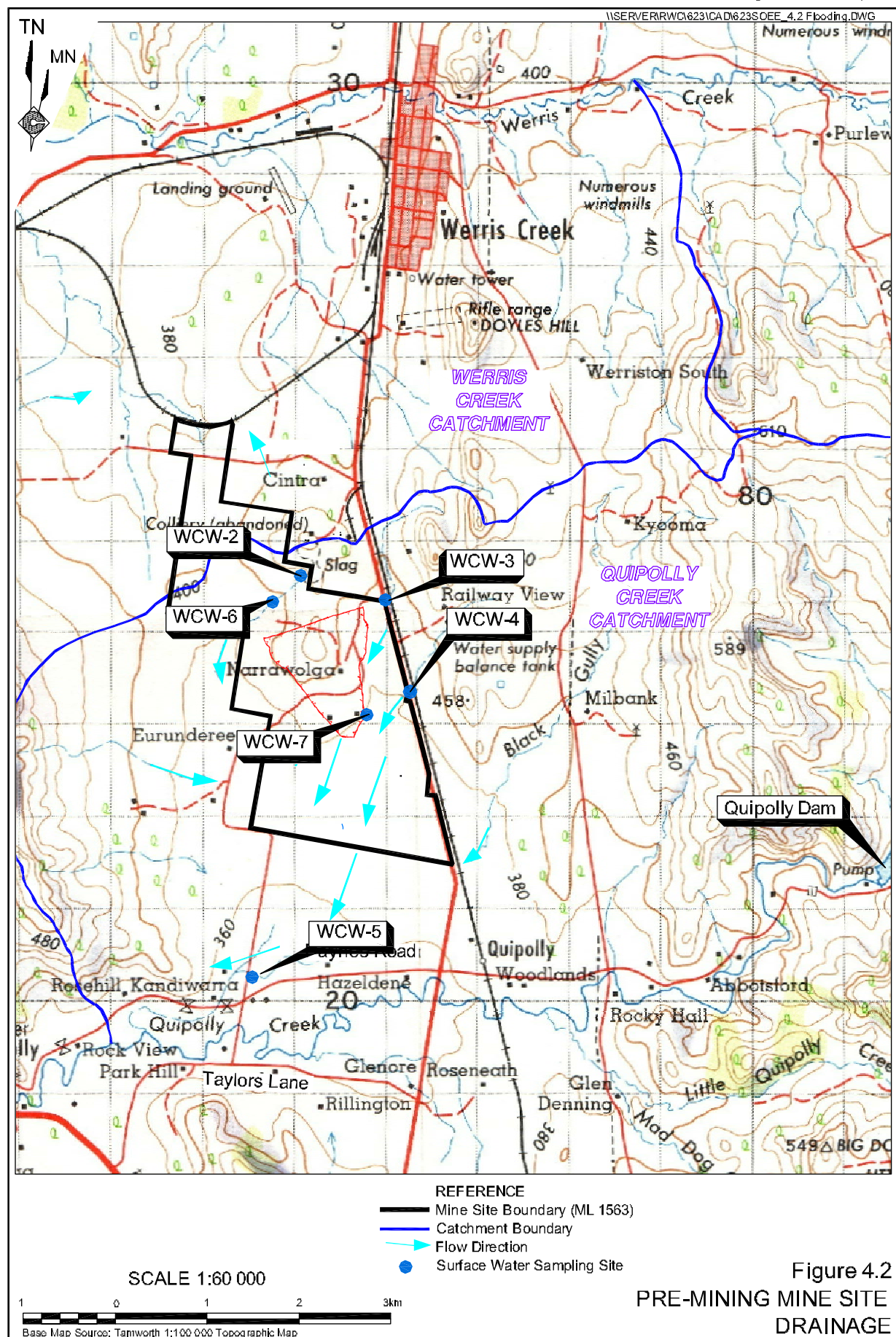


Table 4.1
Mine Site Water Quality (February 2004)

Catchment	Sampling Site	Description	Flow [#]	pH	EC (µS/cm)	TSS (mg/L)	Fe (mg/L)	Na (mg/L)	Bicarbonate as CaCO ₃ (mg/L)
Quipolly Creek	WCW1	Agricultural dam adjacent to rail load-out facility	N	7.16	138	1070	7.95	5	53
Werris Creek	WCW2	Natural drainage line north of Council quarries	Y	7.42	132	45	0.48	8	58
Werris Creek	WCW3	Culvert on eastern side of Werris Creek - Quirindi Rd	Y	7.58	327	29	0.26	22	74
Werris Creek	WCW4	Culvert between Werris Creek - Quirindi Rd and Main Northern Rail Line	Y	7.83	277	25	0.26	16	81
Werris Creek	WCW5	Sheet flow drainage near intersection of Wadwells Lane and Paynes Rd	Y	6.74	100	39	0.70	11	34
Werris Creek	WCW6	Lower section of drainage line from Council quarries, flowing out of agricultural dam	Y*	7.19	155	170	2.18	7	65
Werris Creek	WCW7	Agricultural dam	N	7.70	206	26	0.08	14	103

*Minimal flow from dam * Flow: Sample taken from flowing water - Y=Yes/N=No

Water sampling has been undertaken within Werris and Quipolly Creeks, upstream of mine site activities, since the commencement of the Werris Creek Coal Mine. **Table 4.2** presents a summary of water quality observed within the two creeks.

Table 4.2
Local Creek Water Quality

Sampling Site	Sampling Date	pH	Electrical Conductivity (µS/cm)	TSS (mg/L)	Oil & Grease (mg/L)
Quipolly Creek	17/07/2007	8.0	940	4	<5
	18/07/2007	7.9	990	7	<2
	21/08/2007	7.5	100	92	<5
	06/02/2008	8.1	400	295	<5
	Average	7.9	608	100	<5
Werris Creek	21/08/2007	7.9	190	165	<5
	06/02/2008	7.8	250	130	<5
	Average	7.9	220	148	<5

The results of water quality monitoring with the two local creeks suggests that a slightly elevated pH, electrical conductivity and TSS from that recorded on the mine site in February 2004 prior to the commencement of mine-related activities. These elevated values are likely a result of surface flows over cleared and fertilised paddocks and are probably a better reflection of background water quality in the local agricultural setting.



4.1.2.6 Flooding Potential

Quipolly Creek is approximately 2.9km south of the mine site (elevation 360m AHD) and 15m lower (elevation 345m AHD) than the southern-most point of the mine site. To the north, Werris Creek is approximately 3.4km and approximately 40m lower than the northern-most point of the mine site. These factors would inhibit floodwaters from moving out of Quipolly and Werris Creeks and inundating the mine site. Even in the event of a failure of the Quipolly Dam, the area of flooding would be restricted to the southern boundary of the mine site (Public Works Department Coepolly² No.2 Dambreak Study, 1996).

4.1.3 Potential Impacts and Constraints

4.1.3.1 Potential Sources of Water Pollution

The potential sources of water pollution from the current and modified mining activities are as follows.

- i) Runoff from areas disturbed in advance of, and during mining.
- ii) Runoff from stockpiles of topsoil, subsoil and overburden.
- iii) Surface runoff from ROM coal and coal product stockpiles.
- iv) Surface runoff from rehabilitated areas prior to full stabilisation.
- v) Runoff from hardstand areas including roads, processing areas, site facilities and load-out facilities.
- vi) Discharge of groundwater stored within either the Void Water Dams (VWD1 and VWD 2) of the dams of the Underground Water Storage Area.
- vii) Leakage or spillage of hydrocarbons.

Following an assessment of 12 representative samples of overburden and interburden, which concluded that none exhibited any acid or salinity generating potential (URS, 2004), it was concluded that acid mine drainage and saline runoff from the overburden emplacement are not potential sources of water contamination.

The principal contaminant for all but items (vi) and (vii) above would be suspended solids, that is, sand, silt, clay or coal particles in the water.

4.1.3.2 Potential Constraints on the Proposed Modification

Erosion and Sedimentation

Uncontrolled runoff from overburden emplacements under construction, soil stockpiles or other cleared areas, including runoff as a result of localised flooding, may lead to sheet, rill and/or gully erosion over areas of the mine site. Recognising this potential, the surface water management controls have been designed to provide controlled flow paths and minimise the number and velocity of water flows on the mine site.

² Refers to Quipolly Creek/Dam



Surface Water Quality

A review of **Table 4.1** indicates that the water quality from locations WCW1 and WCW6 exhibit relatively high suspended solids and iron concentrations. Notably, these samples were taken within or immediately downstream of existing dams suggesting considerable settlement time is required for any water storage structures on the mine site where a discharge may occur. The proposed modification, like the currently approved Werris Creek Coal Mine, would therefore be potentially constrained by the requirement to design adequate water management and storage structures on the mine site.

Surface Water Quantity

Development of the amended mine area would necessitate the clearing of vegetation which could potentially result in increased surface water runoff within the affected sub-catchment and subsequently from the mine site. It is more likely, however, that the volume of water leaving the mine site would decrease marginally as a result of surface water being captured within the open cut and additional water storages constructed on the mine site to provide for operational water requirements. The Applicant has considered its “maximum dam capacity” under the *Water Management Act 2000* (WMA Act) in the design of water management controls and storages to ensure any decrease in the quantity of water leaving the mine site is acceptable and within the 10% permissible harvestable right applicable to the Applicant’s landholding.

4.1.4 Operational Safeguards and Controls

4.1.4.1 Introduction

The proposed ongoing operational safeguards and controls for the management of surface water build upon and modify those contained within the Werris Creek Coal Mine SWMP (GSSE, 2009). Within the SWMP, the surface water catchments within the mine site are divided into five categories, namely:

- **“Clean”** - surface runoff from catchments undisturbed or relatively undisturbed by construction, mining or related activities and from rehabilitated catchments;
- **“Dirty”** - surface runoff from areas disturbed by construction or activities such as soil, overburden and coal stockpiling, and rehabilitation (until stabilised), all of which could contribute suspended solids to the surface water;
- **“Void”** - surface runoff and groundwater seepage captured within the active open cut area;
- **“Underground”** - groundwater contained within the underground workings of the former Werris Creek Colliery and to be dewatered prior to intersection of these workings by the open cut; and
- **“Contaminated”** - surface water containing hydrocarbons or any other contaminant other than suspended solids above DECC or ANZECC (2000) criteria.



The key principles in managing surface water within and around the mine site would continue to be to:

- divert clean water away from disturbed areas;
- capture, store and prevent discharge of void water such that it can be used for dust suppression purposes on the mine site;
- capture dirty water and treat it so that it could be discharged in accordance with relevant DECC and ANZECC guidelines;
- capture and treat contaminated water prior to discharge from and/or re-use on the Mine site; and
- maintain as much vegetation cover (particularly grass) as possible.

Ultimately, the volume of dirty, void and underground water to be controlled is minimised by preventing mixing with clean water, and through maximising the re-use of dirty, void and underground water on-site for dust suppression and other process water requirements.

4.1.4.2 Water Quality Controls

4.1.4.2.1 Introduction

Figure 4.3 identifies the water management structures for the modified mine layout. The clean, dirty and void water management controls presented on **Figure 4.3**, concentrating on those new or modified controls required as part of the proposed modification, are described in the following sections.

4.1.4.2.2 Clean Water Management

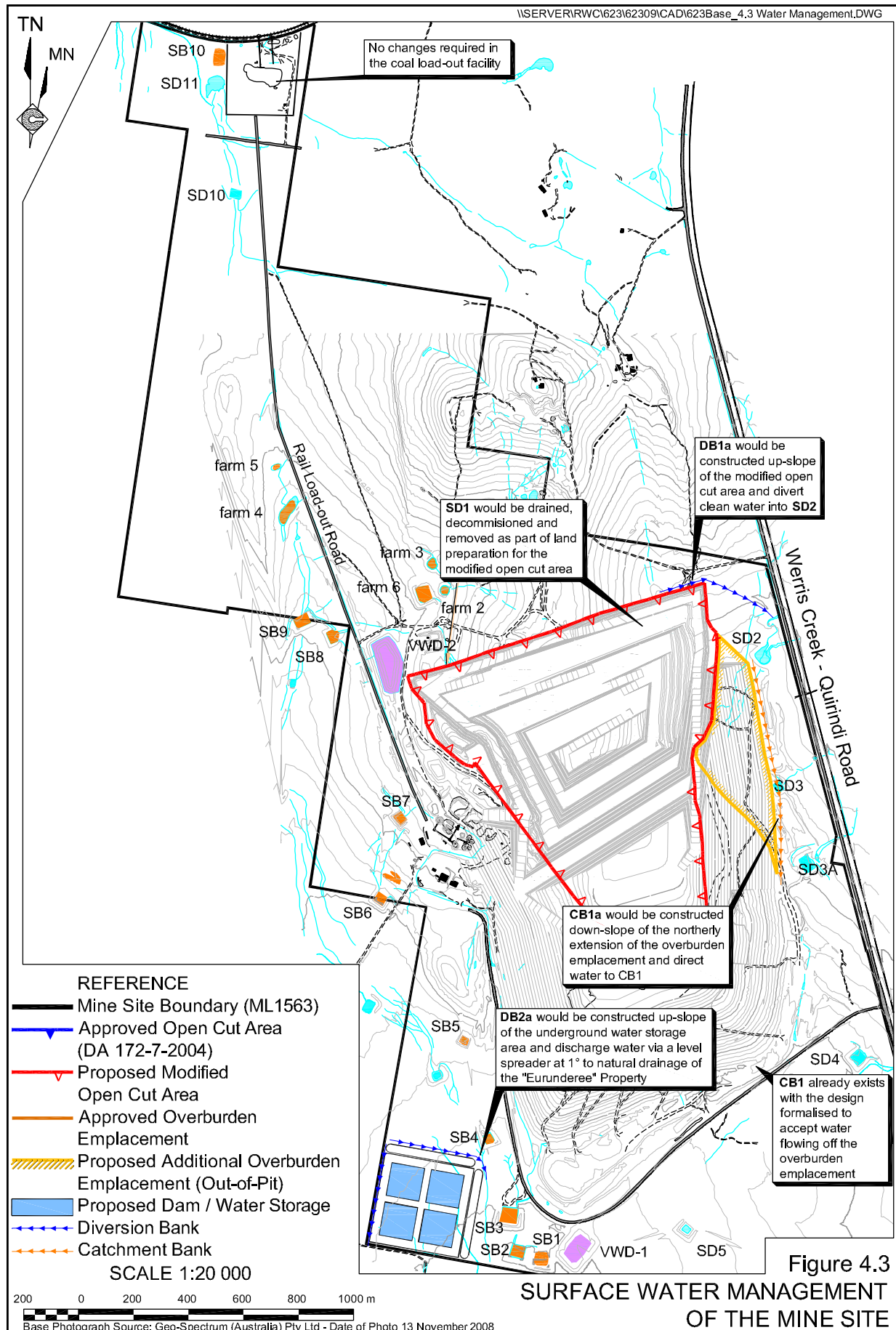
The principal water management structures to divert and / or store clean water flows are as follows.

- Diversion banks / drains (DB) – to divert clean water away from areas of disturbance and thereby minimise the volume of potentially sediment-laden water requiring treatment.
- Storage dams (SD) - for the containment of “clean” water collected from undisturbed catchments and/or settled and clarified discharges from sediment basins.

As noted in Section 2.5.4.3, the existing clean water controls of the mine site would be modified as follows.

- SD1, which is located within the footprint of the modified open cut area, would be drained and removed prior to vegetation clearing and soil stripping in this area.
- DB1a, a diversion bank would be extended and realigned around the northeastern perimeter of the modified open cut area to divert clean runoff initially into SD2.





- DB2a would be constructed up-slope of the underground water storage area, diverting water flowing from the northwest to the west of the four dams and into natural drainage. Water would be discharged from DB2a via a level spreader, constructed with a grade not exceeding 1°.

All water diversion and storage structures would be constructed prior to disturbance within the relevant catchment. In the case of the proposed modifications to the clean water management system described above and on **Figure 4.3**:

- DB1a would be constructed and commissioned prior to the draining and removal of SD1; and
- DB2a would be constructed prior to the commencement of any earthworks associated with the construction of the dams within the Underground Water Storage Area.

As a clean water storage structure, which is not required to provide a settlement and sediment storage capacity, there is no requirement to increase the storage capacity of SD2 (currently estimated to be 3 000m³). The design specifications for DB1a and DB2a were calculated using the Flocal computer program and are summarised in **Table 4.3**.

Table 4.3
Diversion Bank Specifications

Structure ID	Catchment Area (ha)	Channel Bottom Width (m)	Channel Grade (%)	Bank Height (m)	Level Spreader Width (m)	Slope of Level Spreader
DB1a	55	4	0.3	0.6	6	<2°
DB2a	45	6	0.3	0.6	12	<1°

Source: Flocal

The storage dams and their estimated capacities to be maintained on the mine site are identified in **Table 4.4**.

Table 4.4
Clean Water Storage Dams

Label	Capacity (ML)
SD2	3 ¹
SD3	2 ¹
SD3A	5.9 ²
SD4	5.1 ²
SD5	4.0 ²
SD10	1.9 ²
SD11 (Dam 1)	3 ¹
Total	24.9
Note 1: Capacity estimated	
Note 2: Capacity determined through survey	
Source: Modified after GSSE (2009) – Table 2	



The total combined capacity of these and other clean water dams maintained on the mine site against the Maximum Harvestable Right Dam Capacity for a site of this size is considered further in Section 4.1.4.3.2.

4.1.4.2.3 Dirty Water Management

The principal water management structures for capturing and storing water which has flowed over disturbed areas of the mine site are as follows.

- Catch banks (CB) – to intercept potentially sediment-laden water and direct it to the sediment basins. Catch banks would also be used to collect clean water and direct it to the storage dams.
- Sediment basins (SB) – for the detention and treatment of potentially sediment-laden water prior to its discharge to natural drainage lines or the storage dams.

The existing dirty water management system of the mine site would be modified as follows.

- CB1a would be constructed beyond the downstream toe of the overburden emplacement. CB1a would channel runoff from the overburden emplacement into an existing catch bank (CB1) that runs around the toe of the overburden emplacement.
- CB1 would be upgraded to carry water flowing off the overburden emplacement before discharging into SB3.

The design specifications for CB1a and CB1 were calculated using the Flocal computer program and are summarised in **Table 4.5**.

Table 4.5
Diversion Bank Specifications

Structure ID	Catchment Area (ha)	Channel Bottom Width (m)	Channel Grade (%)	Bank Height (m)	Level Spreader Width (m)	Slope of Level Spreader
CB1a	15	4	0.3	0.6	6	<1°
CB1	85	6	0.3	0.8	9	<1°

Source: Flocal

The sediment basins, reference to the catchment within which each is located and their capacities are identified in **Table 4.6**.

Should further dirty water management structures be required, these would be designed and constructed in accordance with the requirements contained within “*Managing Urban Stormwater: Soils and Construction, 4th eds. Vol. 1 and 2E*” (Landcom, 2004 & 2008), and be completed prior to the commencement of any surface disturbing activities (unless impractical to do so, eg. for reasons of access etc.).



Table 4.6
Dirty Water Storage Dams

Label	Capacity (ML)
Rail Load-out Facility Catchment	
SB10	2.9 ²
Rail Load-out Road Catchment	
SB8	3.0 ¹
SB9	4.0 ¹
Mine Area Catchment	
SB1	8.5 ²
SB2	7.0 ²
SB3	6.5 ²
SB4	2.5 ²
SB5	1.4 ²
SB6	4.5 ²
SB7	2.6 ²
Total	42.9
Note 1: Capacity estimated	
Note 2: Capacity determined through survey	
Source: Modified after GSSE (2009) – Table 4	

4.1.4.2.4 Void Water Management

Void water is accumulated from rainfall runoff within the open cut itself and a small amount of groundwater inflow into the void. The volume of water accumulating in the void is minimised by the storage dams and diversion banks which prevent overland flows from surrounding lands entering the void. The water is and would continue to be collected within one or more sumps where it naturally seeps back into the groundwater underground, is pumped directly into water trucks for on-site dust suppression or is pumped to one of the two Void Water Dams (VWD1 and VWD2 - see **Figure 4.3**). These structures, approved through modification to DA 172-7-2004 in September 2008, provide storage capacity of 20ML and 35ML respectively which is in excess of the 45ML calculated to be required during a 90th percentile rainfall year (GSSE, 2009).

The electrical conductivity of the void water has been measured to be between 780µS/cm and 1 470µS/cm, which the ANZECC (2000) guidelines suggest is of suitable quality for irrigation. In addition to dust suppression across the mine site, it is proposed to intermittently irrigate the rehabilitating surfaces of the final landform with this water. This would serve dual purposes of ensuring capacity is maintained in the two VWDs for extreme rainfall events, as well as assisting in the establishment of vegetation on the surfaces of the final landform. To protect against increase in soil salinity, which may be counterproductive to the rehabilitation aims of the proposed irrigation, that Applicant would commit to the following.

- The water of the void water would be sampled and analysed prior to irrigation. Should the electrical conductivity exceed 1 500µS/cm or pH fall outside the 5.5 to 8.5 range, the water would not be used for irrigation.



- The soil of the final landform irrigated using the void water would be regularly sampled and analysed with irrigation activities ceased if the soil salinity increases significantly over time. The Applicant proposed to sample and analyse the soil at 6 monthly intervals.
- The vegetation of the rehabilitated areas of the final landform would be regularly inspected. If signs of vegetation stress or poor condition are observed, irrigation activities would be ceased until it can be established the condition is not attributable to the irrigation.

4.1.4.2.5 Underground Water Management

Water from the underground workings would be pumped into one of four cells within the underground water storage area in the southwestern corner of the mine site. The combined capacity of the water storage cells, based on a surface area of approximately 5.8ha and average depth of 6m, would be at least 370ML.

DB2a and the banks of the dams themselves would isolate the active cells from natural surface water drainage, restricting the total inflows to the dams to the groundwater and a small volume of direct rainfall.

The water quality within the underground workings was analysed by RCA (2009) and found to be brackish (EC of approximately 3 000 μ S/cm). The water quality was found to generally meet NHRMC health guidelines, although was not considered of ANZECC drinking water guideline standard. To accommodate this slightly saline water, and to prevent seepage through the floor and banks of the cells which might ultimately discharge downstream of the mine site, the cells would be compacted to achieve a hydraulic conductivity < 1x10⁻⁹m/s. The Applicant would submit design specifications, construction QA/QC program and an "as constructed" report by a qualified engineer to the DECC prior to and following construction of the cells.

4.1.4.2.6 Contaminated Water Management

The following management practices would continue to be adopted to ensure water emanating or flowing from wash-down areas, workshops, hydrocarbon storage and refuelling areas is not contaminated by hydrocarbons or is treated appropriately, if contaminated.

- All water from wash-down areas and workshops would be directed to oil separators and containment systems for subsequent removal.
- All storage tanks would be bunded with an impermeable surface and a capacity to contain a minimum 110% of the largest storage tank capacity.
- All hydrocarbon products would be securely stored.
- With the exception of less mobile mining equipment which would be refuelled within the open cut mine, designated areas would be allocated for refuelling and minor maintenance work and the use of these areas enforced by mine management.



In the event of a hydrocarbon spill, which may enter natural or constructed drainage, a 4-phase remedial action plan would be adopted.

- **Phase 1** Identify the source of the contamination, stop the spill or leak and isolate the source from discharging to drainage through the construction temporary bunds or sumps.
- **Phase 2** Place oil booms or similar equipment within end-point structures, eg. sediment basins or storage dams, to prevent material from discharging.
- **Phase 3** Pump contaminated water from end-point structures and either pump through on-site oil-water separator or transport to a facility licensed to accept contaminated water. Recover any contaminated soil and either spread within a designated “land farming” area for natural remediation or transport to a facility licensed to accept contaminated soil.
- **Phase 4** Remediate any temporary diversion, bunding or sump structures, treating residual contamination as outlined in Phase 3 above.

4.1.4.2.7 Vegetation Management

The maintenance of vegetation, particularly ground cover, is an important factor in reducing the velocity of surface water flows and maintaining surface water quality. By reducing flow velocity, the potential for soil erosion is reduced as is the potential for further sediment to be entrained by the runoff. The vegetation itself would also act to filter a proportion of suspended solids contained within the water. As a general rule, a ground cover would be maintained on the mine site beyond the proposed areas of disturbance. Importantly, the Applicant would undertake progressive revegetation of all completed landforms as discussed in Section 2.11. The Applicant proposes to maintain this ground cover at 70% or better in all areas immediately adjacent to the active areas of disturbance on the mine site.

In addition to the undisturbed areas of the mine site, the Applicant would also reduce the erosion potential (or C-factor) of all drainage paths, ie. diversion and catch banks, by establishing and maintaining a vegetative cover or installing a Rolled Erosion Control Product (RECP), eg. jute mesh, coconut fibre, etc. within the channel. A vegetative cover of 70% or better, or RECP installation, would be achieved within 3 months of channel construction.

4.1.4.3 Water Availability Controls

4.1.4.3.1 Introduction

The Applicant would continue to manage water availability with two primary goals in mind.

1. Minimising any reduction in the availability of surface runoff to downstream users. This would be achieved by ensuring that the clean water dam capacity of the mine site remains within the Maximum Harvestable Rights Dams Capacity (MHRDC) allocation for the mine site.
2. Ensuring sufficient water is captured on the mine site to meet the operational requirements of the mine.



Section 4.1.4.3.2 presents the calculated maximum dam capacity for the mine site and additional land owned by the joint venture partners. Sub-section 4.1.4.3.3 presents a water balance for the mine site to identify the quantities of water available during the life of the mine.

4.1.4.3.2 Maximum Harvestable Rights Dam Capacity

The MHRDC for a property (or in this case mine site), introduced as part of the DWE Farm Dams Policy in 1999, exempts small rural type dams capturing a small proportion of a catchment from licensing requirements and is determined by multiplying the area of the landholding by a multiplier factor, in this case 0.0775 (DIPNR, 1999)³.

The maximum dam capacity for the mine site was determined in the following manner.

$$\begin{aligned}
 \text{Maximum Harvestable Right} &= \text{Catchment Area (ha)} \times \text{Multiplier}^3 \text{ Value} \\
 &= 679 \times 0.0775 \\
 &= 52.62\text{ML}
 \end{aligned}$$

Table 4.4 identified the combined capacity of the mine site storage dams to be 24.9ML. Within the mine site there are an additional six farm dams (identified as Farm 1 to 6 on **Figure 4.3**) with a combined capacity of approximately 18ML (GSSE, 2009). Therefore, the combined clean water dam capacity of the mine site is 42.9ML, well within the MHRDC for the mine site.

4.1.4.3.3 Site Water Balance

The water balance prepared for the proposed modification effectively updates that provided within the SWMP for the Werris Creek Coal Mine (GSSE, 2009), which was previously updated from an initial water balance prepared by Soil Services for the original development application (Soil Services, 2004). The water balance, which is provided as **Appendix 2**, considers the water capture and storage capacity of the mine site (see **Figure 4.3**), and the relative surplus or deficit of water available during dry, average and wet years (10th, 50th and 90th percentile rainfall years). As is the current practice, the water balance would be updated each year in the AEMR, reflecting changes to water management structures or refinements in the input / output calculations.

Given the management of water on-site into three separate water types, ie. clean, dirty and void, with the only commonality being that water of each type may be used for dust suppression purposes, the separate balances are provided for each water type, along with an overall water balance including all water types. **Table 4.7** presents the annual water balance for the void, dirty and clean water on the mine site, for dry average and wet years and assuming void water would be used in preference to dirty water which would be used in preference to clean water.

³ The calculation is based on the Department of Infrastructure, Planning and Natural Resources document *Rural Production and Water Sharing Landholders Information Package (1999)*



Table 4.7
Mine Site Water Balance

Inputs and Outputs		Avg Yr (ML)		Dry Yr (ML)		Wet Yr (ML)	
		Yr 1*	Yr 3*	Yr 1*	Yr 3*	Yr 1*	Yr 3*
Void Water							
Inputs	Rainfall Runoff	109		74		146	
	Groundwater Inflow	212	79	212	79	212	79
	Total	321	188	286	153	358	225
Outputs	Evaporation (from dams)	33		33		33	
	Evaporation (from open cut)	138		138		138	
	Dust Suppression and Crushing/Screening Operations	128		93		117	
	Total	299		264		288	
Balance		+22	-111	+22	-111	+70	-63
Dirty Water							
Inputs	Rainfall Runoff	403		277		541	
	Total	403		277		541	
Outputs	Evaporation	48		48		48	
	Dust Suppression and Crushing/Screening Operations	0	111 [#]	0	111 [#]	0	63 [#]
	Total	48	159	48	159	48	111
Balance		+355	+292	+229	+166	+493	+430
Clean Water							
Inputs	Rainfall Runoff	608		422		816	
	Total	608		422		816	
Outputs	Evaporation	33		33		33	
	Dust Suppression and Crushing/Screening Operations	0 [@]		0 [@]		0 [@]	
	Total	33		33		33	
Balance		+575		+389		+783	
Mine Site Balance		+952	+930	+640	+618	+1346	+1276

* Refers to the year of operation used for calculating groundwater in-flow (see Section 4.2.5.3).
[#] The majority of the dust suppression and crushing/screening operations requirements are sourced from the void water system.
[@] The dust suppression and crushing/screening operations requirements are sourced from the void and dirty water system. A maximum of 52.62 ML can be sourced from the clean water, in accordance with the calculated Maximum Harvestable Right.

The supply of water used for drinking and bathhouse facilities is sourced and disposed of separately to the water management system presented on **Figure 4.3** and as such is not included in the mine site water balance.

The availability of water to meet the environmental and operational requirements of the proposed modification is discussed as follows.

- With combined void water dam capacity of at least 55ML, it is likely that sufficient capacity is present to store void water during all but the wettest years. Additional capacity is present on the mine site in the form of the Underground Water Storage Dams should void dewatering in excess of 55ML be required.
- There is a large excess of dirty water. Sediment basins have been designed and would be constructed to ensure an adequate storage and settlement zone is provided for a 90th percentile 5 day rainfall event (see **Table 4.9**).
- No clean water is required for use on the mine site and as such the Applicant would not utilise its Maximum Harvestable Right for the mine site.

4.1.5 Assessment of Impacts

4.1.5.1 Criteria

4.1.5.1.1 Surface Water Quantity

The acceptability of any decrease in the quantity of clean water available downstream of the mine site would be assessed against the MHRDC for the mine site of 47.53ML.

4.1.5.1.2 Surface Water Quality

The quality of surface water discharged from the mine site would be assessed against NSW DECC guidelines for pH, suspended solids and grease and oil as identified in **Table 4.8**.

Table 4.8
Discharge Limits – Surface Water

Parameter	50 th Percentile Limit	90 th Percentile Limit	100 th Percentile Limit
pH	-	-	6.5 to 8.5
Total Suspended Solids (mg/L)	20	35	50
Grease and Oil (mg/L)	-	-	10

Source: Modified after EPL 12290 – Condition L3.3

4.1.5.1.3 Namoi River Catchment Salinity

The Namoi Catchment Management Authority has established targets to be achieved within the Namoi River Catchment with reference to river salinity (NCMB, 2003). The proposed modification has therefore been assessed against the four following targets.

- Target RS.1 - water quality. By 2010 to have all land managers (including urban) using better management practices throughout the catchment to minimise the mobilisation of salt to rivers.
- Target RS.2 - gully control. By 2010, halt existing gully erosion and bed lowering within priority salinity sub catchments by constructing 1000 gully control and bed lowering structures to reduce the mobilisation of salt to the river.
- Target RS.3 - new development. From 2001, new investment requiring a Development Application or requiring approval under Part 5 of EP&A Act, to result in no net increase in the salt load to the river.
- Target RS.4 - point sources. By 2010 existing point sources of river salinity to have a reduction of 10% on 2001 salt loads.



4.1.5.2 Residual Impacts

4.1.5.2.1 Surface Water Quantity

By maximising the use of void and dirty water and limiting the clean water storages to those identified on **Figure 4.3** (which remain below the MHRDC for the mine site), the proposed modification would be unlikely to significantly impact on surface water available to landholders downstream of the mine site.

4.1.5.2.2 Surface Water Quality

Dirty Water Management

The surface water management system for the proposed modification is consistent with the system already in use which minimises the volume of water entering the dirty water system and to capture all dirty water and direct it to sediment basins, via a number of existing and proposed diversion banks.

The water balance presented in **Table 4.7** indicates that there is likely to be a large excess of dirty water requiring settlement prior to any discharge from the mine site. The dirty water storage capacity of the northern middle and southern sections of the mine site (see **Figure 4.3**) has been identified (see **Table 4.6**) and compared to the capacity required to accommodate surface flows following the 90th percentile, 5 day rainfall calculations in each of the three sections of the mine site (the rainfall event nominated by Landcom, 2004 and 2008). **Table 4.9** presents a summary of these calculations, illustrating that the dirty water storage capacity of the mine site is well in excess of that required to satisfy the standards for settlement and storage identified in Landcom (2004, 2008).

Table 4.9
Sediment Basin Capacity Balance (90th Percentile, 5 Day Rainfall Event)

Site Water Management Zone ¹	Area (ha)	Required Total Basin Capacity (m ³)	Total Catchment Basin Capacity
Northern	6.5	1 510	2 850
Middle	89	20 643	23 150
Southern	122	28 297	32 900
Note 1: see Figure 4.3			
Source: Modified after GSSE (2009) – Table 9			

Void and Underground Water Management

The proposed modification provides for the storage of all void and underground water within the dams VWD1 and VWD2 and the underground water storage area. These dams would be isolated from natural drainage and would be maintained to ensure no discharge of water, which may be slightly to moderately saline, from the mine site.

The permeability of these dams would not exceed 1×10^{-9} m/s, the permeability standard below which the risk of infiltration of salt or saline water to the underlying material is determined to be minimal and acceptable (South Australia EPA, 2004).



Based on the above, it is concluded that the proposed modification would not result in water being discharged from the mine site with pH, TSS or salinity (EC) levels exceeding or outside the nominated range of the water quality criteria identified by **Table 4.7**.

4.2 GROUNDWATER

4.2.1 Introduction

While monitoring at the Werris Creek Coal Mine has demonstrated that the open cut mining operations is having minimal, if any impact on the availability of groundwater to landholders in close proximity to the mine (see Section 1.6.3.4), the proposed modification has the potential to impact on local hydrogeology, which in turn may impact on the availability of groundwater to downstream landholders or the environment. The following sub-sections provide a summary of the pre-mining hydrogeological setting, identify the potential impacts on local groundwater and constraints on the proposed modification, identify the operational safeguards and controls to be implemented by the Applicant and assess the impact of the proposed modification on ground water quality, quantity and availability.

This section has been prepared with considerable reference to a Groundwater Impact Assessment prepared by Robert Carr and Associates Pty Ltd (RCA Australia, 2009). Reference is also made to the original groundwater impact assessment of RCA Australia (2004), where relevant. The report of RCA Australia (2009) is presented in full as Part 1 of the *Specialist Consultant Studies Compendium*.

4.2.2 Existing Environment

4.2.2.1 Regional and Local Hydrogeology

Within the vicinity of the mine site, groundwater occurs in three main aquifers (RCA Australia, 2009), namely:

- i) Permian coal measures;
- ii) Werrie Basalt; and
- iii) Quaternary sediments.

Further details on the local geology are provided in Section 3.3.2.

Permian Coal Measures

The Permian coal measures strata within the open cut area of the mine site occur as a closed basin surrounded by weathered basalt and low permeability claystone. The basalt and claystone have a generally low permeability and porosity with groundwater typically occurring in fractures, joints, cleats and bedding. While the interburden within the coal measures are generally confining layers, there would be some limited vertical movement of groundwater between the coal seams and the interburden layers.



Groundwater monitoring undertaken on the mine site has measured the groundwater level within the closed coal measures basin to be between 10m and 30m below surface level (at approximately 365m AHD – Geoterra, 2008). The underground workings of the former Werris Creek Colliery are located below this elevation (340m and 345m AHD) and are currently inundated with water. Based on the estimated cross-sectional area and surveyed length of the underground workings, it is estimated up to 330ML of water is contained within the underground workings. Recent groundwater monitoring completed by RCA (2009) identified the groundwater in the underground workings occurs at distinctly different elevations suggesting that water held within different sections of the former underground may not be connected.

Groundwater flow is from north to south (following surface topography) and has been estimated by RCA Australia (2004) to not exceed 1m/year.

Werrie Basalt

Below the closed basin of the Permian coal measures, groundwater occurs at between 8m and 52m below natural ground level (Geoterra, 2008) within the Werrie Basalt. This aquifer is recharged by direct infiltration of rainfall and also from runoff from the surrounding Carboniferous sandstone ridges which drive the flow of groundwater south towards Quipolly Creek. Based on the average permeability and gradient, groundwater flow within the Werrie Basalt is calculated to approximate 3m/year (RCA, 2004). There would be minimal flow between the Permian coal measures and Werrie Basalt as the upper layers of weathered basalt effectively form an impermeable barrier between the two water-bearing strata.

Quaternary Alluvial Sediments (Quipolly Alluvium)

Groundwater occurs at approximately 4.4m to 8.7m below surface level within high permeability alluvial sediments that occur approximately 3km south of the mine site within the Quipolly Creek Valley. This aquifer is recharged through direct infiltration of rainfall, and from the upper catchment of the Quipolly Creek to the east. This significant source of recharge flowing from the sandstones from the Rossmore Formation and preferentially through the high permeability sediments drives the groundwater flow to the west at an estimated rate of 150m/year (RCA Australia, 2004).

Minor interaction between the Werrie Basalt and this alluvial aquifer would be expected as south-flowing groundwater within the basalt strata meets the westerly-flowing groundwater of alluvial sediments.

In addition to the above three water-bearing strata, sandstone and tight volcanic formations have been identified to the northeast and west of the mine site. **Figure 4.4** presents the contours of groundwater flow within the three water-bearing strata beneath and surrounding the mine site.



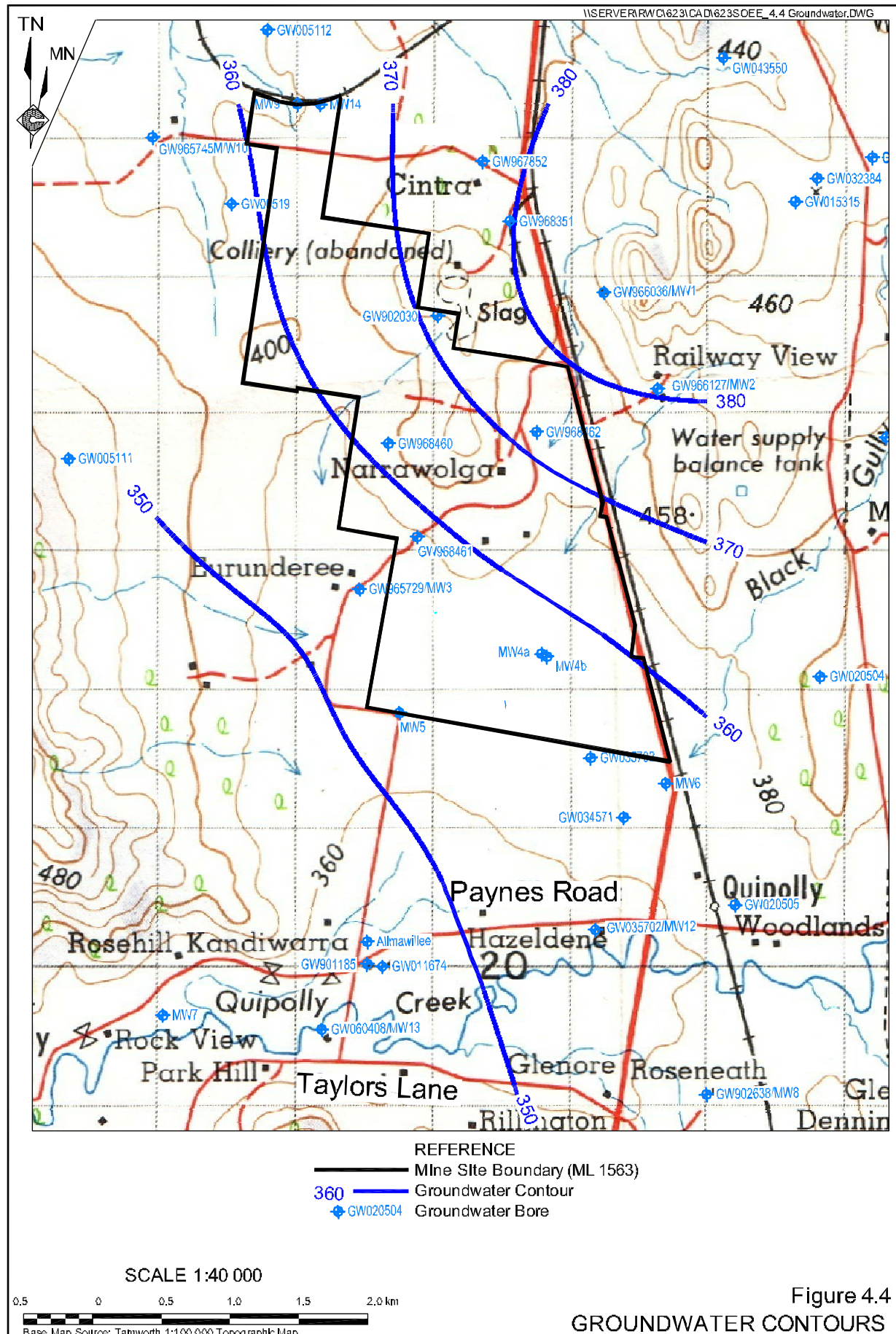


Figure 4.4

GROUNDWATER CONTOURS



4.2.2.2 Groundwater Quality

Groundwater samples are collected and analysed quarterly from 13 monitoring locations on and surrounding the mine site. The groundwater quality of the three water-bearing strata and the underground workings is as follows.

Permian Coal Measures

Groundwater samples taken from the coal-bearing strata of the mine site have been analysed and found to be slightly acidic with low salinity. The low salinity (brackish) was considered unusual for coal measures and attributed to the close proximity of the recharge point (the sub-crop). With the exception of three samples which displayed slightly elevated zinc or nickel concentrations (RCA, 2004), the concentration of metals is generally within the accepted limits for irrigation purposes. In all cases, these slightly elevated results were well under the accepted limits for livestock use. Concentrations of other analytes tested indicated the water is suitable for the purpose of irrigation or reuse in site operations (RCA, 2009).

Underground Workings

Analysis of groundwater collected from BH1, BH2 and the mine site production bore found similar water quality characteristics to those taken from the coal measures, ie. brackish, slightly acidic but with concentrations of other analytes tested indicated the water is suitable for the purpose of irrigation or reuse in site operations (RCA, 2009).

Werrie Basalt

The water of the basalt aquifer displays a consistent pH of between 6.7 to 7.8 and is fresh to slightly brackish (electrical conductivity of between 810 μ S/cm to 2940 μ S/cm) (Geoterra, 2008). Sampling of other analytes indicate the water body is generally suitable for irrigation or stock use although the concentration of manganese in some bores exceeds ANZECC for irrigation (Geoterra, 2008).

Quaternary Alluvial Sediments (Quipolly Alluvium)

Groundwater within the Quipolly Creek alluvium has a salinity range between approximately 400 μ S/cm and 1260 μ S/cm, and displays a near neutral pH of between 6.7 and 7.3. The concentration of metals and other analytes generally meets the ANZECC requirements for irrigation or stock use (Geoterra, 2008).

An evaluation of the groundwater chemistry, undertaken as part of the original groundwater impact assessment (RCA Australia, 2004) identified a distinction in chemical “type” of water between each strata ie. distinct differences are evident in the dominant ions between samples analysed from each strata. A summary of the chemical characteristics of each water type is presented in **Table 4.10**.



Table 4.10
Summary of Groundwater “Types”

Water-bearing Strata	Water Type	General Identifier
Quaternary Sediments	Ca-Na-Mg-HCO ₃ -Cl Ca-Na-Mg-HCO ₃ -Cl Ca-Na-Mg-HCO ₃ -Cl Ca-Na-Mg-HCO ₃ -Cl	Calcium Bicarbonate type
Werrie Basalt	Na-Mg-Ca-Cu-HCO ₃ Na- Ca-HCO ₃ -Cl Na- Ca- HCO ₃ -Cl	Sodium Bicarbonate type
Permian Coal Measures	Na-Ca-Mg-HCO ₃ -Cl Na-Ca-HCO ₃ -Cl Na-Ca-Mg-HCO ₃ -Cl Na-Ca-Mg-HCO ₃ -Cl Ca-Na-Cl	Sodium Bicarbonate type
Underground Workings (within Permian Coal Measures)	Ca-Na-SO ₄ -Cl Ca-Na-Cl	Calcium Chloride type
Source: Modified after RCA Australia (2004) – Table B		

This distinction in groundwater type supports the conclusion that there is little interaction between the groundwater of the three water-bearing strata.

4.2.2.3 Water Use and Availability

RCA Australia (2009) undertook a review of DWE records and identified a total of 17 registered bores within 5km of the mine site. The location of each bore is presented in **Figure 4.4** with **Table 4.11** providing a summary of the available data for each.

The use of the groundwater resources can be categorised generally by the aquifer from which it is drawn. Landholders drawing water from the higher yielding Quaternary sediments, currently use the groundwater for the irrigation of lucerne crops as well as for stock and domestic purposes. North of Taylors Lane, where groundwater is drawn from the Werrie Basalt, yields are lower and the groundwater is generally restricted to domestic or stock watering purposes.

It is noteworthy that only one bore (namely GW902030 on the “Old Colliery” property), draws groundwater from the Permian coal measures. This is for two reasons. Firstly, the coal measures water-bearing strata cover only a limited area with very few of the local properties located over this aquifer. Secondly, due to the closed nature of the coal measures, and the impermeability of the weathered basalt and claystone layer between it and the Werrie Basalt, the potential quantity of water available and likely yields would be very low.



Table 4.11
Summary of Groundwater Bores within 5km of the Mine Site[@]

Registered Number	Property	Aquifer	Usage
GW965729	"Eurunderee"	Basalt	Stock
GW034571	"Eurunderee"	Basalt	NK
GW020504	"Woodlands"	Basalt	Stock
GW035072	"Hazeldene"	Alluvial	Stock
GW055108	"Escott"	Sandstone	NK
GW020505	"Woodlands"	Alluvial/Basalt	Stock
GW005111	"Eurunderee"	Sandstone	NK
#	"Allmawillee"	Alluvial	Domestic & Irrigation
GW902030	"Old Colliery"	Coal Measures	Domestic
GW011674	"Gedhurst"	Alluvial	Domestic & Irrigation
GW901185	"Mountain View"	Alluvial	Domestic & Irrigation
GW900708	"Talavera"	Basalt	Domestic & Stock
GW966036 (MW1)	"Hillview"	Basalt	Domestic & Stock
GW966127 (MW2)	"Railway View"	Basalt	Domestic & Stock
965729 (MW3)	"Eurunderee"	Basalt	Domestic & Stock
MW4	ML 1653	Basalt	Monitoring
MW5	ML 1653	Basalt	Monitoring
MW6	ML 1653	Basalt	Monitoring
966349 (MW7)	"Rosehill"	Alluvial	Domestic & Stock
902638 (MW8)	"Roseneath"	Basalt	Domestic & Stock
MW9	ML 1653	Basalt	Monitoring
965745 (MW10)	"Escott"	Basalt	Domestic
MW11	"Escott"	Sandstone	NK
60408 (MW13)	"Parkhill"	Alluvial	Irrigation
MW14	ML 1653	Basalt	Monitoring
[@] See Figure 4.4			
NA – not available NT – not tested NK – not known # not registered			
Source: Modified after RCA (2009) – Table 3			

4.2.2.4 Groundwater Planning Regime

The mine site is located outside the mapped area of the Water Sharing Plan for the Phillips Creek, Mooki River, Quirindi Creek and Warrah Creek Water Sources 2004 ("the WSP"). However, the WSP is identified as regulating groundwater sources within the alluvium aquifer of each water source with Quipolly Creek, located approximately 2.7km from the southern boundary of the mine site boundary, occurring within the Quirindi Creek Water Source. The Quirindi Creek Water Source is identified as having highly variable flow with a 50th percentile flow volume of 2ML/day (RCA, 2009). As a consequence of the Quipolly Alluvium forming part of the Quirindi Creek Water Source, any change to groundwater availability within the Quipolly Alluvium must be managed in accordance with the rules of the WSP.



The Werrie Basalt and Permian Coal Measures do not occur within the boundary of the WSP and as such are not regulated by the rules of the WSP. This notwithstanding, the Applicant requires an appropriate licence to extract groundwater from the underground workings which occur within the Permian Coal measures aquifer.

4.2.3 Constraint(s)

Impacts on groundwater could potentially constrain the modified mining operation on the basis of three potential impacts. These are considered as follows.

Pollution of Groundwater

The potential sources of groundwater contamination include:

- fuel, oil or other hydrocarbon spills or leaks;
- acid or salinity generation by the overburden; and
- explosives residues.

Characterisation of the overburden and interburden material identified no potential acid or salinity-generating material that might lead to contamination of the groundwater (URS, 2004). Based on experience on site to date and elsewhere, explosives residues would be unlikely to have any measurable effect on the chemistry of the groundwater. Contamination by fuel, oil or other hydrocarbons is therefore the only major issue to be managed as part of the proposed modification.

Groundwater Availability

The modification to the open cut area and overburden emplacement may influence local groundwater drawdown and flows, which in turn may reduce the saturated thickness of groundwater within the bores of local landholders and potentially the yield of these bores. The predictions of RCA (2004), ie. minimal change to local groundwater levels, have been largely validated by groundwater monitoring completed to date. Therefore, given the modification to the open cut area is relatively minor, it is not anticipated that groundwater availability will constrain the proposed modification.

Groundwater Licensing

The approved open cut and proposed modification are likely to have a very minor impact on the groundwater level of the Quipolly Creek Alluvium. Any drawdown, no matter how minor will ultimately result in a reduction in the flow of groundwater through the groundwater source, potentially triggering the requirement to obtain a licence for the groundwater removed from the groundwater source.

The inability to obtain an appropriate licence allocation, or exemption from the Minister (see Section 1.8.1), for interference in the groundwater resource of Quipolly Creek could potentially constrain the proposed modification.



4.2.4 Operational Safeguards and Controls

4.2.4.1 Groundwater Contamination

Although it is not anticipated that the proposed modification would have a significant or long-term impact on the quality of groundwater beneath landholdings surrounding the mine site, specific controls and management practices have been proposed by the Applicant for the management of hydrocarbons (identified as the only likely source of groundwater contamination – see Section 4.2.3). These would ensure hydrocarbon products are prevented from seeping into the ground and ensure that water flowing from areas on the mine site with the potential to generate hydrocarbon-contaminated water, eg. wash down areas, workshops, hydrocarbon storage and refuelling areas, is not contaminated by hydrocarbons.

- All hydrocarbon products would be securely stored.
- All of the mining fleet would be refuelled within designated surface facilities area. With the exception of some maintenance activities on mobile equipment, all maintenance works requiring the use of oils, greases and lubricants would be undertaken within designated surface facilities areas, ie. maintenance workshop.
- All water from wash-down areas and workshops would be directed to oil/water separators and containment systems.
- All storage tanks would either be self-bunded tanks or bunded with an impermeable surface and a capacity to contain a minimum 110% of the largest storage tank capacity.

4.2.4.2 Groundwater Availability

Monitoring conducted to date (Geoterra, 2008), as well as modelling groundwater drawdown resultant from mine in-flows (see Section 4.2.5.3) suggests that there would be limited impact on the standing water levels of registered groundwater bores on properties not owned by the Applicant. Emphasis on the management of groundwater would therefore continue to be placed on monitoring of surrounding groundwater bores to verify the predicted minimal impact on groundwater availability and developing mitigation measures to ensure that any reduction in available groundwater is replaced by a comparable water source or otherwise compensated. Replacement and/or compensatory measures would be developed in consultation with the affected land owner but may include:

- deepening of the affected bore to increase the available saturated thickness;
- drilling and installation of a replacement bore outside the area of drawdown impact;
- construction of surface water capture and containment structures such as dams or rainwater tanks to supplement reduced groundwater source; or
- transfer of groundwater drawn from Applicant-owned bores or the void itself.



4.2.5 Assessment of Impacts

4.2.5.1 Criteria

As groundwater in the local area is used predominantly for stock or irrigation purposes, water quality would be assessed predominantly against the (NEPM) agricultural irrigation guideline levels, with the ANZECC guideline levels used where no NEPM guidelines have been published. **Table 4.12** presents the various groundwater quality criteria of the National Environment Protection Measure (NEPM) (1999) and ANZECC (2000).

Table 4.12
Groundwater Quality Criteria

Analyte	NEPM Guideline Levels		ANZECC Guideline Levels*	
	Agricultural Irrigation mg/L	Livestock mg/L	Agricultural Irrigation mg/L	Livestock mg/L
Arsenic (total)	0.1	0.5	2.0/0.1	0.5
Cadmium	0.01	0.01	0.05/0.01	0.01
Chromium (Total)	1.0	-	-	-
Chromium (VI)	0.1	1.0	1/0.1	1
Copper	0.2	0.5	5/0.2	0.4 - 5+
Lead	0.2	0.1	5/2	0.1
Manganese	2.0	-	10/0.2	-
Mercury (total)	0.002	0.002	0.002	0.002
Nickel	0.02	1.0	2/0.2	1
Zinc	2.0	20.0	5/2	20
Calcium	-	1 000	-	1000
Conductivity (us/cm)	-	-	1900 – 4500 [@]	2000 – 5000 [#]
Magnesium	-	-	230 – 460 [@]	-
Chloride	-	-	350 – 700 [@]	-
Sulphate	-	-	-	1 000
[@] For moderately tolerant crops [#] Poultry - sheep * Short term trigger value / long term trigger value ^{\$} Concentrations of up to 2000mg/L have been found to have no adverse effects on cattle *Poultry – sheep - No published values				
Source: NEPM Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater & ANZECC (2000)				

Impacts on the water quality parameters of pH, TDS, other anions and heavy metals (not considered by the NEPM criteria) would be based on comparisons to baseline monitoring of groundwater quality taken from all groundwater bores within the mine site.

Groundwater levels and the saturated thickness within bores on neighbouring landholdings would be monitored with any variations over 10% considered a significant impact given these levels would be expected to naturally vary by this amount. Hence, the criteria for assessing the degree of impact upon groundwater level and saturated thickness has therefore been determined to be a >10% decrease in water level or saturated thickness.



4.2.5.2 Methodology

The extent of groundwater inflows into the open cut void and the effect the proposed modification would have on groundwater levels, borehole saturated thickness, groundwater level re-establishment and availability of groundwater from existing bores has been predicted using a groundwater modelling program, “Visual Modflow” (RCA Australia, 2009). The model was designed to simulate the behaviour of the five separate geological strata potentially affected by the Project, which from shallowest to deepest are as follows.

1. Permian Coal Measures.
2. Weathered Werrie basalt layer.
3. Quipolly Alluvium.
4. Consolidated Werrie basalt and surrounding volcanic and sandstone strata.

Figure 4.5 presents an east-west and north-south cross-sectional representation of the groundwater model and hydraulic conductivity parameters. The model was calibrated to ensure it predicted the observed groundwater levels identified in groundwater bores surrounding the mine site with an acceptable level of error. Further detail on the model design, extent and input parameters is provided by *Section 6* of RCA Australia (2009) with *Section 7* of RCA Australia (2009) providing information on model calibration and validation.

Once calibrated (and validated), the model was run in transient mode for a period of 3 years (the period of proposed modified operations) to allow comparison of mine in-flows and aquifer drawdown over time. Impacts on mine in-flow, groundwater drawdown and changes to groundwater flow within the Quipolly Creek Alluvium were then considered after 1 year and 3 years of the proposed modified operations. These impacts were then compared to the impacts predicted by RCA (2004), ie. for the approved operations, to determine what impact the proposed modification is likely to have on local groundwater. Finally, the model was used to estimate the time taken for the re-establishment of groundwater to pre-mining levels (or the final groundwater level if pre-existing levels are unlikely to be achieved).

4.2.5.3 Residual Impacts

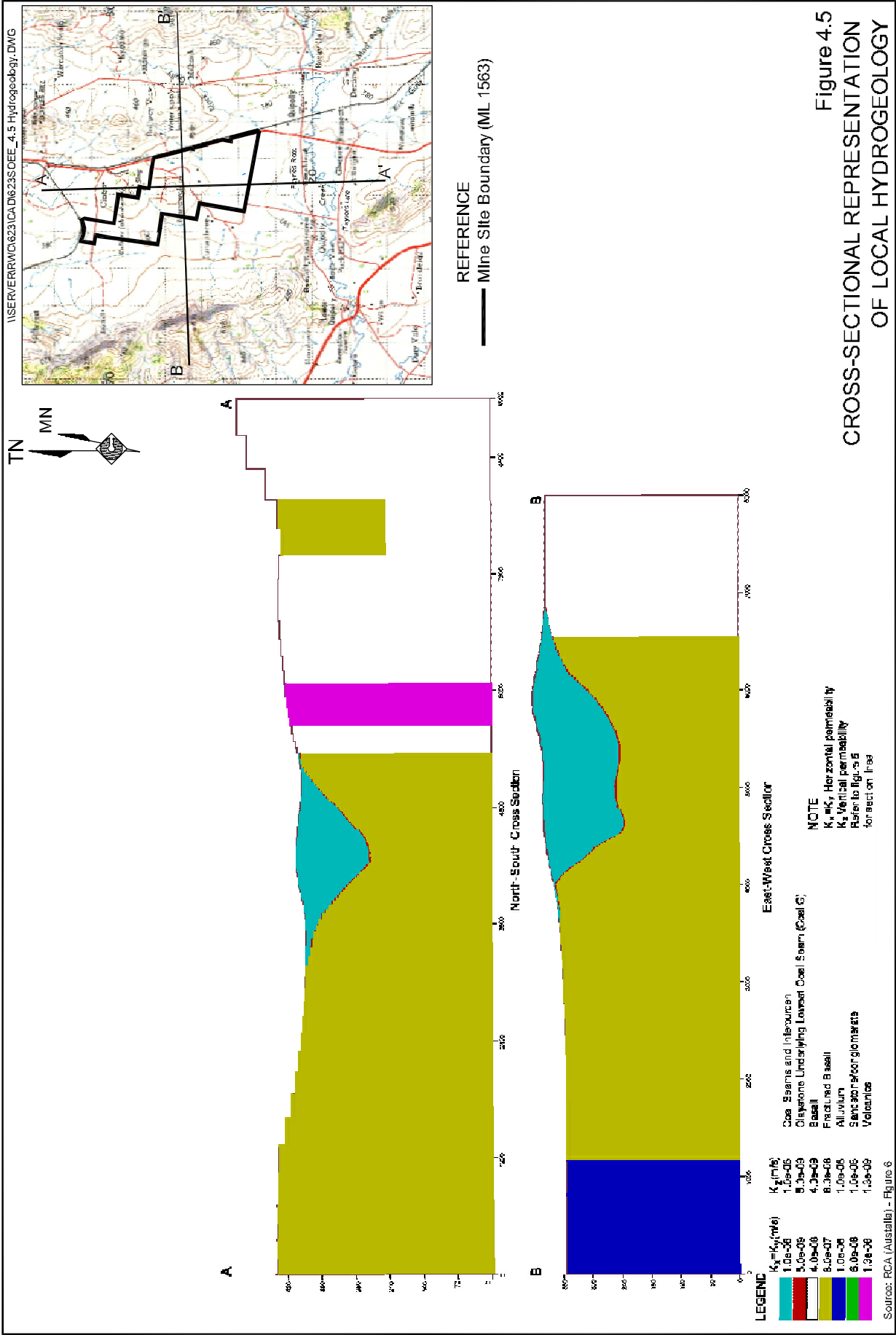
Mine In-flows

Based on the model simulations, the average in-flow of groundwater to the open cut during Year 1 and Year 3 of the modified operations is presented in **Table 4.13**.

Table 4.13
Total Seepage to the Void

Time Period	Year 1	Year 3
Flow Total (m ³ /day)	580	215
Annual In-flow (ML/year)	211.7	78.5





Notably, the predicted in-flows of RCA Australia (2009) are much less than those of RCA (2004) (628m³/day in Year 4 and 648m³/day in Year 7) as a result of dewatering the adjacent mine workings. Groundwater flow through the coal measures from the underground workings currently occurs, albeit at low levels, and provides continual seepage to the open cut operations. The lowering of the water table will reduce this seepage, as evidence by the Year 3 in-flow prediction.

The evaporation rate for the area is more than 1.9m/year (see **Table 3.1**). Considering this evaporative rate over the surface area of the open cut, the total evaporation would exceed the in-flow suggesting little groundwater in-flow would actually accumulate in the open cut void. Variations in climatic conditions may result in water make within the open cut from time to time with this water either pumped to one of two void water dams approved and constructed at surface (with the water then being used for dust suppression across the mine site).

Groundwater Levels / Drawdown

Table 4.14 presents the predicted maximum drawdown (reduction in standing water level) and reduction in saturated thickness predicted in the bores located on properties not owned by the Applicant. The values in brackets in the table represent the drawdown levels predicted by modelling completed by RCA Australia in 2004 for the original development application.

Table 4.14
Predicted Drawdown after 7 Years

Borehole	Property	Distance from open cut (m)	Predicted Maximum Drawdown (m)	Recorded Saturated Thickness (m)	% Decline in available Saturated Thickness (m)
GW005109	"Narrawolga"	1640	1.1	NK	NK
GW967852	"Cintra"	1350	0.9	NK	NK
GW005111	"Eurunderee"	2400	0.5 (nil)	56.7	0.8 (nil)
GW034571	"Eurunderee"	650	0.4 (nil)	NK	NK
GW020505	"Woodlands"	2050	0.2 (nil)	NK	NK (nil)
GW005110	"Escott"	2300	0.15	3.1	4.8
GW900708	"Talavera"	1935	<0.1 (nil)	190.6	<0.1 (nil)
GW020504	"Woodlands"	2260	<0.1 (nil)	NK	NK (nil)
GW035072	"Hazeldene"	2600	<0.1 (nil)	4.5	<2.2 (nil)
GW005112	Lomax*	2650	<0.1	NK	NK
GW043549	Richardson*	2700	<0.1	NK	NK
#	"Allmawillee"	2750	<0.1 (nil)	2.7	<3.7 (nil)
GW032384	"Hillview"	2890	<0.1	62.2	0.0
GW011674	"Gedhurst"	2900	<0.1 (nil)	1.1	<9.1 (nil)
GW043550	Teskera*	2920	<0.1	NK	NK
GW901185	"Mountain View"	3000	<0.1 (nil)	0.9	<11.1
GW016796	"Galla"	3220	<0.1	14	<0.7
GW900981	"Kyooma"	3340	<0.1	188	0
GW060408	"Parkhill"	3560	<0.1 (nil)	0.4	<26 (nil)
GW070733	"Werriston Sth"	3800	<0.1	39.3	<0.3
GW902638	"Roseneath"	4000	<0.1	26.7	<0.4
GW966349	"Rosehill"	4040	<0.1	NK	NK
GW032592	"Eurunderee"	4410	<0.1	35.6	<0.3

= Not a registered bore * Refers to land owner

Source: Modified after RCA Australia (2009) - Table 8



In order to illustrate the possible impact of the modified open cut mining proposal, **Figure 4.6** presents the predicted drawdown of groundwater within the Quipolly Alluvium aquifer after 1 and 3 years. The predicted drawdown is presented as 0.1m, 0.5m, 1.0m, 5.0m, 10.0m, 15.0m and 20.0m contours generated by the modelling of RCA Australia (2009). Of the bores identified within a 5km radius of the mine site, and on properties not owned by the Applicant, the predicted drawdown would only affect the saturated thickness by greater than 10% in two bores. Notably, the elevated reduction in saturated thickness within these two bores is attributable primarily to the very low initial saturated thickness of these bores. The actual drawdown in both cases is predicted to be <0.1m (see **Figure 4.6**), ie. a level well below natural groundwater fluctuations. The predicted loss in head is very small and within the expected levels of seasonal variation. Therefore, whilst the predicted loss in saturated thickness meets the trigger criteria, it is unlikely that any observable impacts will occur at these locations. These bores are therefore not considered to be impacted by the operations.

It is important to note that the predicted drawdown presented on **Figure 4.6** and **Table 4.14**, is very similar to that predicted by RCA Australia (2004) (for the approved open cut operations). That is, the proposed modification is unlikely to have any perceptible impact on local groundwater levels or the availability of water on surrounding properties.

At the completion of mining operations, modelling completed by RCA Australia (2009) predicts that a 75% recovery of the water table would be achieved within approximately 24 years. The remaining 25% recovery is predicted to occur over a far longer timeframe (approximately 100 years). Considered with reference to current and predicted future groundwater levels, the modelling predicts the groundwater immediately surrounding the open cut void would be reduced by up to 20m at the completion of mining (~345m AHD). Within 24 years, the groundwater level would recover to within 5m of the original level, ie. 360m AHD, with the remaining 5m recovery taking up to 100 years.

Impact on the Quipolly Creek Alluvium

In recognition of the licensing requirements for interference or access of groundwater within sources of the WSP, an evaluation of the loss of groundwater flow to the alluvium of Quipolly Creek was undertaken. **Table 4.15** presents the calculated flow to Quipolly Creek, before and after mining (with the difference between the pre- and post-mining flows provided in brackets). **Table 4.15** also provides the predicted flows to the Quipolly Creek Alluvium based on the final year of the approved mining operations to allow the level of impact modification to be assessed.

The flow rates presented in **Table 4.15** suggests that the current contribution of groundwater to Quipolly Creek is 648m³/day. This would reduce to 488m³/day approximately 5 years following the completion of mining with full recovery of flows achieved between 20 and 30 years after the completion of mining. Flows to the Quipolly Creek Alluvium would actually increase in the longer term (30 to 50 years) given the more permeable nature of the final landform and large water storage which would both result in increased recharge rates.

As can be seen when comparing the predicted groundwater flow for the final year of mining, the proposed modification has a relatively minor additional impact when compared to the impact predicted for the approved operation. At the completion of mining, the modified open cut layout would reduce flows to the Quipolly Creek Alluvium by approximately 3MLpa more than the approved operations.



Table 4.15
Groundwater Contribution to Quipolly Creek

Time Period	Flow Total (m ³ /day)	Flow Total (MLpa)
Pre mining	648	237
Yr 1 of modified mining layout	583	213 (-24)
Yr 3 of modified mining layout	541	197 (-40)
<i>Approved Mining (end Year 7)¹</i>	<i>549</i>	<i>200 (-37)</i>
5 years post completion	488	179 (-58)
10 years post completion	508	185 (-52)
15 years post completion	565	206 (-31)
20 years post completion	629	230 (-7)
30 years post completion	687	251 (+14)
40 years post completion	738	269 (+22)
50 years post completion	782	285 (+48)
Note !: Approved Open Cut Layout		
Source: Modified after RCA Australia (2009) – Table 10		

Based on the maximum loss in groundwater flow to Quipolly Creek of 160m³/day, a Water Access Licence for the equivalent annual groundwater consumption is technically required (59ML). However, it is considered appropriate that an exemption be granted in this case, given the reduction in flow has been predicted based on a drawdown of <0.1m within the Quipolly Creek Alluvium layer of the RCA Australia groundwater model. That is, this level of drawdown would have no adverse impact on the availability of groundwater to local users or the environment and would ultimately increase the flow of groundwater to Quipolly Creek.

Impact on Groundwater Dependent Ecosystems

No groundwater dependent ecosystems (GDEs) are identified within the groundwater sources of the WSP. This notwithstanding, RCA Australia (2009) assessed the impact on groundwater which could contribute to the health of a GDE that may occur in the local area, eg. along Quipolly Creek.

The proposed modification is predicted to impact on groundwater within the Quipolly Creek alluvium, Permian coal measures and Werrie Basalt aquifers. The pre-mining depth to groundwater on and immediately surrounding the mine site (Permian coal measures and Werrie Basalt “hard rock” aquifers) is variable and in the order of between 5m and 50m below surface. Importantly, groundwater in the vicinity of the mine site has not been observed to form perched water tables or springs and groundwater dependent ecosystems are therefore not likely impacted from drawdown effects within the hard rock aquifers.

The predicted reduction in groundwater levels within the Quipolly Creek alluvium is <0.1m, which is within the expected seasonal fluctuations of the aquifer. This reduction in groundwater level could contribute to a reduction in the contribution of the mine site to the groundwater flow to Quipolly Creek of up to 160m³/day, a reduction of approximately 25% (160 / 648). However, this level of groundwater flow reduction is also within the expected seasonal fluctuation for this groundwater source given Quipolly Creek is described as a highly variable creek with flows varying from no flow to over 1 000ML/day.



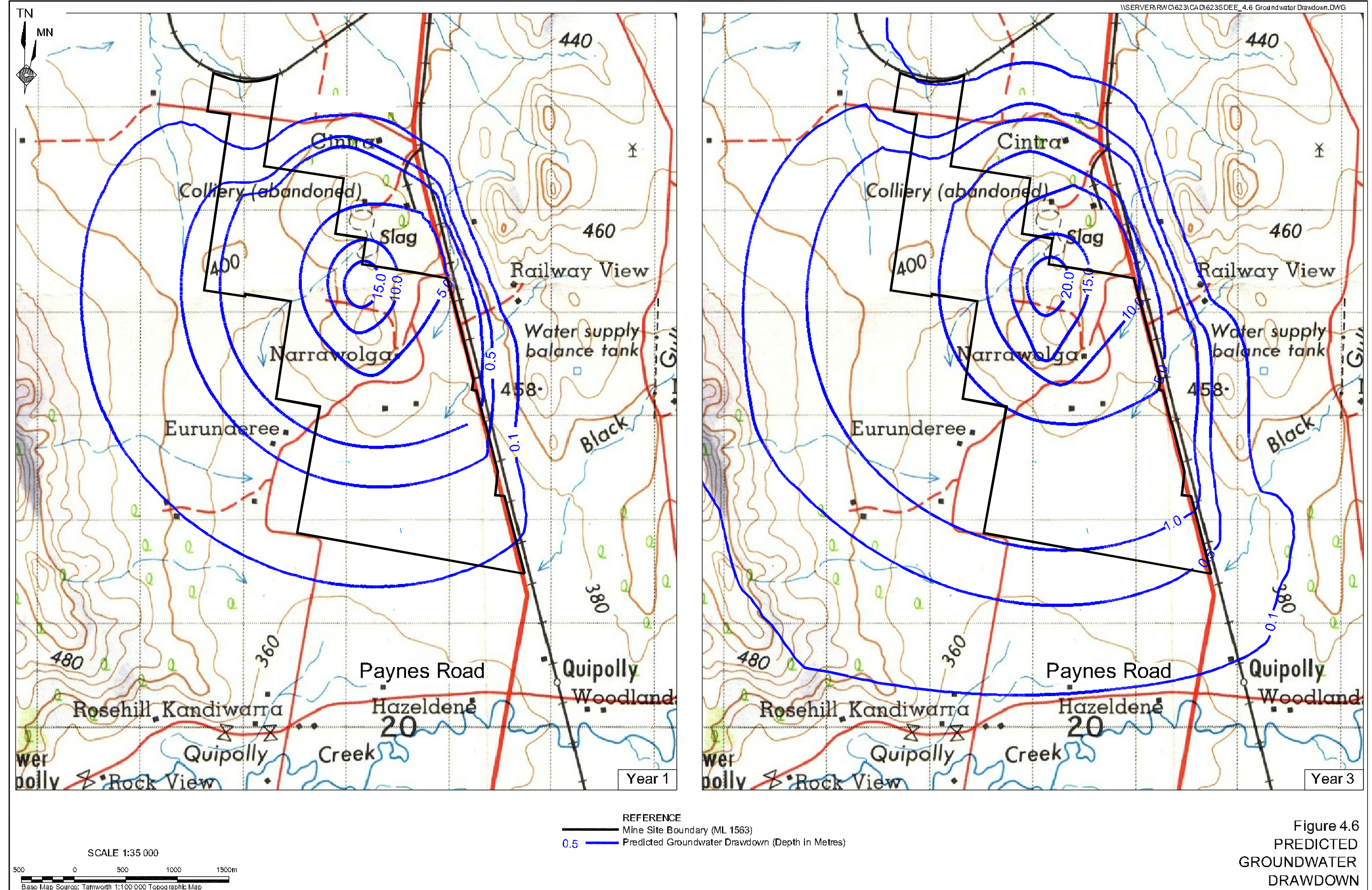


Figure 4.6
PREDICTED
GROUNDWATER
DRAWDOWN

Impact on Water Quality

Groundwater is utilised at sites surrounding the mine site for the purpose of irrigation and stock watering. Changes to water quality can occur as a result of significant movement in the water table resulting in oxidation of some compounds and changes to the chemical composition. Given the minimal impact of the proposed modified mining operations on groundwater levels, the potential for this to occur is considered highly unlikely.

Furthermore, the presence of a low permeability layer separating the groundwater within the Permian coal measures (the aquifer predicted to be most affected by the mining operations) from the local and regional aquifers, would restrict any impact on groundwater quality to this aquifer within the Permian coal measures.

4.2.6 Monitoring

Groundwater monitoring of groundwater levels and quality is currently being undertaken by the Applicant (see Section 1.6.3.3). No modification to the Groundwater Monitoring Program included as a component of the Site Water Management Plan is considered necessary. The Groundwater Monitoring Program and monitoring result would continue to be assessed annually by a hydrogeological specialist, with changes to the program incorporated as deemed appropriate by this person(s).

4.3 NOISE

4.3.1 Introduction

As noted in Section 1.6.4.4, mining, processing and associated activities at the Werris Creek Coal Mine have led to an increase in the noise received at residences on properties surrounding the mine site. Historically, these noise levels have on occasion exceeded the relevant noise criteria identified at a number of these residences, however, following the 100% acquisition of the mine by Whitehaven Coal Limited in December 2007, and the implementation of the additional noise management measures identified in Section 1.6.4.2, the frequency of exceedance of noise criteria reduced dramatically. The proposed modification would not require any additional noise generating activities, however, the following activities would be modified slightly, primarily through changes to the location of these activities.

- Vegetation clearing, soil stripping and soil stockpiling activities.
- Overburden removal, coal recovery and associated on-site transportation to the coal processing area.
- Construction of an additional rail load-out bin and conveyor within the Coal Product Storage Area and Rail Load-out facility.
- Construction of water storages and movement of the mine water truck to and from these dams.



This sub-section describes the existing noise environment surrounding the Werris Creek Coal Mine and presents the noise criteria relevant to the continued operation of the mine. The design and operational safeguards, and management procedures to be employed to meet these criteria are presented, together with predicted noise levels and likely impacts arising from the proposed modification.

Predictions of noise levels associated with the proposed modification have been drawn from the results of a noise assessment conducted by Spectrum Acoustics Pty Ltd (Spectrum, 2009), whose report is incorporated in full as Part 2 of the *Specialist Consultant Studies Compendium*.

4.3.2 Existing Environment

Excluding the operation of the Werris Creek Coal Mine, background noise levels surrounding the mine are typical of a rural environment with minor contributions from transport noise and small local industry. The principal sources of noise that contribute to background noise levels include:

- through traffic on the Werris Creek–Quirindi Road and local traffic on Escott Road;
- rail traffic along the Main Northern Railway Line and on the various sidings of the Werris Creek Rail Centre;
- farm equipment such as tractors and cultivators;
- processing noise associated with the Zeolite Australia processing plant;
- insect noise such as cicadas, especially during Spring and Summer months;
- livestock and other farm and native animals; and
- wind through vegetation.

4.3.3 Operational Safeguards and Controls

The Applicant would continue to implement the operational safeguards and controls documented in Section 1.6.4.2. Recognising the additional height of the overburden emplacement, requiring the operation of trucks and bulldozers at increased elevation relative to the surrounding properties and residences, the Applicant is committed to the following controls and safeguards specific to the proposed modification.

- Construction of the second rail load-out bin and conveyor and underground water dams would only be undertaken during the day time, excluding those periods when inversion conditions occur.
- Each lift of the overburden emplacement would continue to be constructed using the same controls as currently approved. That is:
 - the initial overburden emplacement would form a 15m high acoustic bund around the outside of the emplacement lift, with all subsequent overburden placement for that lift undertaken behind this 15m high bund;



- the 15m high bund would only be constructed during the day time when inversion conditions or winds from the northwestern quadrant do not prevail; and
- overburden emplacement during the evening and night time, as well as when inversion conditions or winds from the northwestern quadrant prevail, would be undertaken within the mine void or behind the 15m high acoustic bund.
- Surface clearing and soil stripping operations using scrapers would not be undertaken under inversion conditions or when winds from the southeast quadrant prevail.
- As far as practicable, mining operations would be scheduled such that when land preparation or overburden removal activities occur at or within 10m of surface, overburden placement would be undertaken below surface level, ie. within the completed section of the open cut.
- The Applicant would provide for the planting of trees along the northern boundary of this property in order to provide a visual as well as acoustic barrier for noise propagated from the mine to the north.

4.3.4 Assessment of Impacts

4.3.4.1 Criteria

The assessment of impacts of the proposed modification upon the local noise environment has been undertaken by calculating likely noise levels during both construction and operational stages of development and comparing those noise levels against the noise criteria established through reference to:

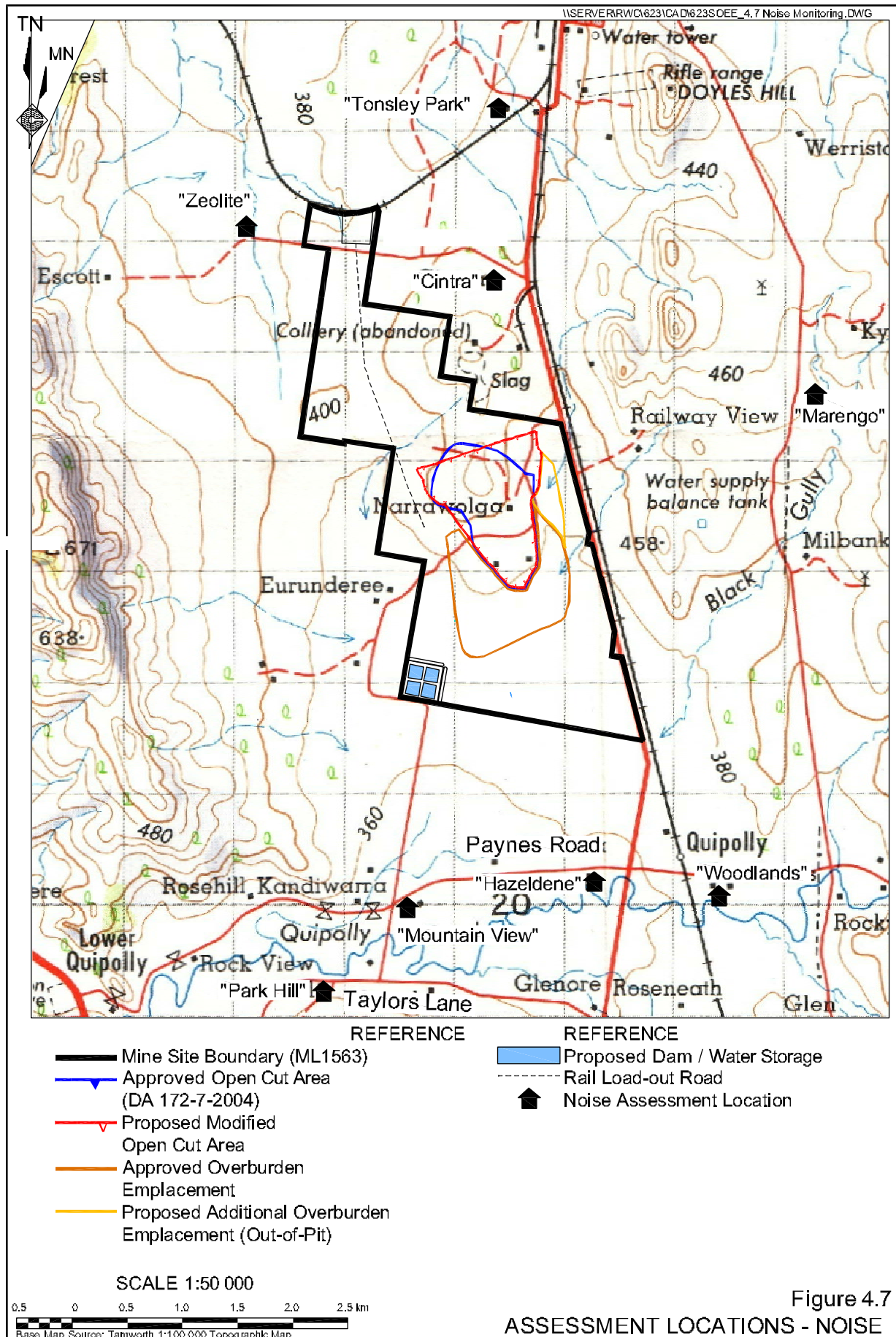
- the Industrial Noise Policy (INP) - for site operational noise;
- relevant sections of the DEC Environmental Noise Control Manual (ENCM) - for rail traffic.

Construction activities would be undertaken concurrently with the continued operation of the Werris Creek Coal Mine and as such there is no construction noise criterion nominated as part of the proposed modification.

Operational Noise Criteria

Condition 4(7) of DA 172-7-2004 nominates a noise criterion of 35dB(A) for all non-project related residences surrounding the mine site for day time, evening and night time operations. Predictions of noise associated with the proposed modification have been assessed against this established noise criterion, although the assessments note that the Applicant currently holds agreements with the land owners and residents of the Zeolite Australia and “Cintra” properties (see **Figure 4.7**) acknowledging an exceedance of up to 5dB(A) above this criteria as acceptable.





Sleep Disturbance Criteria

Sleep disturbance criteria need also be considered and are nominated in the INP as L_{Amax} noise levels, ie. maximum noise levels recorded over one minute, to not exceed $RBL + 15dB(A)$. Sleep disturbance criteria are only applicable to night-time operations and equal to an L_{Amax} of 45dB(A).

Rail Traffic Noise Criteria

The proposed modification would not result in any change in the frequency of rail movements on the Werris Creek rail siding or the Main Northern Railway Line. As such, the criteria as provided by *Condition 4(8)* of DA 172-7-2004 for $L_{Aeq(24hour)}$ (representing the equivalent daily noise level of the operating rail wagons) and $L_{A(max)}$ (representing the maximum noise level, measured over 1 minute, of the shunting rail wagons) noise levels have been retained (see **Table 4.16**).

Table 4.16
Rail Traffic Noise Criteria

Noise Parameter	Criteria
Daily Operations ($L_{Aeq, 24\text{ hour}}$)	55dB(A)
Shunting Wagons (L_{Amax})	80dB(A)
Source: Modified after Spectrum Acoustics (2004) – Table 10	

The proposed modification would not result in any change to railway operations on the Werris Creek Siding. Therefore, as train noise levels have previously been assessed as complying with the applicable criteria (as part of the original acoustic assessment for the Werris Creek Coal Mine – Spectrum, 2004), no further assessment of this aspect of the Werris Creek Coal Mine operations has been included.

4.3.4.2 Methodology

The assessment of potential noise impacts arising from the modified operations was based on computer model predictions undertaken by Spectrum (2009) for three operational scenarios at the closest non-project related residences (“Assessment Locations”). The three scenarios represent the modified open cut and overburden emplacement layout during Years 5 and 7 of the life of the mine, including the noise likely to be generated by the continued operation of the Coal Processing Area, Rail Load-out Road, Rail Load-out Facilities and Coal Product Storage Area.

Table 4.17 presents a summary of the modelled scenarios and **Figure 4.8** presents the locations of noise generating activities for the two modelled scenarios.

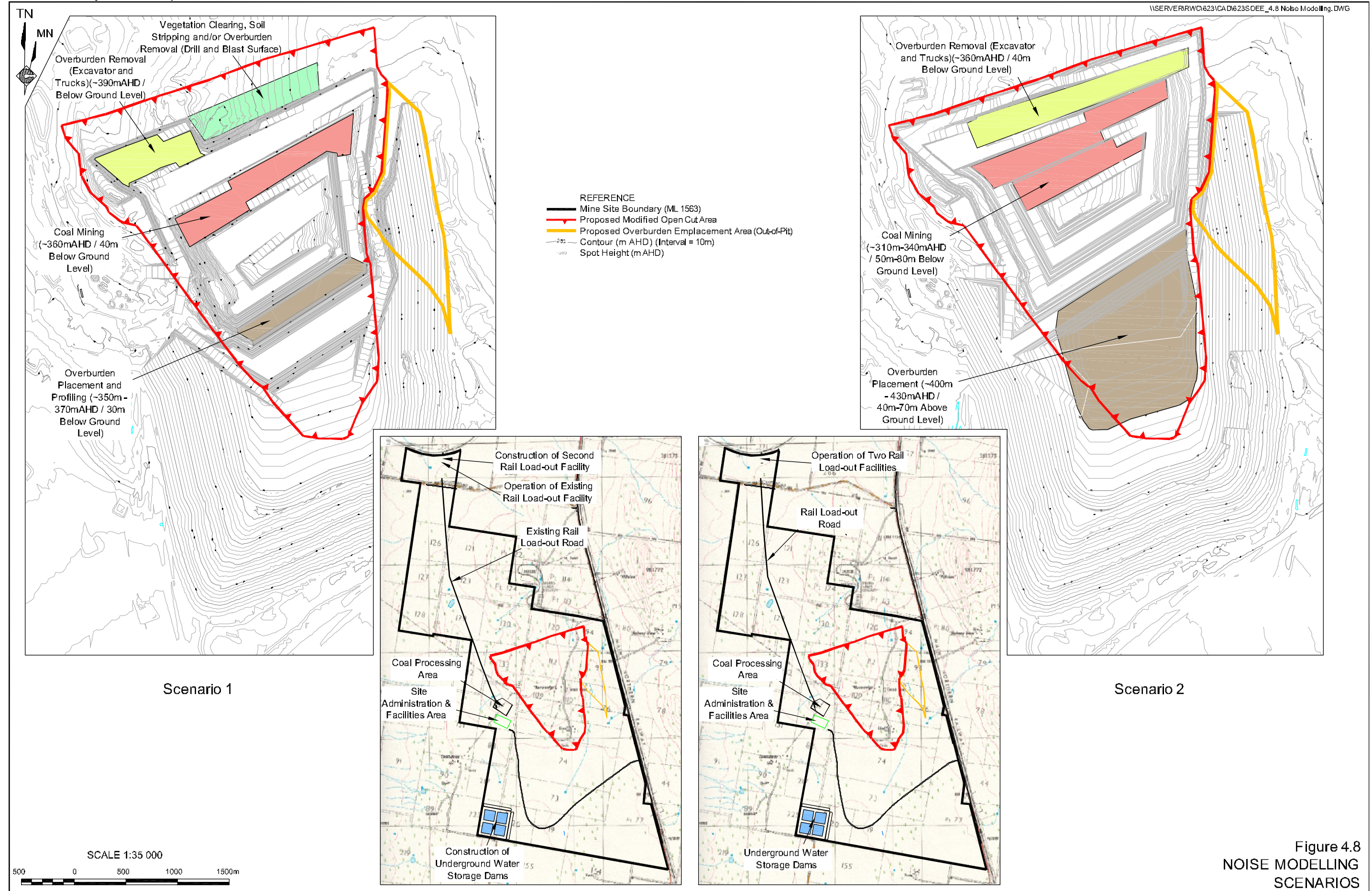
The three scenarios modelled are considered indicative of the worst-case operating conditions (relative to noise generation) likely to be encountered over the proposed life of the modified mine. Notably, the noise modelling incorporated a ground absorption level actually measured on the mine site by Spectrum (2004).



Table 4.17
Noise Modelling Scenarios

Modelled Scenario	Description
1. Year 5 Mining (including Construction but no soil stripping)	Including the following activities identified on Figure 4.8a. - Operation of two rotary overburden drills operating at natural ground level (~430m AHD). - Overburden excavation and removal from the northwest corner of the open cut area at an elevation of approximately 390m AHD (~20m below natural ground level). - Coal mining from Strip 10 at an elevation of approximately 360m AHD (~40m below natural ground level). - Overburden placement and profiling at an elevation of between 350m AHD and 370m AHD (10m to 30m below natural ground level and to the north of more elevated section of the out-of-pit overburden emplacement). - Stockpile management and coal processing within Coal Processing Area. - Heavy vehicle traffic between the Coal Processing Area and Product Coal Storage Area via the Rail Load-out Road. - Stockpile management and train loading from the existing Rail Load-out Facility within the Product Coal Storage Area. - Earthmoving operations associated with the construction of dams within the Underground Water Storage Area.
2. Year 5 Mining (including soil stripping)	This scenario is identical to that of Scenario 1, however, instead of two rotary overburden drills operating at natural ground level at natural ground level, one rotary overburden drill and two CAT scrapers have been modelled to replicate concurrent soil stripping and overburden drilling operations (see Figure 4.8a).
3. Year 7 Mining	Including the following activities identified on Figure 4.8b. - Overburden excavation and removal from Strip 12 at an elevation of approximately 360m AHD (~40m below natural ground level). - Coal mining from Strips 10 and 11 at an elevation of between 310m AHD and 340m AHD (~50m to 80m below natural ground level). - Overburden placement and profiling at an elevation of between 400m AHD and 430m AHD (40m to 70m above natural ground level and without any acoustic shielding provided by previously constructed sections of the overburden emplacement). - Stockpile management and coal processing within Coal Processing Area. - Heavy vehicle traffic between the Coal Processing Area and Product Coal Storage Area via the Rail Load-out Road. - Stockpile management and train loading from the existing and additional Rail Load-out Facilities within the Product Coal Storage Area.
6. Sleep Disturbance	Mining operations modelling general impact of noise from mining and overburden placement activities, coal loading into empty trucks and dozer tracks. Sound power levels of modelled L_{Amax} noise sources.
8. Rail Transportation	Rail transportation has been modelled based on the maximum number of trains despatched from the Werris Creek Siding and bound for Port Newcastle.
Notes: Modelling was conducted for the following atmospheric conditions. - <i>Neutral</i> – 20°C, 70% relative humidity (RH), no wind, -1°C/100m vertical temperature gradient (dry adiabatic lapse rate, DALR). - <i>Inversion</i> – 4°C, 70% R.H., +4°C/100m vertical temperature gradient. - <i>Wind 1</i> – 20°C, 70% R.H., 3m/s wind from northwest. - <i>Wind 2</i> – 20°C, 70% R.H., 3m/s wind from southeast.	
Source: Modified after Spectrum Acoustics (2009) – Section 4.1.2	





The results of the noise modelling and assessment of impacts on surrounding residents are presented as:

- operational noise impacts (Section 4.3.4.3.1); and
- sleep disturbance (Section 4.3.4.3.2).

The assessment of impacts presents the predicted noise levels assuming the adoption of the various design and operational safeguards as described in Section 4.3.3.

4.3.4.3 Residual Impacts

4.3.4.3.1 Operational Noise

Table 4.18 presents a summary of the predicted noise levels generated by the mining and associated activities of the modified operations.

Table 4.18
Predicted Operational Noise Levels - dB(A), $L_{eq}(15min)$

Location*	Meteorological Condition					
	Neutral	Inversion	Northwest Wind	Southeast Wind	Criterion	Differential
Scenario 1 – Year 1 Mining (including Construction but no Soil Stripping)						
“Zeolite”	30	37	24	39	35	+4 [#]
“Cintra”	30	37	40	36	35	+5 [#]
“Tonsley Park”	22	33	25	34	35	-1
“Marengo”	20	30	30	20	35	-5
“Woodlands”	<20	28	32	<20	35	-3
“Hazeldene”	<20	29	32	<20	35	-3
“Mountain View”	23	30	32	20	35	-3
“Park Hill”	20	28	30	<20	35	-5
Scenario 2 – Year 1 Mining (including Soil Stripping)						
“Zeolite”	30	38	28	40	35	+5 [#]
“Cintra”	30	40	40	38	35	+5 [#]
“Tonsley Park”	24	36	25	34	35	+1
“Marengo”	24	33	32	20	35	-2
“Woodlands”	20	30	34	<20	35	-1
“Hazeldene”	<20	30	35	<20	35	0
“Mountain View”	23	34	35	21	35	0
“Park Hill”	<20	32	33	<20	35	-2
Scenario 3 – Year 3 Mining						
“Zeolite”	30	38	25	40	35	+5 [#]
“Cintra”	30	40	40	35	35	+5 [#]
“Tonsley Park”	24	33	24	30	35	-2
“Marengo”	24	35	32	20	35	0
“Woodlands”	20	31	31	<20	35	-4
“Hazeldene”	20	31	32	<20	35	-3
“Mountain View”	23	33	31	20	35	-2
“Park Hill”	21	31	29	<20	35	-4

* See **Figure 4.8**

A negotiated agreement is held between the Applicant and the owners / residents of the “Cintra” and Zeolite assessment locations with respect to noise levels.

Source: Modified after Spectrum Acoustics (2009) – Table 1



Under most conditions, the 35dB(A) noise criteria could be achieved. Notably, the noise levels received at the “Cintra” and Zeolite assessment locations would not exceed 40dB(A), which is within the target range included with the negotiated agreements.

A minor exceedance of 1dB(A) is predicted at the “Tonsley Park” residence under inversion conditions when soil stripping activities are undertaken concurrently with surface drilling and other mining activities (Scenario 2). In order to mitigate against these exceedances of noise criteria, the Applicant has committed to ceasing all soil stripping activities when inversion or southeast wind conditions prevail.

Assuming the proposed operational controls and safeguards identified in Section 4.3.3 are implemented, the modified mining operations of the Werris Creek Coal Mine would remain compliant with the noise criteria of DA 172-7-2004 or not exceed this criteria by more than 5dB(A) at those assessment locations for which the Applicant holds an agreement with the owner or resident.

4.3.4.3.2 Sleep Disturbance

The impact on sleep disturbance was assessed for Years 1 and 3 of the modified mining and associated operations at each of the eight assessment locations. For each year, the following activities with potentially high instantaneous noise emissions were modelled to determine the L_{Amax} noise level received at each of the assessment locations.

1. Discharging of coal from the rail load-out bin into train wagons and re-charging of the bins.
2. Excavator loading overburden into trucks.
3. Placement of overburden on an exposed section of the overburden emplacement.
4. Operating bulldozer on the overburden emplacement and shunting of rail wagons on the Werris Creek Siding.

Table 4.19 presents the predicted highest L_{max} noise levels for the two scenarios.

Table 4.19
Predicted Noise Levels – Mining and Associated Activities dB(A), L_{max}

Page 1 of 2

Page 1 of 2

Location*	Meteorological Condition					
	Neutral	Inversion	Northwest Wind	Southeast Wind	Criterion	Differential
Scenario 1 – Year 1 Mining						
“Zeolite“	29	38	27	38	45	-7
“Cintra“	33	40	27	41	45	-4
“Tonsley Park“	36	42	44	39	45	-1
“Marengo“	27	37	27	37	45	-8
“Woodlands“	25	35	35	23	45	-10
“Hazeldene“	25	37	38	24	45	-7
“Mountain View“	25	36	37	24	45	-8
“Park Hill“	27	37	37	25	45	-8



Table 4.19 (Cont)
Predicted Noise Levels – Mining and Associated Activities dB(A), L_{max}

Page 2 of 2

Location*	Meteorological Condition					
	Neutral	Inversion	Northwest Wind	Southeast Wind	Criterion	Differential
Scenario 3 – Year 3 Mining						
“Zeolite”	35	43	29	42	45	-2
“Cintra”	36	45	44	41	45	0
“Tonsley Park”	30	38	29	39	45	-6
“Marengo”	29	40	40	26	45	-5
“Woodlands”	28	40	42	28	45	-3
“Hazeldene”	29	39	40	29	45	-5
“Mountain View”	31	39	39	28	45	-9
“Park Hill”	30	38	38	27	45	-7
* See Figure 4.8						
Source: Modified after Spectrum Acoustics (2009) – Table 2						

For both the Year 1 and Year 3 mining scenarios, the predicted maximum noise levels (dB(A), L_{max}) do not exceed the sleep disturbance criteria of 45dB(A).

4.3.5 Monitoring

Attended noise compliance monitoring is currently conducted monthly and given the potential for the proposed modification to slightly increase noise levels at some distant receivers, it is proposed that the monthly monitoring be continued until such time as the DECC is satisfied that noise criteria can be consistently met.

A number of the current noise monitoring locations are now located on Applicant owned properties, notably: “Escott”; “Hillview”; “Railway View”; and “Old Colliery”. The Applicant proposes to replace these monitoring locations with those of “Tonsley Park”, “Marengo”, “Woodlands” and “Park Hill”.

The proposed noise monitoring locations(subject to agreement by owners), which are all identified on **Figure 4.7**, are as follows.

- “Tonsley Park”;
- “Zeolite Australia”;
- “Cintra”;
- “Marengo”;
- “Woodlands”;
- “Hazeldene”;
- “Mountain View”; and
- “Park Hill”



4.4 BLASTING

4.4.1 Introduction

Blasting of the competent overburden and interburden materials would be undertaken generally in accordance with proposed blasting design parameters previously been described in Section 2.5.5.3.

The following sub-sections identify the emissions resulting from blasting, the criteria adopted for assessing blast impacts, the proposed design and operational safeguards, and an assessment of impacts from the proposed blasting activities at surrounding residences. The criteria for assessment and the resulting ground vibration and airblast overpressure impacts have been drawn from a blasting assessment conducted by Spectrum Acoustics Pty Ltd whose report is provided in full as Part 2 of the *Specialist Consultant Studies Compendium*.

4.4.2 Constraint(s)

Blasting emissions resultant from blasting that could potentially constrain the proposed modification area as follows.

- Ground vibrations.
- Air vibrations (noise and airblast).
- Fly rock.
- Dust.

However, each of these emissions is highly transient and, through the implementation of appropriate safeguards in blast design and procedures, can be limited to a level where it is likely that:

- i) the safety of the public, mine employees and visitors is not threatened;
- ii) ground vibration from blasting is at acceptable levels and ensures the continued integrity of any nearby dwellings, structures and facilities;
- iii) noise and ground and air vibrations have no impact on livestock adjacent to, or on, the mine site;
- iv) noise and air vibration levels at nearby residences are within acceptable limits and compatible with the safety and comfort of human beings; and
- v) the generation of dust is minimised and maintained at acceptable levels.



4.4.3 Assessment Criteria

4.4.3.1 Annoyance Criteria

The impacts associated with blasting are assessed based on the ANZECC “annoyance” criteria which are routinely specified in project approvals, development consents and environment protection licences for open cut coal mines.

- The recommended maximum overpressure level for blasting is 115dB (Linear).
- The level of 115dB (Linear) may be exceeded for up to 5% of the total number of blasts over a 12 month period, but should not exceed 120dB (Linear) at any time.
- The recommended maximum vibration velocity for blasting is 5mm/s Peak Vector Sum (PVS).
- The PVS level of 5mm/s may be exceeded for up to 5% of the total number of blasts over a 12 month period, but should not exceed 10mm/s at any time.
- Blasting is only permitted during the hours of 9:00am to 5:00pm Monday to Friday, and should not take place on Sundays and Public Holidays.
- Blasting occurs no more than once per day.

Criteria could also be developed based on issues related to building damage. However, as the annoyance criteria discussed above are significantly more stringent than the building damage criteria, they would be taken as the governing criteria for the Project.

4.4.3.2 Safety Criteria

It is fundamental that blasting does not injure any person or animal or damage property through the generation of fly rock. Blasting, by its very nature, requires rocks to be broken and propelled away from the blast site.

For the purposes of this document, the area in which blasted rock should normally fall is referred to as the blast envelope with any rock propelled beyond the blast envelope referred to as “fly rock”. From a safety perspective, the Department of Primary Industries - Mineral Resources typically nominates a distance of 500m from a blast in an open cut coal mine as a safe distance. This distance is not site specific and consequently is recognised to be conservative. Experience gained to date at the Werris Creek Coal Mine, and at other similarly sized open cut coal mines, indicates that a blasting envelope of 100m to 200m from a blast site would be more than adequate.



4.4.4 Operational Safeguards and Controls

4.4.4.1 General Blast Design

Central to all safeguards is the conservative design and careful implementation of each blast to minimise impacts, ie. designing each blast to satisfy environmental and public safety requirements as the first priority, with ongoing blast design refinement based on measured operational and environmental performance. Blast design and implementation would be undertaken by a suitably qualified blasting engineer and/or experienced and appropriately certified shot-firer.

Careful design is also fundamental to safe, successful blasting. Industry has developed best practice procedures centred around the design of blasts that ensure:

- airblast overpressure and ground vibration levels are within nominated limits;
- the required fragmentation (the size of broken rock) is achieved; and
- all rock that is blasted is contained in a pre-determined blast envelope.

Blast design for the modified operations at the Werris Creek Coal Mine would continue to include the following features to meet these industry standards.

- Ensuring that burden distances and stemming lengths are such that explosion gases are almost completely without energy by the time they emerge into the atmosphere.
- Ensuring that charges consistently detonate in carefully designed sequences.

4.4.4.2 Air Vibrations (Noise and Airblast)

When a confined explosive charge (ie. a charge within a blasthole) detonates, the resulting explosion gases break and then displace the rock to produce a well fragmented and loose pile of blasted rock (or muckpile).

If some of the gaseous expansion energy escapes into the atmosphere, it is manifested as:

- Noise - the audible part of the air vibration spectrum; and
- Airblast - the remaining sub-audible part of the air vibration spectrum.

Airblast is also created where a rock face, ie. a rock/air interface, is heaved forwards or upwards by the explosion gases. However, where blast design is sub-standard, airblast can vibrate buildings, thereby disturbing or possibly annoying or worrying the occupants. The noise level created by a blast is, however, a very poor indicator of damage potential.

Noise and airblast generation would continue to be controlled by ensuring that all, or nearly all, of the explosion energy is consumed in fragmenting and displacing the overburden by the time the gases vent (via the broken burden rock and/or ejected stemming material) into the atmosphere. This objective would be met by ensuring that:

- blasthole spacing is implemented in accordance with blast design;
- the burden distance and stemming length are carefully selected and then implemented precisely;



- appropriate materials, eg. 20mm aggregates, are used for stemming;
- charges detonate in the correct sequence and with inter-row delays that provide good progressive release of burden; and
- the maximum weight of explosive detonated in a given delay period (the maximum instantaneous charge (MIC)) is limited to conservative and proven levels.

Subsequent refinements of these controls would continue to be implemented on the basis of the blast monitoring program.

4.4.4.3 Ground Vibrations

When a confined explosive charge detonates, a fraction of the liberated energy is manifested as seismic energy, ie. as ground vibrations. The magnitude of ground vibrations depends upon:

- the MIC for the blast;
- the distance between the blast and a residence or sensitive structure; and
- the characteristics of the intervening material (rock, soils, geological structures, etc.) through which the ground vibration wave propagates.

Ground vibration would continue to be controlled by ensuring:

- the minimum practicable weight of explosive detonates at an instant, ie. minimising the MIC, by using the maximum number of delay periods in each blast; and
- most of the energy liberated by the charge(s) on a given delay number is consumed in providing good fragmentation, adequate displacement and/or a loose, highly diggable muckpile, rather than in creating ground vibrations, ie. by ensuring that the burden distance and effective sub-drilling are not too large.

4.4.4.4 Dust and other Post-blast Emissions

When a blast is initiated, some dust would be created as a result of:

- partial or complete ejection of the stemming column;
- the escape of explosion gases through discontinuities and cracks in the face; and/or
- impacts between rock fragments and between rock fragments and the active floor of the mine.

Blast-generated dust would be minimised by ensuring that stemming columns are not ejected for considerable distances into the atmosphere. Stemming column lengths would be such that their ejection velocities are low.

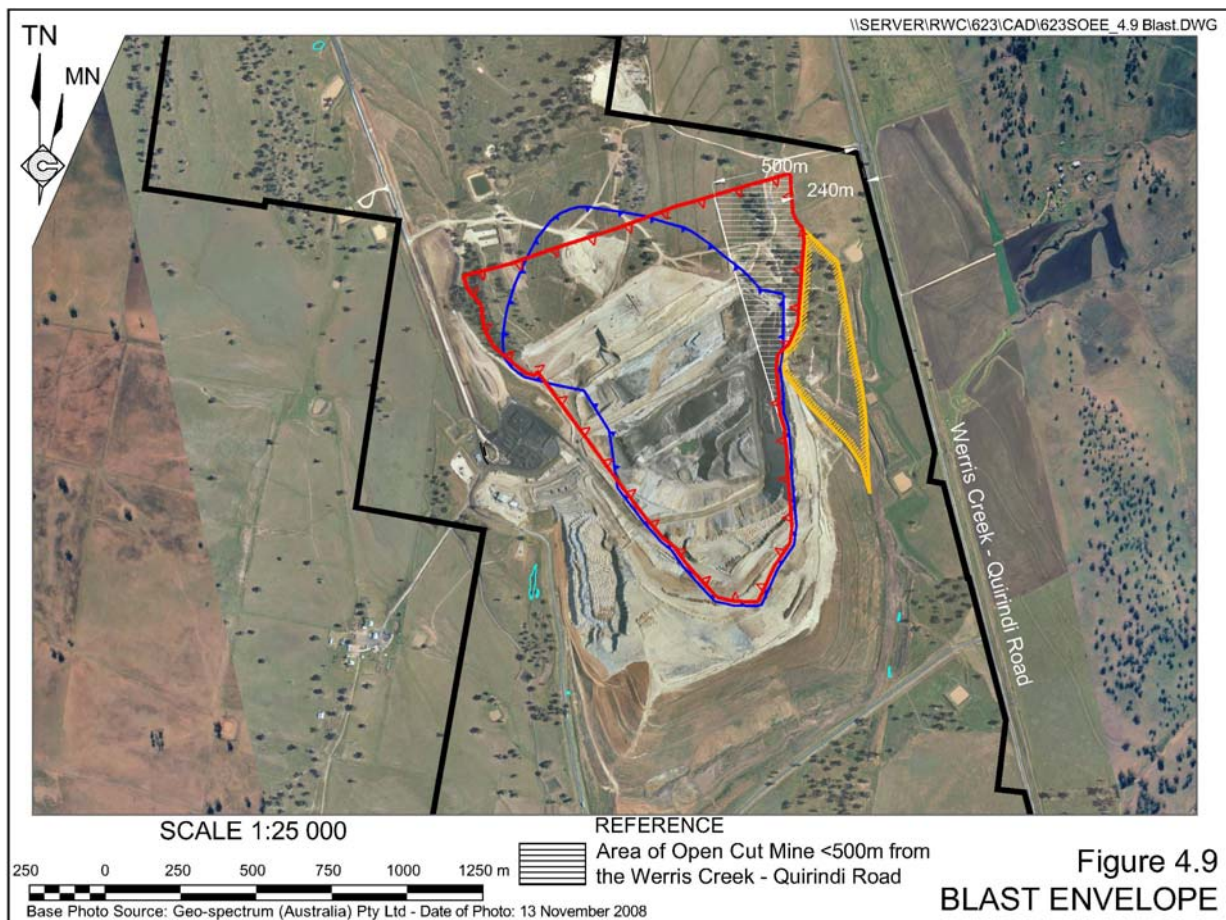


Additionally, the blasting contractor would be required to use aggregates for blasthole stemming and to use nonel delay-type or electronic detonators to initiate charges. The use of nonel-type delay or electronic detonators would avoid the requirement for detonating cord downlines and, with the absence of detonating cord trunklines (ie. surface lines), prevents the dust cloud that is formed when such trunklines detonate on a dry dusty surface.

4.4.4.5 Fly Rock

Approximately 85% of the open cut mine lies more than 500m beyond the Werris Creek - Quirindi Road. All blasts would however, be greater than 250m from the Werris Creek - Quirindi Road. **Figure 4.9** displays the area of the modified open cut mine area within the 500m and 250m (blast envelope) setbacks from the Werris Creek - Quirindi Road.

Through monitoring of blasts, the Applicant has confirmed that fly-rock has always been confined to the area immediately surrounding the blast. To be conservative, and to ensure no impacts on personnel or equipment, the Applicant proposes to maintain a blast envelope of 250m around each blast. All mobile equipment and personnel would be required to be relocated to at least 250m from the site of the blast prior to initiation and remain outside the blast envelope until the shot firer confirms it is safe to re-enter.



The Applicant would continue to monitor the distance fly-rock travels to ensure that the blast envelope remains appropriate.

4.4.4.6 Community Notification

The Applicant maintains a blast notice board near the mine entrance on the Werris Creek - Quirindi Road notifying passing motorists and landholders when the next blast is programmed, and at what time.

4.4.5 Assessment of Impacts

4.4.5.1 Introduction

This sub-section assesses the potential impacts associated with blast-induced ground and air vibration and fly-rock. The potential blast-induced noise and vibration impacts are addressed in detail in Spectrum (2009).

The predictions of impacts discussed in this sub-section are supported by the experience gained during the mining operations at the Werris Creek Coal Mine over the past 4 years. During that period, blasts comparable to those planned as part of the proposed modification have not caused any reported conflicts regarding the personal safety of any neighbouring residents or stock.

4.4.5.2 Methodology

Reference to the original blast modelling prepared as part of the original development application for the Werris Creek Coal Mine (Spectrum, 2004) has been reviewed to identify the residence(s) potentially most affected by blasting emissions. The predicted emissions received at this residence(s) based on the modified mining area layout was then predicted to determine whether compliance at this (and therefore all other residences) could be achieved.

For both Spectrum (2004) and Spectrum (2009), airblast overpressure and ground vibration were predicted using the initial drilling and blasting parameters presented in **Table 2.8** and the following equations.

$$\text{Airblast Overpressure (OP)} = 165 - 24(\log_{10}(D) - 0.3 \log_{10}(Q)),$$

where D is distance from the blast to the assessment point (m), and
 Q is the weight of explosive per delay (MIC, kg).

As this equation has often been found to underestimate blast overpressure levels by up to 3dB(A), so 3dB(A) has been added to the predicted levels for presentation in this report.

Blast (Ground) Vibration levels calculated as Peak Particular Velocity, may be predicted using the following equations.



$$PPV = 1140 \left(\frac{D}{Q^{0.5}} \right)^{-1.6}, \text{ mm/s (for average ground type)}$$

$$PPV = 500 \left(\frac{D}{Q^{0.5}} \right)^{-1.6}, \text{ mm/s (for hard rock)}$$

where D is distance from the blast to the assessment point (m), and
 Q is the weight of explosive per delay (MIC, kg).

Note that the only difference between equations (2) and (3) is the value of the coefficient (either 1140 or 500). Geological data for the site show that most of the material to be mined contains bands of sandstone, conglomerate and mudstone, all of which may be considered as relatively hard materials. A coefficient value of 700 was adopted by Spectrum (2005) and Spectrum (2009) in the equation for prediction of ground vibration levels from blasting.

4.4.5.3 Residual Impacts

Table 4.20 shows predicted 95th percentile blast overpressure and ground vibration levels (PPV) at several residential locations. The predictions of blast overpressure and PPV were based on a typical blast MIC of 800kg and a maximum MIC of 1600kg, for the final year of the now approved open cut mine (as presented in the 2004 Werris Creek Coal Mine EIS (RWC, 2004). The residences now owned by the Applicant and considered by Spectrum (2004) have been excluded from **Table 4.20**.

Table 4.20
Predicted Blasting Impacts (Year 7 of Approved Werris Creek Coal Mine)

Location	Approximate Distance (m)	Overpressure (dB)		PPV (mm/s)	
		MIC 800kg	MIC 1600kg	MIC 800kg	MIC 1600kg
Werris Creek Town	4000	101	104	0.2	0.3
Zeolite Australia	2500	104	107	0.4	0.7
Cintra	1800	109	112	0.7	1.2
Hazeldene	3700	102	105	0.2	0.3
Paynes Lane ¹	3800	102	105	0.2	0.3
Note 1: Identified as Wadwells Lane in Spectrum (2004)					
Source: Modified after Spectrum (2004) – Table 23					

The closest non-Applicant owned residence to the modified location of blasting is “Cintra”, approximately 1 300m to the north. Re-calculated blast overpressure and ground vibration levels at this distance are summarised in **Table 4.21**.

Table 4.21
Predicted blasting impacts at “Cintra”

Location	Approximate Distance (m)	Overpressure (dB)		PPV (mm/s)	
		MIC 800kg	MIC 1600kg	MIC 800kg	MIC 1600kg
“Cintra”	1300	112	115	1.1	1.6



Results in **Table 4.21** illustrate that overpressure levels from the largest overburden blasts may equal the overpressure criterion at “Cintra”. Therefore, on the basis that compliance with criteria can be achieved at the “Cintra” residence, it would be achieved at all other receivers which are at greater distances from the site.

4.4.6 Blast Monitoring

The blast monitoring program as identified in Section 1.6.5.3 would be continued.

4.5 AIR QUALITY

4.5.1 Introduction

Dust generation would be one of the main air quality issues relevant to the ongoing and proposed modified operations at the Werris Creek Coal Mine. Depending upon the size and concentration of particles in the air and their composition, airborne dust has the potential to affect human health as well as contribute to the general degradation of the environment. The term “*particulate matter*” refers to a category of airborne particles typically less than 50µm in aerodynamic diameter and ranging down to 0.1µm in size. Particles less than 10µm and 2.5µm are referred to in this document as PM₁₀ and PM_{2.5} particles respectively. The human respiratory system has a built-in defensive system that prevents particles PM₁₀ from reaching sensitive areas of the respiratory system. As particles larger than 10µm can also contribute to environmental degradation, the air quality assessment also considers the total mass of particles suspended in the air, ie. Total Suspended Particulate matter (TSP). Particles that have an aerodynamic sufficiently large so as not to be suspended in air (typically >35µm) are referred to as deposited dust.

Greenhouse gases would also continue to be produced as a consequence of the proposed modification, as a result of:

- the use of fuel to power mobile equipment on the mine site;
- coal carrying trucks which transport the coal from the mine site to the Rail Load-out Facility via the rail load-out road and to domestic customers via the public road network
- methane emissions from the exposed coal seams of the open cut, and
- the eventual burning of the coal to generate energy.

The effects of greenhouse gas emissions on global temperatures, most notably the Greenhouse Effect, are well documented and an assessment of greenhouse gas emissions has been included in this assessment of air quality impacts.

The following sub-sections describe and assess the existing air quality environment, identify the air quality management issues and the proposed air quality controls, safeguards and mitigation measures. Additionally, the assessment of the residual impacts upon the air quality following the implementation of these safeguards and mitigation measures is also presented.



This section has been prepared with considerable reference to an Air Quality Impact Assessment prepared by Heggies Pty Ltd (Heggies, 2009), the report of which is incorporated in full as Part 3 of the *Specialist Consultant Studies Compendium*.

4.5.2 Existing Environment

Air quality standards and goals refer to pollutant levels which include both the operational and existing sources. To fully assess impacts against all the relevant air quality standards and goals, it is therefore necessary to have information or estimates on existing dust concentration and deposition levels.

Dust Deposition

Table 4.22 presents the results of dust deposition monitoring undertaken at the Werris Creek Coal Mine.

Table 4.22
Ambient Dust Deposition Monitoring Data (September 2004 and December 2008)

Dust Gauge ID / Location	Number of Samples	Average (g/m ² /month)	Maximum 12 month Average (g/m ² /month)
WCA1 / "Escott"	52	0.6	0.8
WCA2 / "Cintra"	52	1.2	1.6
WCA3 / "Old Colliery"	52	2.5	4.0
WCA4 / "Eurunderee"	51	0.8	1.1
WCA5 / "Hill View"	52	1.1	2.1
WCA6 / "Railway View"	52	7.2	10.7
WCA7 / Southern mine site boundary	46	1.9	3.9
Source: Modified after Heggies (2009) – Table 6			

Dust Gauge WCA1 represents the location furthest from the mining operation and therefore most likely to represent ambient conditions. Considering dust deposition levels are likely to fluctuate in response to seasonal and other local conditions, eg. status of agricultural activities, a conservative background dust deposition level would be equivalent to 1.6g/m²/month.

Particulate Matter

"*Particulate matter*" refers to airborne particles typically 0.1µm to 50µm in aerodynamic diameter. Particles less than 10µm and 2.5µm are referred to PM₁₀ and PM_{2.5} particles respectively.

While PM₁₀ and TSP concentrations are monitored at a number of locations surrounding the mine site, this data does not provide at least one year of continuous measurements as required by the DECC guideline *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, 2005). Continuous data is available from the DECCs Tamworth air quality monitoring station, approximately 45km northeast of the proposed Werris Creek Coal Mine. Background particulate matter has been estimated using data for the period 1 September 2007 to 31 August 2008. Excluding anomalous data which would skew the data, the annual average PM₁₀ concentration for the Tamworth dataset was 15.1µg/m³.



Carbon Dioxide and Methane

Existing background concentrations of carbon dioxide and methane are recognised to be negligible and typical of a rural area.

Summary of Existing Air Quality

For the purposes of assessing the potential air quality impacts of the Project, **Table 4.23** records the background levels adopted.

Table 4.23
Background Air Quality Environment for Assessment Purposes

Air Quality Parameter	Averaging Period	Assumed Background Level
PM ₁₀	24-Hour	Daily Varying
	Annual	15.1µg/m ³
Dust	Annual	1.6g/m ² /month

Source: Heggies (2009) – Table 8

4.5.3 Constraint(s)

The proposed modification could potentially be constrained should dust emissions exceed the criteria nominated for the mine. The main sources of dust emissions would include:

- mining activities (including vegetation clearing, soil stripping, overburden ripping and placement, and drilling and blasting activities);
- coal processing area activities (crushing / screening plant, front-end loader);
- rail load-out facility activities (coal dumping, conveying to bins, stockpile management, and dozer operation);
- wind erosion off areas within the open cut area, emplacements and soil stockpiles;
- general movement of heavy vehicles on unsealed roads within the site (haul truck wheel dust); and
- transportation of product coal between the mining area and the rail load-out facility.

4.5.4 Operational Safeguards and Controls

The Applicant would apply a wide range of air pollution control measures to ensure air quality standards are not compromised by its activities. These operational controls have been categorised as either dust control measures or controls for other air contaminants.

Dust Control Measures

The individual sources of dust and controls are outlined in **Table 4.24**.



Table 4.24
Dust Control Measures

Dust Emission Source	Operational Controls
Mining Activities	
Vegetation Clearing	Cleared trees and branches would be retained for use in stabilising slopes identified for rehabilitation with native woodland communities.
Soil Stripping	- Where practicable, soil stripping would be undertaken at a time when there is sufficient soil moisture to prevent significant lift-off of dust. - Soil stripping during periods of high winds would be avoided. - Dust suppression by water application would be used to increase soil moisture should stripping occur during periods of high wind.
Overburden Ripping and Placement	Ripping of softer overburden material would be avoided during periods of high wind.
Drilling and Blasting	- The drilling rig would utilise water injection or, alternatively be fitted with dust collectors. - Blast hole stemming using aggregates to prevent venting of explosion gases
Crushing and Screening	- Notwithstanding the moist nature of the ROM coal, water would be applied to the coal at the feed hopper, crusher and at all conveyor transfer and discharge points. - All conveyors would be fitted with appropriate cleaning and collection devices to minimise the amount of material falling from the return conveyor belts. - Some flexibility would exist to temporarily cease operation in the event of protracted dry periods, high winds, and significant dust generation and dispersal towards the surrounding residences.
Internal Coal transport	- The mine entrance road and rail load-out road are sealed. - Internal haul roads are watered.
Wind Erosion from Exposed Surfaces and Stockpiles	- The extent of clearing/site preparation in advance of mining is minimised. - Progressive rehabilitation of areas of disturbance including topsoil and subsoil stockpiles. - Installation of bund walls and windbreaks as required.
Coal Loading to Rail Wagons	The coal loaded to the conveyor of the rail load-out facility would be watered as required to prevent dust lift-off.
Coal Loading to Trucks	- Coal would not be loaded above the truck body sides, thereby preventing the accidental loss of the coal from the truck during transportation. - All trucks carrying product coal from the mine would be covered with approved covers and the tailgates securely fixed to prevent windblown dust emission or spillages.

Blasting Fumes

No specific safeguards are required as fumes liberated by any blasting undertaken would be fully oxidised (eg. CO₂ and NO₂), only minor in quantity and would be rapidly dispersed into the atmosphere without any hazardous levels extending beyond the immediate area.

Greenhouse Gas Reduction

The major greenhouse gas reduction initiative of the Werris Creek Coal Mine involves the use of rail over road for the transport of coal products. The fuel use associated with transporting 1.6Mtpa of coal by rail would be significantly less than for the road transport of a comparable quantity of coal. As a result, the emission of greenhouse gases attributable to the proposal would be significantly less. **Table 4.25** presents a comparison of the fuel use between rail and road transportation for production, sale and despatch of 1.5Mtpa of coal.



Table 4.25
Greenhouse Gas Emission Comparison

	Road	Rail
Required number of return trips	53 000	530
Fuel Consumption per trip	4 00L ¹	5 000L ²
Total Fuel Use	21 200kL	2 600kL
¹ based on 0.5L/km fuel use over return trip of 440km to Newcastle		
² based on pers. comm.. Pacific National (2004)		

4.5.5 Air Quality Goals

4.5.5.1 Goals Applicable to PM₁₀

Emissions of PM₁₀ and PM_{2.5} particles are considered important pollutants in terms of impact due to their ability to penetrate into the respiratory system.

The NSW DECC PM₁₀ assessment goals as expressed in the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, (DEC 2005) are:

- a 24-hour maximum of 50µg/m³; and
- an annual average of 30µg/m³.

The 24-hour PM₁₀ reporting standard of 50µg/m³ is numerically identical to the equivalent National Environment Protection Measure (NEPM) reporting standard except that the NEPM reporting standard allows for five exceedances per year.

4.5.5.2 Goal Applicable to Total Suspended Particulates

The annual goal for Total Suspended Particulates (or TSP) is given as 90µg/m³, as recommended by the National Health and Medical Research Council (NHMRC). This goal was developed before the more recent results of epidemiological studies suggested a relationship between health impacts and exposure to PM₁₀ concentrations.

In rural areas, the PM₁₀ particle size fraction is typically of the order of 50% of the TSP mass, and as such, this goal is consistent with an annual PM₁₀ goal of approximately 45µg/m³. Thus, the historical NHMRC goal may be regarded as less stringent than the newer DECC PM₁₀ goal of 30µg/m³ expressed as an annual average. Therefore, as the annual TSP goal is seen to be achieved if the annual PM₁₀ goal is satisfied, TSP has not been considered further in this assessment.



4.5.5.3 Deposited Dust

In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed $4\text{g/m}^2/\text{month}$.

In order to avoid dust nuisance, the DECC (EPA) developed assessment goals for dust fallout. **Table 4.26** presents the allowable increase in dust deposition relative to the ambient levels.

Table 4.26
DECC Goals for Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	$2\text{g/m}^2/\text{month}$	$4\text{g/m}^2/\text{month}$
Source: Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, (DEC 2005)		

Condition 4(1) of DA 172-7-2004 incorporates this air quality goal by nominating a maximum incremental increase in dust deposition of $2\text{g/m}^2/\text{month}$ and maximum of $3.6\text{g/m}^2/\text{month}$ ⁴. Given the relatively minor changes to dust-generating activities on the mine site, these criteria have been retained.

4.5.5.4 Goals Attributable to Greenhouse Gas Emissions

There are no specific guidelines provided for maximum emissions of greenhouse gases.

4.5.5.5 Summary of Air Quality Goals

In summary, the air quality goals for the ongoing (modified) operations of the Werris Creek Coal Mine remain the same as those included in *Condition 4(1)* of DA 172-7-2004, namely:

- PM₁₀: A 24-hour maximum of $50\mu\text{g/m}^3$
An annual average of $30\mu\text{g/m}^3$
- TSP: An annual average of $90\mu\text{g/m}^3$
- Dust: Incremental annual average dust deposition levels increase $2\text{g/m}^2/\text{month}$
Maximum annual average dust deposition levels of $3.6\text{g/m}^2/\text{month}$

Notably, *Condition 4(2)* of DA 172-7-2004 also identifies land acquisition criteria for PM₁₀, TSP and dust deposition. For dust deposition, TSP, and annual average PM₁₀, this land acquisition criteria is the same as the air quality goals listed above, however, acknowledging the potential for occasional elevated concentrations of 24 hour PM₁₀, the land acquisition criteria is as follows.

	99 th percentile	98.6 th percentile
24-hour maximum PM ₁₀ :	$150\mu\text{g/m}^3$	$50\mu\text{g/m}^3$

⁴ The original Air Quality Assessment for the Werris Creek Coal Mine (Heggies, 2004) assumed a background dust deposition rate of $1.6\text{g/m}^2/\text{month}$.



4.5.6 Assessment of Impacts

4.5.6.1 Methodology

The assessment of impacts of the proposed modification to the Werris Creek Coal Mine has been undertaken principally through computer modelling to establish likely concentrations of particulate matter and deposited dust at residences surrounding the mine site. **Table 4.27** identifies the locations of the residences included in the air quality modelling.

Table 4.27
Residential Receivers (Air Quality)

Receptor ID	Distance (km) / Direction From			Elevation (m, AHD)
	Open Cut	Coal Processing Area	Rail Load-out Facility	
"Cintra"	1.7	2.3 / NNE	1.2 / ESE	420
"Tonsley Park"	2.9	3.9 / NNE	1.6 / NE	385
"Marengo"	2.7	3.4 / E	5.1 / SE	410
"Woodlands"	3.3	4.1 / SE	6.9 / SSE	370
"Hazeldene"	2.7	3.5 / SSE	6.3 / SSE	360
"Glenara"	2.6	3.1 / SSE	6.1 / SSE	360
Source: Modified after Heggies (2009) – Table 1				

The modelling undertaken by Heggies (2009) has assumed the adoption of operational controls as set out in Section 4.5.4.

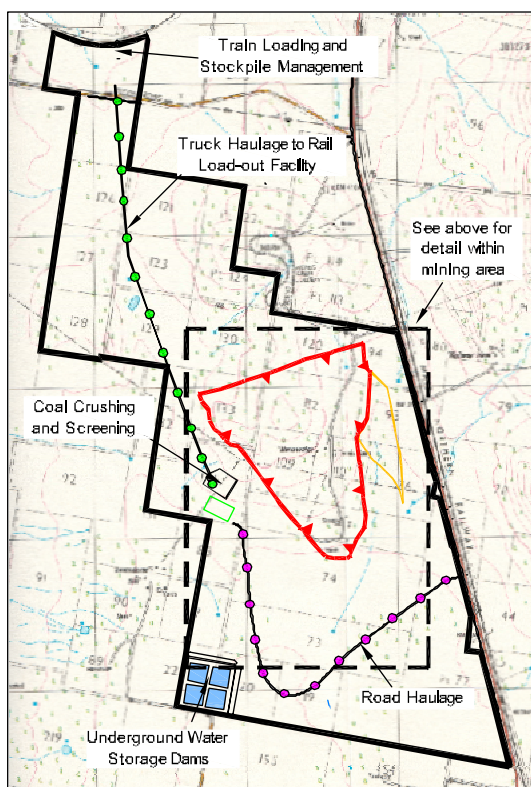
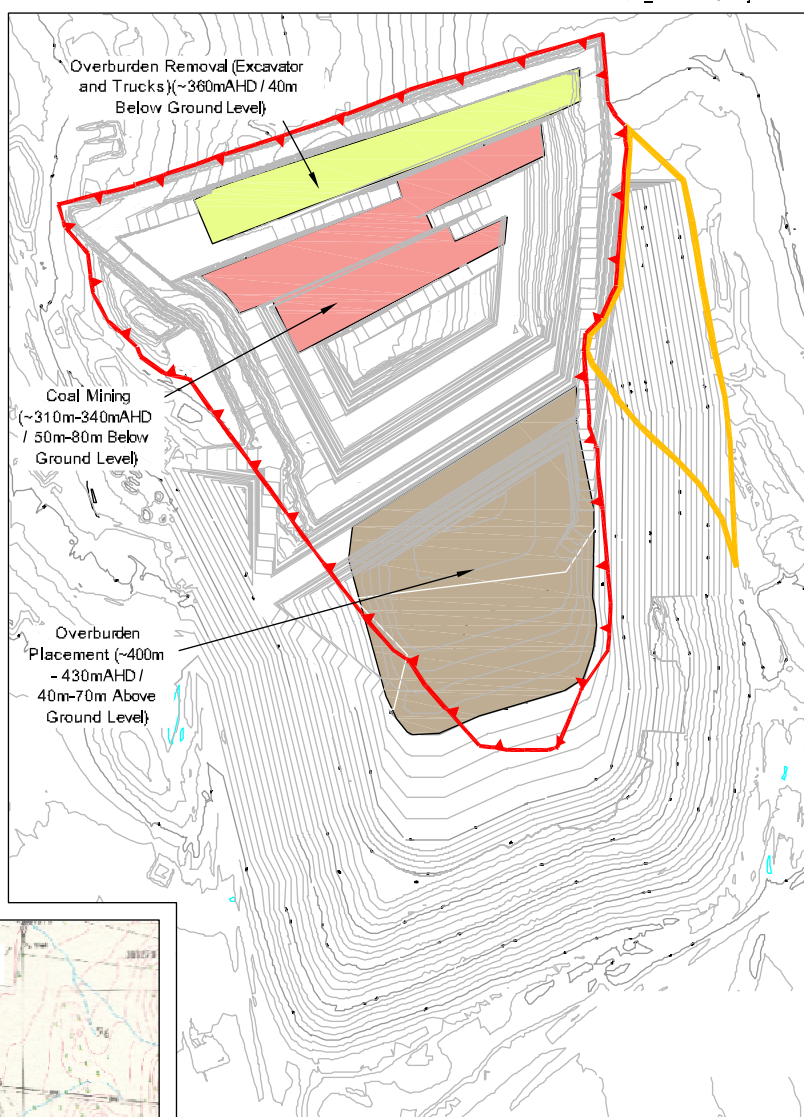
One operational scenario has been modelled to reflect proposed modified operations at the mine site. The modelling scenario combines the worst case location of coal mining (at the northernmost point of open cut area) with the maximum rate of annual overburden removal (10,042,000 bank cubic metres/year) to create a highly conservative representation of the modified operations. The modelling scenario incorporates the following dust generating activities.

- Coal extraction operations, including drilling and blasting, bulldozer and excavator.
- Overburden removal, including use of a scraper on topsoil and excavator.
- Construction and maintenance of the overburden dump, including wind-generated erosion.
- Processing Area operations.
- Movement of haul trucks about the mine site.
- Operation of the Rail Load-out Facility in the north of the mine site.

Figure 4.10 illustrates the location of the emission sources included in the modelling.



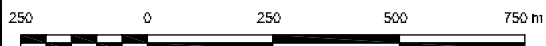
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REFERENCE

- Mine Site Boundary (ML 1563)
- Proposed Modified Open Cut Area
- Proposed Overburden Emplacement Area (Out-of-Pit)
- 250 Contour (m AHD) (Interval = 10m)
- Spot Height (m AHD)

SCALE 1:15 000

Figure 4.10
AIR QUALITY MODELLING SCENARIO

In order to assess the level of impact, the predicted concentrations are compared against air quality goals established in Section 4.1.3.4.

4.5.6.2 Residual Impacts

Dust Deposition

The computer modelling predictions of Heggies (2009) for dust deposition at the nearest residences, including the assumed background level of dust deposition of $1.0\text{g/m}^2/\text{month}$, are displayed in **Table 4.28**.

Table 4.28
Predicted Dust Deposition at Nearest Residences

Residence	Dust - Annual Average ($\text{g/m}^2/\text{month}$)			
	Background	Increment attributable to the Mine	Background + Increment	Project Goal
"Cintra"	1.6	3.3	4.9	3.6
"Tonsley Park"	1.6	0.4	2.0	3.6
"Marengo"	1.6	0.3	1.9	3.6
"Woodlands"	1.6	0.1	1.7	3.6
"Hazeldene"	1.6	0.2	1.8	3.6
"Glenara"	1.6	0.2	1.8	3.6
Source: Heggies (2009) – Table 12				

With the exception of the "Cintra" property, the results presented in **Table 4.28** indicate that the total mean monthly dust deposition (background plus increment) associated with the modified mining operations would comply with the nominated dust deposition goal.

It is noted that the model predictions are likely to overestimate dust deposition levels given the highly conservative nature of the modelled scenario. The probable overestimation of dust deposition levels is supported by the results of dust deposition monitoring completed at the "Cintra" property to date. The monthly deposition rate, average over four years is approximately $1.2\text{g/m}^2/\text{month}$, which is well below the predicted increment of **Table 4.28** ($3.3\text{g/m}^2/\text{month}$). On the basis that the predicted dust deposition concentration is likely to overestimate the actual deposition levels, and assuming the Applicant continues to monitor deposition levels at the "Cintra" property and incorporates additional emission controls into the operations should the deposition rate recorded at this dust gauge begin to rise over time, it is assessed that the proposed modification would not result in a significant change to the current acceptable dust emissions.

Particulate Matter

The maximum 24-hour average PM_{10} concentration at the nearest residences was predicted using Ausplume over a one-year time frame (see **Table 4.29**). It has been assumed that background levels of PM_{10} vary on a daily basis with these background levels incorporated into the model. Appendix 2 of Heggies (2004) provides an explanation regarding the use of varying background PM_{10} levels.



Table 4.29
24-hour Average PM₁₀ Concentrations at the Nearest Assessment Locations

Residence	PM ₁₀ – 24-hour Average (µg/m ³)			
	Background (date) ¹	Increment attributable to the Modified Operations	Background + Increment	Goal
“Cintra”	17.0 (12/05/2008)	41.8	58.8	50
“Tonsley Park”	48.8 (03/10/2007)	0.1	48.9	50
“Marengo”	48.8 (03/10/2007)	4.7	53.5	50
“Woodlands”	48.8 (03/10/2007)	0.1	48.9	50
“Hazeldene”	48.8 (03/10/2007)	0.8	49.6	50
“Glenara”	48.8 (03/10/2007)	1.0	49.8	50
Note 1: The Tamworth DECC Monitoring Station data for the period 1 September 2007 to 31 August 2008 has been used (see Section 4.5.2)				
Source: Modified after Heggies (2004) – Table 10				

Exceedance of the maximum 24-hour average PM₁₀ concentration is predicted at the “Cintra” and “Marengo” residences. Of these, the single exceedance at the “Marengo” residence is primarily a consequence of the elevated background PM₁₀ level (48.8µg/m³) and not indicative of elevated dust levels from the mine site.

In contrast, the primary contributor to the exceedance at the “Cintra” residence is the incremental contribution of the mining operations (41.8µg/m³). Further analysis of the modelling results at the “Cintra” residence have been undertaken by Heggies (2009) to determine the potential for multiple exceedances of the maximum 24-hour average PM₁₀ concentration criterion.

Table 4.30 presents both the incidences of highest background (and their corresponding predicted increment), and the highest predicted incremental increases (and their corresponding background) which result in the highest combined 24-hour average PM₁₀ concentration at the “Cintra” residence.

Table 30
Predicted Background and Incremental 24-Hour PM₁₀ Maxima at “Cintra”

Date	PM ₁₀ - 24-Hour Average (µg/m ³)		
	Background	Predicted increment	Highest Predicted Total
12/05/2008	17.0	41.8	58.8
28/06/2008	20.4	32.5	52.9
03/10/2007	48.8	2.7	51.5
22/02/2008	21.9	28.8	50.7
14/09/2007	42.5	4.5	47.0
23/12/2007	26.2	18.7	44.9
04/10/2007	35.9	6.9	42.8
13/05/2008	15.8	27.0	42.8
04/07/2008	12.7	29.1	41.8
11/07/2008	15.1	25.0	40.1
03/03/2008	10.0	25.3	35.3
02/06/2008	9.2	20.9	30.1
Bold identifies the primary contribution to PM ₁₀ concentration			
Source: Modified after Heggies (2009) – Table 14			



A review of **Table 4.30** indicates that the maximum 24 hour PM₁₀ concentration is predicted to exceed the criterion a further three times. Of the four predicted exceedance, the incremental contribution of the Werris Creek Coal Mine is the primary contribution on three occasions.

When the results of **Table 4.30** are considered against the land acquisition criteria identified in Section 4.5.5.5, the highest predicted total is less than 150µg/m³ and the highest predicted increments comply with increment only goal of 50µg/m³ expressed as a 98.6th percentile.

Table 4.31 presents the predicted annual average PM₁₀ concentrations assuming a background annual PM₁₀ concentration of 15.1µg/m³ at the nearest residences. **Table 4.31** shows that for the scenario modelled, annual average PM₁₀ concentrations as a consequence of the modified mining operations would be less than 21.1µg/m³ and satisfy the project goal of 30µg/m³.

Table 4.31
Annual PM₁₀ Concentrations at the Nearest Assessment Locations

Residence	PM ₁₀ - Annual Average (µg/m ³)			
	Background	Increment attributable to the Modified Operations	Background + Increment	Goal
"Cintra"	15.1	6.0	21.1	30
"Tonsley Park"	15.1	1.2	16.3	30
"Marengo"	15.1	1.1	16.2	30
"Woodlands"	15.1	0.7	15.8	30
"Hazeldene"	15.1	0.9	16.0	30
"Glenara"	15.1	1.0	16.1	30
Source: Modified after Heggies (2007) – Table 11				

4.5.7 Greenhouse Gas Assessment

The mining and related activities of the Werris Creek Coal Mine have the potential to generate greenhouse gas emissions from a number of sources. These sources include the following.

- i) The combustion of fuel by diesel-powered equipment and vehicles.
- ii) Emissions associated with explosive use.
- iii) The release of coal bed methane during excavation and post-excavation activities.
- iv) Distribution (transport) of coal products materials.
- v) The use of purchased electricity in mine site buildings.
- vi) End use of produced materials.

Greenhouse gas emitting sources are classified according to accepted greenhouse gas protocol as either Scope 1, 2 or 3 emissions as follows.

Scope 1 Emissions

Those emissions resultant from activities under the Applicant's control or from sources which they own. Emission sources (i), (ii) and (iii) are considered Scope 1 emissions.



Scope 2 Emissions

Those emissions result which relate to the generation of purchased electricity consumed in its owned or controlled equipment or operations. Emission source (v) is considered a Scope 2 emission, however, this is likely to be a relatively minor source of greenhouse gas emissions.

Scope 3 Emissions

These emissions are defined as those which do not result from the activities of the Applicant although arise from sources not owned or controlled by the Applicant. In the case of the Werris Creek Coal Mine, this includes the transportation of sold coal and the use of this coal, either domestically or overseas, ie. emission sources (iv) and (vi).

The annual greenhouse gas emissions from the above sources were calculated by Heggies (2009) using data on coal production, diesel and electricity consumption and explosive use sourced from the 2007/2008 AEMR for the Werris Creek Coal Mine and assuming annual production of 1.5Mt of coal and 12.05Mt of overburden each year for the 3 remaining years of the mine life. **Table 4.32** presents the annual consumption of each emission source (see (i) to (vi) above) based on this rate of coal production.

Table 4.32
Greenhouse Gas Emissions Sources

Emission Source	Usage			Total Use
	Scope 1	Scope 2	Scope 3	
Diesel Consumption (operations) (kL)	11 581			11 581
Explosives (t)	6 799			6 799
Coal bed Methane (t)	3 250			3 250
Diesel Consumption (transport) (kL)				
- Employee Commute to Mine Site			60	
- Rail Transport			4 275	
- Road Transport			83	
Purchased Electricity (MWh)		1 452		1 452
End use Coal (t)			1 500 000	1 500 000
Note: Assumes 100% sale of coal (1.5Mtpa)				
Source: Modified after Heggies (2009) – Table 17				

Further detail on how each consumption figure was calculated is provided in Section 8.2 of Heggies (2009).

Emissions factors, sourced from the DECC document, *National Greenhouse Accounts (NGA) Factors* NGA Workbook for the Scope 1 to 3 emissions sources, were applied to these consumption rates to calculate annual greenhouse gas emissions. **Table 4.33** provides the calculated greenhouse gas emissions (as CO₂-e) for the modified operations of the Werris Creek Coal Mine.



Table 4.33
Predicted Greenhouse Gas Emissions for the Werris Creek Coal Mine Expansion

Emission Source	Emissions (t CO ₂ -e)			Total (t CO ₂ -e)
	Scope 1	Scope 2	Scope 3	
Diesel Consumption (operations)	31 268			31 268
Explosives	1 156			1 156
Coal Bed Methane	68 250			68 250
Diesel Consumption (transport)			3 200	3 200
Purchased Electricity		1 293	247	1 540
End use Coal			293 625	293 625
TOTAL	100,674	1,293	297 043	399 039

Source: Modified after Heggies (2009) – Table 19

The results of this assessment indicate that the total annual emissions of CO₂-equivalent as a result of the operations at the modified operations are predicted to be of the order of 0.4Mt of CO₂-equivalent per annum. Australia's national net emissions of greenhouse gas in 2006 were 576 Mt of CO₂-e and 552.6 Mt of CO₂-e in 1990. The greenhouse gas emission of the modified operations at the Werris Creek Coal Mine would therefore represent less than 0.1% of these 'baseline' emissions.

It should be noted that the calculated annual greenhouse gas emissions consider the Werris Creek Coal Mine in its totality, not just the modified component. When compared to a greenhouse gas assessment completed as part of the original EIS for the Werris Creek Coal Mine, which only considered Scope 1 and 2 emissions, the annual emission levels are equivalent to those predicted for the approved mine (102 967t of CO₂-e vs 77 283t of CO₂-e). The increase is largely attributable to the increased volume of overburden proposed to be managed each year, which would require increased use of the mine's mobile equipment and not a result of increased inefficiencies in the mining process.

The Applicant is committed to reducing greenhouse gas emissions and will investigate low emissions technology as it can be practically applied to the mining operation.

4.5.8 Monitoring

With the following exceptions, the Applicant proposes to maintain the same monitoring program as identified in Section 1.6.6.3 and described in the Air Quality Monitoring Program (AQMP) approved for the Werris Creek Coal mine in April 2005.

- The high volume samplers at locations WCHV1 and WCHV3 ("Old Colliery" and "Railway View") would be relocated to non-project related residences, possibly on the "Marengo" and/or "Cintra" properties.
- The dust gauges at locations WCA3, WCA4 and WCA5 ("Old Colliery", "Hillview" and "Railway View") would be relocated to non-project related residence, possibly on the "Marengo", "Hazeldene", "Woodlands" and/or "Glenara" properties.



The monitoring would continue to be undertaken in accordance with the DECC document “*Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*”, 2001 and with the following Australian Standards:

- AS 2922-1987 “Ambient Air - Guide for the Siting of Sampling Units” (NSW DEC Method AM-1).
- AS 3580.10.1-1991 “Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method” (NSW DEC Method AM-19).

4.6 FLORA AND FAUNA

4.6.1 Introduction

Flora and fauna investigations of the proposed modification have been completed by two specialist consultants. The investigations undertaken by each consultant are as follows.

- Flora - Geoff Cunningham Natural Resource Consultants Pty Ltd (GCNRC).
- Fauna – Ecotone Ecological Services Pty Ltd (Ecotone).

Complete copies of the reports provided by these specialists are included in the *Specialist Consultant Studies Compendium* as Part 4 (Flora) and Part 5 (Fauna).

The investigations by both consultants included a review of relevant literature and field work to assess the features of the existing environment and the potential for the proposed modification to impact upon the existing environment. Where practicable, operational safeguards and/or mitigation measures have been recommended and adopted to remove, reduce or compensate for the potential impact(s).

The flora and fauna assessments build upon the following studies completed in 2004 over the mine site as part of the original development application process for the Werris Creek Coal Mine.

- *Flora Assessment for the Proposed Werris Creek Coal Mine* completed by GCNRC (2004).
- *Fauna Assessment for the Proposed Werris Creek Coal Mine* completed by Countrywide Ecological Service (2004).

4.6.2 Flora

4.6.2.1 Existing Environment

4.6.2.1.1 Regional Vegetation

A review of published literature relevant to the vegetation of Tamworth and Quirindi Districts indicates the area incorporating the mine site is dominated by two main native vegetation communities, namely:

- the *Eucalyptus albens* (White Box) community; and
- the *Eucalyptus albens* (White Box) - *Callitris* spp. (Cypress Pine) community.



Both these communities typically occur as open woodlands and contain a variety of tree, shrub and grass species.

The above communities are best described as 'remnant' vegetation given much of the vegetation of the region, especially on the flatter more fertile areas, has been cleared for agriculture. The mine site itself is representative of the regional vegetation with cleared areas on the flatter areas with deep and fertile soil, with native woodland remaining on the less fertile slopes of the ridge which is located centrally within the mine site.

4.6.2.1.2 Vegetation of Conservation Significance within the Region

GCNRC (2009) obtained a listing of vulnerable and endangered flora species, Endangered Ecological Communities (EECs), endangered populations and critical habitat (contained within the schedules of the *Threatened Species Conservation Act 1995* [TSC Act]) from the 'Atlas of NSW Wildlife' that have been recorded, or are predicted to occur, within the region (defined by the Curlewis [8935] and Tamworth [9035] 1:100 000 map sheet areas). GCNRC (2009) also obtained a listing of threatened flora species and EECs (contained within the schedules of the *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act]) identified as likely to occur within a 10km radius of the mine site.

No records or predictions of endangered flora populations or critical habitat were identified.

No records of threatened species were identified, however, the potential for the following species to occur was predicted (reference is made to the legislation under which the species is listed).

- *Cadellia pentastylis* (TSC Act).
- *Calotis glandulosa* (TSC Act).
- *Dichanthium setosum* (TSC Act).
- *Digitaria porrecta* (EPBC Act).
- *Diuris shaeffiana* (EPBC Act).
- *Homorantus darwinioides* (TSC Act).
- *Philotheca ericifolia* (TSC Act / EPBC Act).
- *Pilularia novae-hollandiae* (TSC Act).
- *Pterostylis cobarensis* (EPBC Act).
- *Swainsona murrayana* (TSC Act).
- *Thesium australe* (TSC Act / EPBC Act).
- *Tylophora linearis* (EPBC Act).

The following EECs were recorded or predicted to occur within the region (reference is made to the legislation under which the species is listed).



TSC Act

- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray - Darling Depression, Riverina and NSW South Western Slopes Bioregions.
- Fuzzy Box Woodland on Alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions.
- Coolibah – Black Box Woodland of the Northern Riverine Plains in the Darling River Plains and Brigalow Belt South Bioregions.
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions.
- McKies Stringybark / Blackbutt Open Forest in the Nandewar and New England Tableland Bioregions.
- Semi-evergreen Vine Ticket in the Brigalow Belt South and Nandewar Bioregions.
- Native Vegetation on Cracking Clay Soils of the Liverpool Plains.
- White Box Yellow Box Blakely's Red Gum Woodland.
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions.

EPBC Act

- Natural Grasslands on Basalt and Fine Textured Alluvial Plains of Northern New South Wales and Southern Queensland.
- Weeping Myall Woodlands.
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grassland.

4.6.2.1.3 Mine Site Vegetation

A flora study of the mine site completed by GCNRC (2004) identified a total of six vegetation communities. GCNRC (2004) revealed that the ground cover over much of the mine site was invaded by introduced weed and pasture species. None of the threatened flora species listed in Section 4.6.2.1.2 were identified, however, remnants of two EECs were identified, namely:

- White Box Yellow Box Blakely's Red Gum Woodland⁵; and
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions.

⁵ This community listed as endangered under the *Threatened Species Conservation Act 1995* is equivalent to the Grassy White Box Woodland listed under the *Environment Protection and Biodiversity Conservation Act 1999*.



GCNRC (2009) completed a survey of a further 18 sites within and to the north of the modified open cut mining and overburden emplacement area (see **Figure 4.11**). This survey did not identify any threatened flora species, however, confirmed the distribution of the White Box Yellow Box Blakely's Red Gum Woodland EEC and other communities identified by GCNRC (2004) over the area surveyed.

Figure 4.11 also presents the mapped extent of the six vegetation communities recorded on the mine site by GCNRC (2004, 2009). A description of these vegetation communities is as follows.

Community 1 – Cleared - Cultivated / Pasture Lands

This community comprises cleared and cultivated land. Scattered individual *Eucalyptus albens* [White Box] and *Eucalyptus melliodora* [Yellow Box], trees remain. Shrubs are absent. Ground cover is absent or dominated by crop stubble, volunteer weeds, sown pasture species and native groundcover species.

Community 2 – Cleared Land - Uncultivated

This community comprises cleared and cultivated land. The main tree species are scattered White Box, Yellow Box, *Eucalyptus blakelyi* [Blakely's Red Gum] and *Brachychiton populneus* [Kurrajong]. *Maireana microphylla* [Eastern Cottonbush] is usually the only shrub present. The groundcover is dominated by both native and exotic grasses.

Community 3 – *Acacia harpophylla* [Brigalow] Community

This community occurs as a single remnant near the western boundary of the mine site and comprises a clump of between 50 and 60 *Acacia harpophylla* [Brigalow] trees. Some *Callitris glaucophylla* [White Cypress Pine] trees were recorded around the perimeter of the community. The only shrub recorded was a single bush of *Maytenus cunninghamii* [Yellow-berry Bush] and the groundcover is relatively sparse.

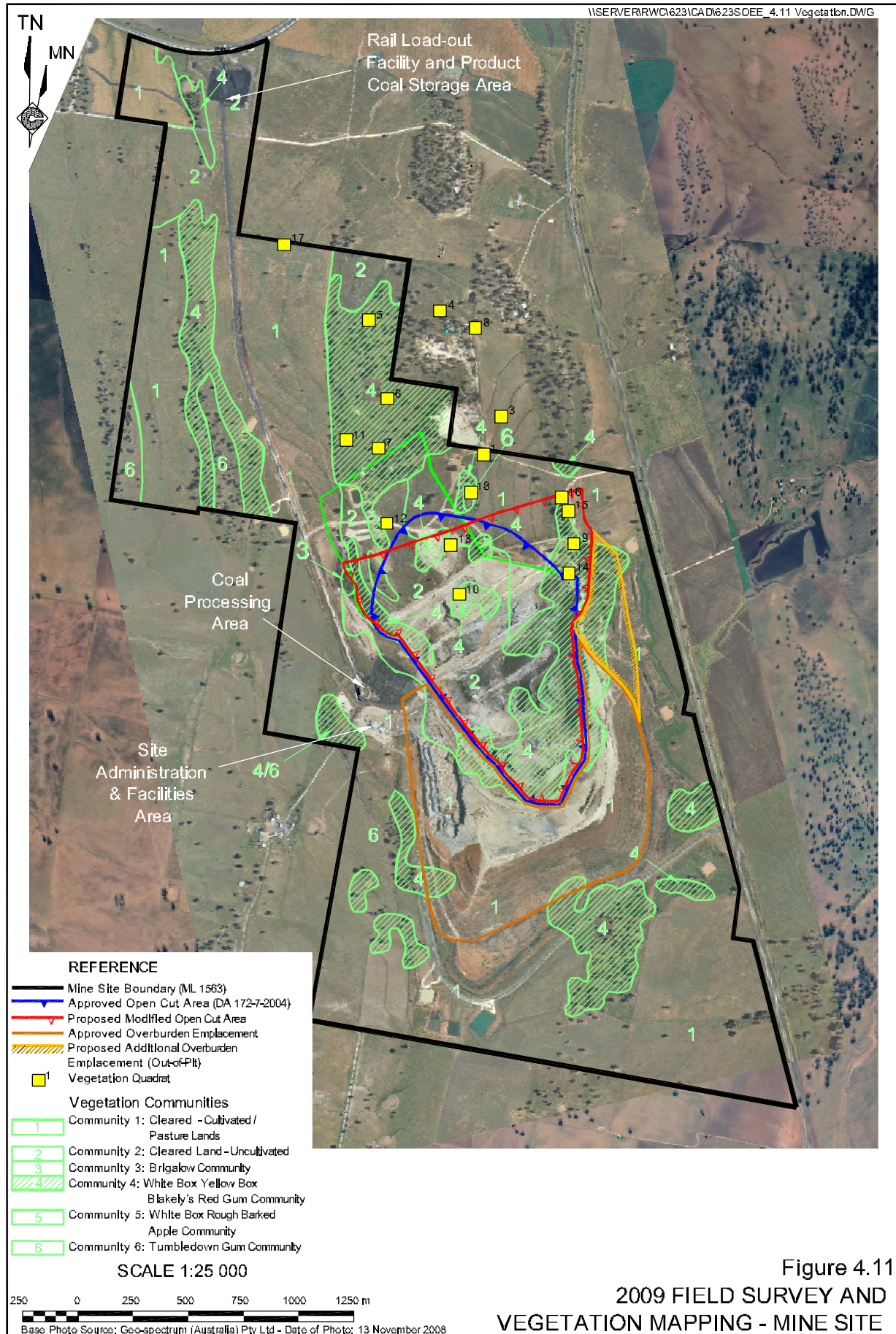
Community 4 – *Eucalyptus albens* [White Box] *Eucalyptus melliodora* [Yellow Box] *Eucalyptus blakelyi* [Blakely's Red Gum] Community

The main tree species are White Box, Yellow Box, Blakely's Red Gum and Kurrajong. Shrub cover is mainly provided by Eastern Cottonbush but some *Pittosporum angustifolium* [Butterbush], *Acacia decora* [Western Golden Wattle] and the noxious weed *Lycium ferocissimum* [African Boxthorn] are present. The groundcover contains a variety of native and exotic grasses.

Community 5 – *Eucalyptus albens* [White Box] - *Angophora floribunda* [Rough-barked Apple] Community

The main tree species are White Box, Blakely's Red Gum, Kurrajong, *Alectryon oleifolius* [Rosewood], *Angophora floribunda* [Rough-barked Apple] and White Cypress Pine. Shrubs are scattered and include *Acacia implexa* [Hickory], *Notelaea microcarpa* var. *microcarpa* [Native Olive], Yellow-berry Bush, Eastern Cottonbush, *Bursaria spinosa* [Native Blackthorn] and *Olearia elliptica* [Sticky Daisy Bush]. Ground cover consists of native and exotic grasses.





Community 6 – *Eucalyptus dealbata* [Tumbledown Gum] Community

The main tree species in this ridgetop community is *Eucalyptus dealbata* [Tumbledown Gum] with what appear to be hybrids between this species and Blakely's Red Gum also present. Saplings and seedlings of Tumbledown Gum are present in some areas. This community usually has a White Box community, sometimes with Yellow Box, Rough-barked Apple and Kurrajong below it in the landscape. Shrubs are uncommon, but where present include Yellow-berry Bush and *Native Olive*. The groundcover predominantly comprises native grasses.

Across the mine site, ground cover has been invaded by introduced weed and pasture species. Of these, Bathurst Burr [*Xanthium spinosum*], Paterson's Curse [*Echium plantagineum*] and Spiny Burrgrass [*Cenchrus incertus*], all of which are listed as noxious for Liverpool Plains Shire by the NSW Department of Primary Industries were identified during the field survey.

4.6.2.2 Constraint(s)

While no threatened flora species were identified on the mine site, the proposed modification would require disturbance to an additional 8.8ha of Community 4, identified as a variant of the White Box Yellow Box Blakely's Red Gum Woodland EEC. This would be in addition to an area of approximately 43ha of this EEC, which is located within the open cut and overburden emplacement approved by DA 172-7-2004. This current level of disturbance was approved on condition that the biodiversity offset area identified in Section 2.11.7.

The proposed modification would be potentially constrained by the ability of the Applicant to identify a suitable biodiversity offset for the additional disturbance to the White Box Yellow Box Blakely's Red Gum Woodland EEC.

4.6.2.3 Operational Safeguards, Mitigation Measures and Offset Measures**4.6.2.3.1 Operational Safeguards**

The Applicant would continue to implement the following operational safeguards in order to minimise any potential adverse impacts on the local flora, particularly the endangered ecological communities within the mine site. These safeguards are of a general nature and have been developed in consultation with Geoff Cunningham Natural Resource Consultants Pty. Ltd. Strategies to minimise or offset the impact of the proposal on the communities of conservation significance are outlined in greater detail in Section 4.6.2.3.2.

- i) The extent of clearing undertaken would be minimised and consistent with operational requirements.
- ii) All areas to be cleared would be clearly defined.
- iii) All clearing and topsoil stripping would be undertaken in campaigns on an as-needs basis.
- iv) Soil material and biomass would be directly transferred to an active rehabilitation area, where practicable.
- v) Progressive rehabilitation of all disturbed surfaces would be undertaken in accordance with the procedures described in Section 2.11.



- vi) Any additional internal roads required on the cleared lands would be constructed well away from stands of native vegetation.
- vii) The single occurrence of the Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions Ecological Community would not be affected by the modified open cut mine area although a buffer of 50m is proposed between the edge of the open cut mine and the community.
- viii) Noxious weeds would be controlled at all times.

4.6.2.3.2 Mitigation Measures and Offset Strategies

In order to compensate for the additional disturbance of up to 38.4ha of the mine site, including 8.8ha of the White Box Yellow Box Blakely's Red Gum Woodland EEC, a strategy to rehabilitate specific areas of the mine site to native vegetation, maintain a habitat corridor between the rehabilitated land and existing biodiversity offset area and create an additional biodiversity offset area would be adopted.

Rehabilitation

As illustrated on **Figure 2.10** and described in Section 2.11.3, an area of 115ha has been nominated for the re-establishment of native vegetation. Through the planting of native tree and shrub species tubestock, and sowing of native grasses and other groundcover, White Box Yellow Box Blakely's Red Gum Woodland community type native vegetation would be re-established and designated for nature conservation. The location of the native vegetation re-establishment in the final landform has been chosen to maximise connectivity to remnant patches of the White Box Yellow Box Blakely's Red Gum Woodland community to the east and south of the overburden emplacement.

Maintenance of Habitat Corridors

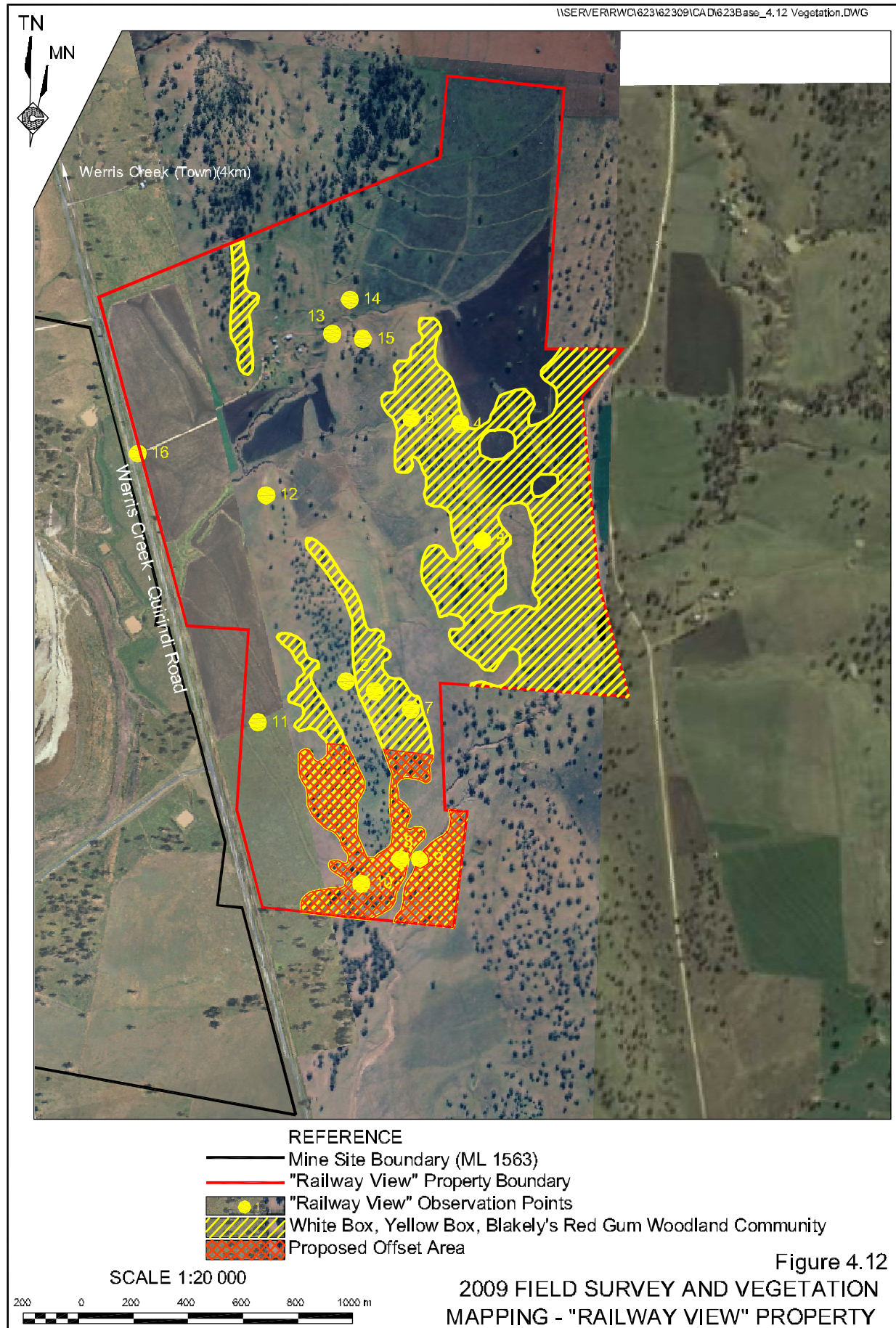
The biodiversity offset strategy for the approved Werris Creek Coal Mine incorporates a 124ha area on the "Eurunderee" property to the west of the mine site. This would be connected to the rehabilitated native vegetation of the final landform through the maintenance of a habitat corridor on which agricultural activity would be ceased. A second habitat corridor would be maintained between the conserved remnant patch of White Box Yellow Box Blakely's Red Gum Woodland community to the south of the overburden emplacement and the Werris Creek – Quirindi Road. Remnant vegetation remains within the road easement as well as on the "Railway View" property to the immediate east.

Stock would be excluded from both corridors through the erection and maintenance of fencing.

Biodiversity Offset Area

As identified in Section 2.11.7, the Applicant proposes to establish a long-term conservation area on the "Railway View" property, adjacent to the second habitat corridor. GCNRC (2009) has completed a survey of the property, which included 16 survey quadrats and has identified approximately 99ha of the White Box Yellow Box Blakely's Red Gum Woodland EEC on the property (see **Figure 4.12**).





For the purposes of offsetting the 8.8ha of the White Box Yellow Box Blakely's Red Gum Woodland EEC to be disturbed by the proposed modification, the Applicant has identified an area of approximately 32ha in size, containing 20ha of the EEC, 4.5ha of a Tumbledown Gum Woodland (Community 6 on the mine site) and a further 7.5ha of cleared land (Community 1 on the mine site). This represents an offset ratio of greater than 2 to 1, which is considered most appropriate, when considered in conjunction with the current 124ha area on the "Eurunderee" property, 115ha of the final landform to be rehabilitated as native woodland and the habitat corridors.

4.6.2.4 Assessment of Impacts

4.6.2.4.1 Introduction

No threatened species, populations or critical habitat was identified on the mine site, nor are any expected to occur. As a consequence, no further assessment of impact on those species previously identified or predicted to occur within the region has been undertaken.

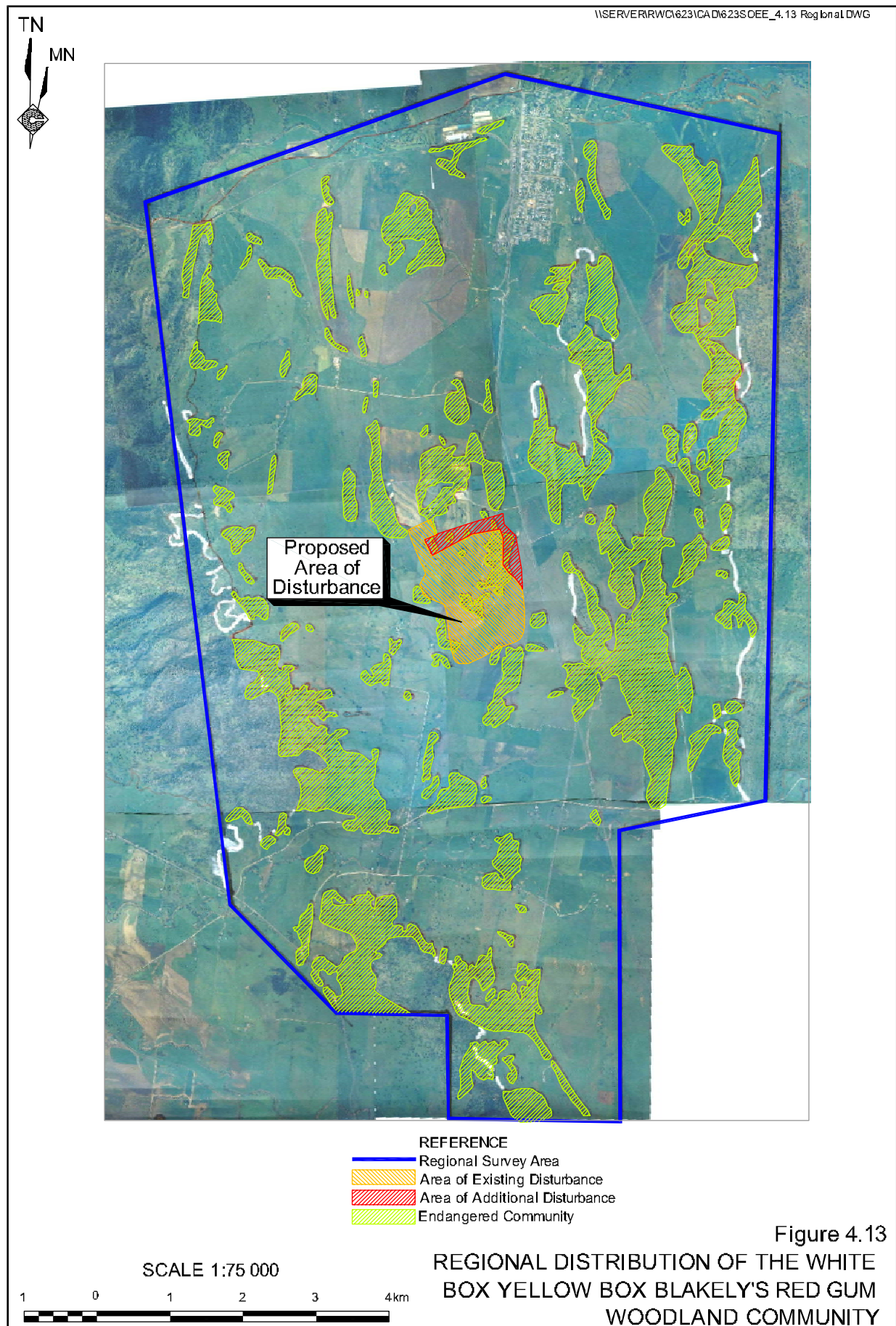
One EEC (White Box Yellow Box Blakely's Red Gum Woodland Community) was identified within the area to be disturbed by the proposed modification. In order to assess the level of impact of the proposed modification on this EEC, the regional distribution of the White Box Yellow Box Blakely's Red Gum Woodland EEC has been considered and a Seven-part Test conducted by GCNRC (2009) in accordance with DECC Guidelines for Threatened Species Assessment (DEC, 2005).

4.6.2.4.2 Regional Distribution and Conservation Significance

In order to determine the local/regional conservation significance of the White Box Yellow Box Blakely's Red Gum Woodland community, an assessment of the local and regional distribution of this community was undertaken (GCNRC, 2004). The area covered by this assessment is presented on **Figure 4.13** along with the identified occurrences of this endangered ecological community. The area surveyed covered approximately 9 400ha, of which 1 800ha or 19% comprises the White Box Yellow Box Blakely's Red Gum Woodland community. GCNRC (2004) also noted extensive additional occurrences of this endangered ecological community within the Werris Creek-Quirindi area beyond the area surveyed. In particular, extensive areas of this community were noted in the vicinity of Quirindi and on the western footslopes of the hills forming the western boundary of the regional survey area.

Based on the results of this local/regional assessment, the 8.8ha of White Box Yellow Box Blakely's Red Gum Woodland community to be cleared during the life of the proposal would represent only 0.5% of the regional distribution of the community. This represents only a small proportion of this community which is relatively well represented regionally. When considered cumulatively with the 43ha to be disturbed within the footprint of the approved Werris Creek Coal Mine, this percentage rises to 2.9%. Once again, this level of clearing, when considered with respect to the regional representation of this community and the proposed offset area on the "Eurunderee" and "Railway View" properties, does not represent clearing that would impact on the local, regional or national conservation status of the community.





On the basis that the proposed clearing of an additional 8.8ha of the Box Yellow Box Blakely's Red Gum Woodland EEC does not represent a locally, regionally, or nationally significant level of clearing GCNRC (2009) concludes that there is no requirement for the preparation of a Species Impact Statement (TSC Act) or a Referral to the Commonwealth Department of Environment, Water, Heritage and the Arts (EPBC Act).

4.6.2.4.3 7 Part Assessment of Significance

The following summarises the results of a seven part test of significance completed by GCNRC (2009) to assess the impacts of the proposed modification on the threatened vegetation identified in Section 4.6.2.1.2.

A: In the case of a Threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction:

No threatened flora species have been recorded within the mine site in the past and none were recorded during field survey. Consequently it is concluded that there would be no adverse affect from the proposed modification on the life cycle of any threatened flora species such that a viable local population of the species is likely to be placed at risk of extinction.

B: In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction:

No endangered flora populations have been recorded from within the mine site in the past and none were recorded during field survey. Consequently it is concluded that there would be no adverse affect from the proposed modification on the life cycle of any flora species that constitutes an endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

C: In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

An 8.8ha remnant of the White Box Yellow Box Blakely's Red Gum Woodland EEC occurs within the area of the proposed modification. Given the extent of the occurrence of this community in the region surrounding the Werris Creek Coal Mine (~1 800ha), it is considered that the clearing of 8.8ha would not have any adverse effect on the community such that its local occurrence is likely to be placed at risk of extinction.

The proposed clearing would be offset by the permanent conservation / reservation of an area of 20ha of this community on an adjacent property. The offset ratio is greater than 2:1.



It is considered that the proposed modification is not likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction. There is a considerable presence of the community in the Werris Creek – Quirindi area and the area proposed to be cleared is small.

D: In relation to the habitat of a threatened species, population or ecological community:

- (i) the extent to which the habitat is likely to be removed or modified as a result of the action proposed, and**
- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- (iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

No threatened flora species or populations were identified within the mine site and there would be no removal, fragmentation, isolation or modification of the habitat of such species or populations. Consequently it is concluded that there will be no significant impact on the habitat of any threatened flora species or population.

8.8ha of the White Box Yellow Box Blakely's Red Gum Woodland EEC that would be cleared if the extension proposed modification is approved. Other than being a remnant of this endangered ecological community, the area proposed for clearing has no special importance in terms of its habitat values than other occurrences in the vicinity – of which there are a number.

Given the extent of the occurrence of this community in the region surrounding the Werris Creek Coal Mine, it is considered that the clearing of 8.8ha would not result in isolation of the habitat of this community nor will it have any adverse effect on the survival of the community within the Werris Creek – Quirindi area.

The proposed clearing would be offset by the permanent conservation / reservation of an area of 20ha of this community on an adjacent property. The offset ratio is greater than 2:1.

E: Whether the action proposed is likely to have an effect on critical habitat [either directly or indirectly].

No critical habitat is present within the study area. Consequently, it is concluded that the Project would not have any effect on any critical habitat.

F: Whether the action proposed is consistent with the objectives or actions of a species recovery plan or threat abatement plan.

No threatened species were identified and so no species recovery plan need be considered.

There are no threat abatement plans relating to the clearing for the proposed modification and so there is no requirement to further consider this issue



G: Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The Project would involve “Clearing of Native Vegetation”, an activity listed as a Key Threatening Processes in the Schedules of the TSC Act.

The proposed clearing would be offset by the permanent conservation / reservation of an area of 20ha of this community on an adjacent property. Permanent conservation of this 20ha area, along with an associated 4.5ha area of Tumbledown Gum community would result in an improvement in community structure through regeneration of native trees and shrubs, and in native groundcover species abundance, that would not have occurred on the area proposed for clearing as it could still be used for domestic livestock grazing.

Therefore, while the proposed clearing constitutes a key threatening process, it is considered that the positive biodiversity offset outcomes linked with the proposed clearing will in fact outweigh any detrimental impact of the clearing.

4.6.3 Fauna

4.6.3.1 Study Methodology

Similar to the flora study, the fauna study has been completed over two distinct periods. An initial assessment was completed over the entire the mine site in 2003 and 2004 by Countrywide Ecological Service. The survey and assessment completed by CES (2004) has been supplemented by additional desktop and field surveys completed in December 2008 to confirm the habitat assessment of the area to be disturbed as part of the proposed modification, undertake opportunistic sampling and ensure the requirements of DECC’s Threatened Species Assessment Guidelines are met.

CES (2004) Survey and Assessment

CES (2004) undertook a fauna survey of the current Werris Creek Coal Mine site as part of the original development application for the mine. CES (2004) established trapping and survey sites amongst the woodland vegetation and scattered paddock trees on the mine site. A summary of survey completed is included in **Table 4.34**.

Table 4.34
Survey Effort of CES (2004)¹ Across the Mine Site

	Woodland Areas	Scattered Trees
Hair tube trap-line	✓	✓
Nocturnal reptile search	✓	
Pitfall trap line	✓	✓
Bird survey transects	✓	✓
Spotlighting transects	✓	✓
Anabat recording	✓	✓
Call playback	✓	
Harp trap		✓
Note 1: Trapping was undertaken in 2003		
Source: Modified after CES (2004)		



Two threatened species were recorded in the study area by CES (2004), the Hooded Robin (*Melanodryas cucullata*) and Eastern Bentwing Bat (*Miniopterus schreibersii*). Both are listed as Vulnerable under Schedule 2 of the TSC Act. The Hooded Robin was recorded on a single occasion, in woodland on the eastern side of the subject site. It is presumed that the Eastern Bentwing Bat was recorded using an Anabat detector and not captured in a harp trap (the method of capture was not noted in the report).

Considering the large areas of similar remnant habitat available within the local and regional area, and the relatively large ranges of the two threatened species identified, CES (2004) assessed that the impact on these two species of the existing Werris Creek Coal mine would be minor and would not place either at risk of local extinction.

Ecotone (2009) Survey and Assessment

A new search of the documented records held on the Department of Environment and Climate Change, Atlas of NSW Wildlife Database and the EPBC Act Protected Matters Search Tool for a 10km radius surrounding the mine site was completed. Following the compilation of the listed threatened fauna species previously identified within the region, a habitat assessment of the additional areas of disturbance associated with the proposed modification was undertaken on 17 of December 2008. Areas of woodland, clumps of scattered trees, and farm dams were investigated for potential threatened or migratory species habitat. While general habitat features were noted in grassland and scattered tree areas, habitat assessment descriptions were completed only at each of the two small woodland areas potentially affected by the proposed modification (see **Figure 4.14**).

Additional detail on the study methodology is provided by CES (2004) and Ecotone (2009) – Part 5 of the *Specialist Consultant Studies Compendium*.

4.6.4 Existing Fauna Assemblage

4.6.4.1 Habitat Types

Table 4.35 identify and describe the habitat types that could potentially be affected by the proposed modification. **Figure 4.14** provides an illustration of the route followed as part of the survey route and location of woodland areas for which a detailed habitat assessment was completed (see **Table 4.35**).



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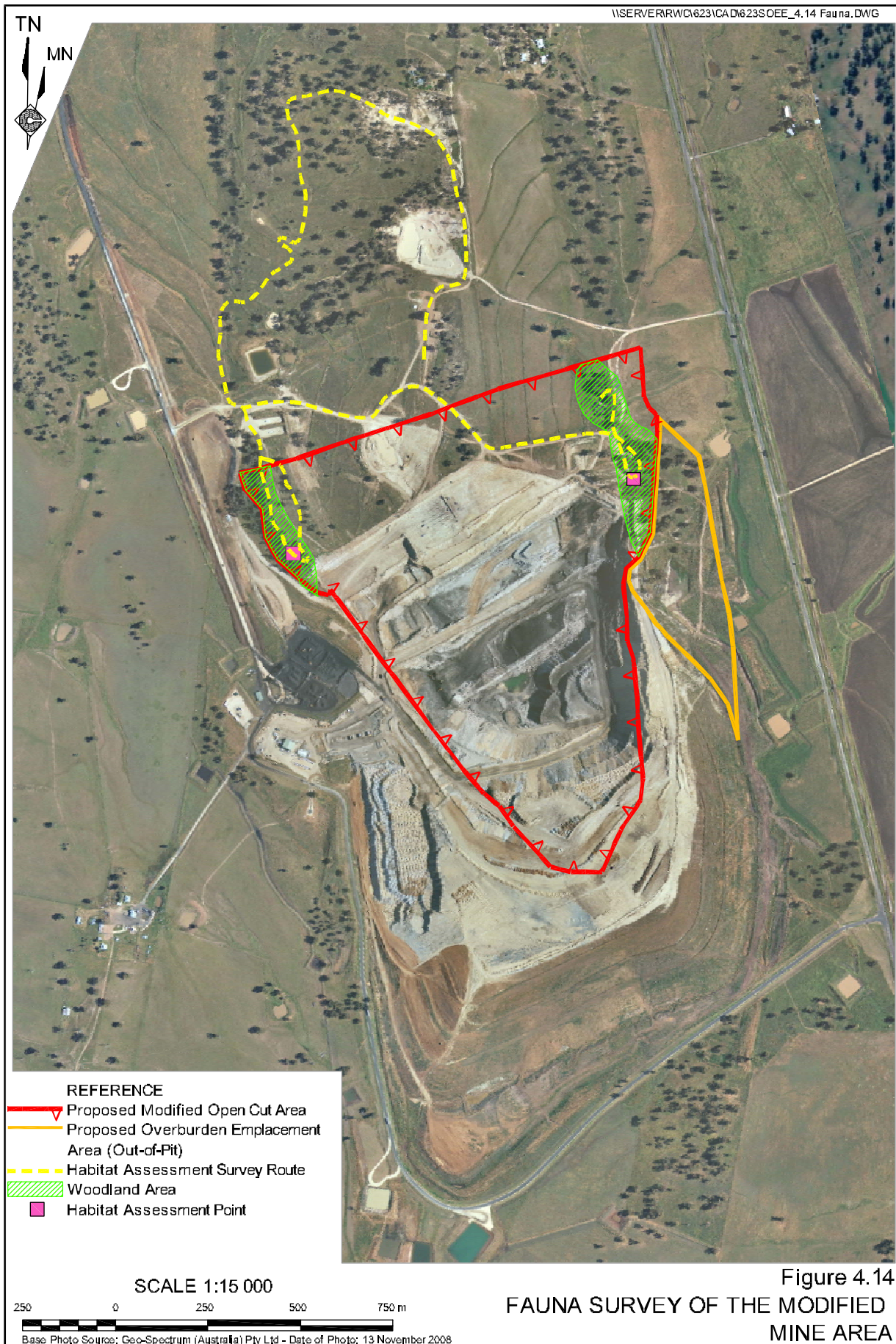


Table 4.35
Summary of Habitat Features Within the Study Area

Habitat feature	Habitat description
1. Woodland Area A (corresponding to Habitat Type 2 of CES, 2004)	Open woodland on a rocky ridgeline dominated by middle-aged eucalypt trees. Trees appeared healthy with little dieback or insect attack. Scattered scrub layer to less than 1.5 m. Ground cover predominately grass to 1.0 m with areas of boulder cover. West to south-west aspect, in parts moderately steep. Few fallen logs. No dead standing trees, saplings or mistletoe were recorded. Tree hollows were uncommon and only small (25 – 50 mm) and medium (50 – 100 mm) sized hollows were recorded. Moderate to high level of weed infestation. No obvious erosion. No domestic grazers, but some macropod grazers present although having little affect.
2. Woodland Area B (corresponding to Habitat 2 of CES, 2004)	Lower slope open woodland of mature eucalypts with a grassy understorey. Trees appeared healthy with little dieback or insect attack. Scattered scrub layer to less than 1.5 m. Ground cover predominately grass to 1.0 metre. No areas of rock or boulder cover. Slight southerly aspect and gently slope. Few natural fallen logs and some piles of fallen trees. Scattered dead standing trees. No saplings or mistletoe were recorded. Tree hollows were common in all size classes except extra large (> 300 mm). Moderate level of weed infestation. No obvious erosion except along dirt tracks. Grazing by cattle in parts. Small farm dam – soil banks with no aquatic or emergent vegetation. Moderate to low levels of 'plugging' along the banks by cattle. No water-birds were recorded
3. Scattered Paddock Trees (corresponding to Habitat 3 of CES, 2004)	Predominately mature trees containing some to many hollows. Tree hollows were common in all size classes except extra large (> 300 mm). Grassy understorey. Little dieback and no mistletoe were recorded.
4. Grassland Areas (corresponding to cleared areas described by CES, 2004)	Mix of grass and weed cover to 1.2 m. Contoured erosion banks present in some areas.
5. Water-bodies (corresponding to Habitat 4 of CES, 2004)	Farm/mine dam – moderate sized farm dam with grassy banks to 1.2 m. Contains water through most years. Quarry depression – small sized depression with grassy banks to 0.5 m. Contains water through most years.

4.6.4.2 Regional Fauna of Conservation Significance

Following the search of the DECC's Atlas of NSW Wildlife Database and the EPBC Act Protected Matters Search Tool, 24 species of threatened or migratory fauna species have either been recorded, or are predicted to occur by EPBC Act Protected Matters Reporting modelling, within a 10km radius of the mine site (Ecotone, 2009). Of these, Ecotone (2009) has concluded, based on preferred habitat requirements and known distribution, that two species are likely to occur on the mine site, 14 may occur and 8 are unlikely to occur as follows.

Likely to Occur

- Hooded Robin
- Eastern Bentwing-bat



May Occur

- Cattle Egret
- Great Egret
- Swift Parrot
- Turquoise Parrot
- Diamond Firetail
- Satin Flycatcher
- Rainbow Bee-eater
- White-throated Needletail
- Koala
- Large-eared Pied Bat
- Border Thick-tailed Gecko
- Eastern Long-eared Bat

Unlikely to Occur

- Australian Painted Snipe
- Latham's Snipe
- Painted Snipe
- Superb Parrot
- Booroolong Frog
- Bell's Turtle
- Speckled Warbler
- White-bellied Sea Eagle

4.6.4.3 Fauna Species of the Survey Areas

A total of eight amphibian, 14 reptile, 21 mammal and 37 bird species were identified on or immediately surrounding the mine site by CES (2004). Of these, two are listed as vulnerable under Schedule 2 of the TSC Act (Hooded Robin and Eastern Bentwing Bat) and nine are exotic.

A total of 16 native species were recorded during the field survey of Ecotone (2009), none of which were threatened or migratory species (see **Table 4.36**).

Table 4.36
Protected Species Recorded Opportunistically During Site Visit.

Scientific name	Common name
Birds	
<i>Accipiter fasciatus</i>	Brown Goshawk
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo
<i>Platycercus eximius</i>	Eastern Rosella
<i>Psephotus haematonotus</i>	Red-rumped Parrot
<i>Nymphicus hollandicus</i>	Cockatiel
<i>Eolophus roseicapillus</i>	Galah
<i>Ocyphaps lophotes</i>	Crested Pigeon
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill
<i>Manorina melanocephala</i>	Noisy Miner
<i>Artamus cyanopterus</i>	Dusky Woodswallow
<i>Cracticus torquatus</i>	Grey Butcherbird
<i>Cracticus nigrogularis</i>	Pied Butcherbird
<i>Gymnorhina tibicen</i>	Australian Magpie
Mammals	
<i>Macropus giganteus</i>	Eastern Grey Kangaroo
<i>Macropus robustus</i>	Common Wallaroo
Reptiles	
<i>Morethia boulengeri</i>	South-eastern Morethia Skink

Source: Modified after Ecotone (2009) – Table 6



4.6.4.4 SEPP No. 44 - Koala Habitat Protection

State Environmental Planning Policy No. 44 - Koala Habitat Protection (SEPP 44), which applies in the Local Government Areas of Parry and Quirindi (now part of the Liverpool Plains LGA), aims to identify potential Koala habitat in the form of native vegetation where the trees of the types listed in Schedule 2 of SEPP 44 constitute at least 15% of the trees in the area. White Box is the dominant tree species within the areas to be disturbed by the proposed modification, representing >15% of all trees present. White Box is identified as a Koala feed tree species and therefore, the area of woodland to be disturbed is classified as “potential Koala habitat”.

4.6.5 Constraint(s)

No threatened fauna species were identified during the most recent survey of the mine site, however, it is noted that two threatened species were identified during the survey of CES (2004). Ensuring these species, as well as those species which may occur on the mine site, are not adversely impacted could potentially constrain the proposed modification.

4.6.6 Operational Safeguards and Controls

Whilst fauna diversity is relatively low on the mine site as a consequence of prior clearing for agricultural activities, the Applicant would continue to implement the following safeguards to minimise the impacts on local fauna and in the medium to longer term enhance the fauna habitats.

- Where possible, the removal of trees would be carried out between late spring to early autumn to avoid and/or minimise impact on spring nesting birds and over-wintering bats.
- Prior to each clearing campaign, a survey would be undertaken to ascertain the presence of any listed threatened species. In the event any listed threatened species are identified, they would be relocated prior to the commencement of clearing.
- No felled timber within the mine site would be burnt. Rather, all stumps would be buried within the overburden emplacement, all branches and tree trunks <300mm in diameter or containing hollows would be placed over the areas of the final landform designated for the re-establishment of native woodland. Large diameter logs not containing hollows may be sold and/or used for farm-related activities.
- Revegetation of the final landform has been designed to re-establish similar areas of the native vegetation to that disturbed, link revegetated areas with remnants of the endangered White Box Yellow Box Blakely's Red Gum Woodland community and create habitat corridors for native fauna.



- The Applicant has provided for an additional offset area including almost 25ha of native woodland (20ha of White Box Yellow Box Blakely's Red Gum Woodland community and 4.5ha of Tumbledown Gum community) to offset the clearing of 8.8ha native vegetation over the modified open cut and overburden emplacement areas. The ratio of conserved to cleared native vegetation is almost 3:1.
- Stock grazing would be excluded from the remaining open woodland remnants within a 200ha area to the north and east of the open cut mine.

A Flora / Fauna Management Plan is maintained by the Applicant and this would be updated to include the new biodiversity offset area included as part of the proposed modification.

4.6.7 Assessment of Impacts

4.6.7.1 TSC Act Consideration

As noted in Section 4.7.2.3, eight species listed under Schedule 2 of the TSC Act have been identified on, or may possibly occur on the mine site. The eight species (and likelihood of occurrence) are as follows.

- Eastern Bentwing-bat (likely to occur - identified);
- Hooded Robin (likely to occur - identified);
- Swift Parrot (may occur);
- Turquoise Parrot (may occur);
- Regent Honeyeater (may occur);
- Diamond Firetail (may occur);
- Koala (may occur); and
- Large-eared Pied Bat (may occur).

Ecotone (2009) completed seven-part tests, in accordance with the DECC's *draft Threatened Species Assessment Guidelines* (DEC, 2005), for each species to assess if the proposed modification would be likely to have a significant impact on any or all.

Following the completion of the seven-part test for each species, Ecotone (2009) concluded that the proposed modification is unlikely to significantly impact upon any local population of threatened species or their habitats

Therefore, based on the results of the seven-part tests, it is concluded that the proposed modification would not result in any of the key thresholds identified in Step 5 of DECC (2005) being reached or exceeded, ie. considering the proposed operational controls, mitigation measures and offset strategies, the proposed modification would:

- maintain biodiversity, and based on the proposed offset strategy, improve biodiversity values;
- not reduce the long-term viability of any species, population or community;



- not accelerate, or place at risk of extinction, any species, population or community; and
- not adversely affect critical habitat.

4.6.7.2 EPBC Act Consideration

The EPBC Act focuses Commonwealth interests on matters of National Environmental Significance (NES) including integrated biodiversity conservation and the management of important protected areas. The matters of NES relevant to the assessment of the proposed modification are as follows.

- Nationally threatened species and ecological communities.
- Migratory species.

Ecotone (2009) has concluded that five threatened species and six migratory species may use the mine site. For these 11 species, Ecotone (2009) assessed the impact of the proposed modification against the criteria provided in the administrative guidelines for the EPBC Act to determine whether the proposed modification is likely to have a significant impact on these species.

In each case, Ecotone (2009) concluded that the proposed modification would not have a significant impact on the species. No other matters of NES or other matters protected by the EPBC Act are directly relevant to the mine site or proposed modification. Therefore, as the proposed modification does not constitute an action that is likely to have an impact on any matter of national environmental significance, the specific assessment process under the provisions of the EPBC Act is not required.

4.6.7.3 SEPP 44 Consideration

No sign of Koala habitation was found by either CES (2004) or Ecotone (2009). Therefore, due to the lack of a resident population on the mine site (determined by the absence of breeding females), recent sightings or historical records, the mine site does not form “core Koala habitat”. As the mine site is not core Koala habitat, no further assessment under SEPP 44 is required.

4.6.7.4 Key Threatening Processes

The following Key Threatening Processes as listed under the TSC Act and the EPBC Act are relevant to an assessment of impact on the native fauna of the mine site, transport route and surrounding environs.

- Clearing of native vegetation.
- Removal of dead wood and dead trees.
- Predation by feral cats.
- Predation by the European Red Fox.
- Competition and grazing by the feral European Rabbit.



The Applicant's proposed rehabilitation and offset strategy would reduce the impact of the proposed clearing of an additional 8.8ha of native vegetation by replacing the areas disturbed and enhancing the habitat value of the vegetation retained. By retaining and spreading cleared vegetation over areas designated for rehabilitation to native vegetation, the impact of dead wood and dead tree removal would be minimised. By reducing the area of cleared agricultural land in the final landform, the Project would also be likely to reduce the existing impact of the feral pest species listed as Key Threatening Processes by reducing their free foraging range over open pastures.

4.6.7.5 Conclusion

On the basis of the investigations undertaken, the proposed modification is:

- unlikely to significantly affect any of the listed threatened species, fauna populations or communities;
- unlikely to augment or significantly contribute to any of the Commonwealth or State listed key threatening processes in the long term;
- unlikely to significantly affect any Ramsar wetland or any CAMBA or JAMBA internationally listed species;
- unlikely to increase the risk or impacts of any Key Threatening Processes listed under the TSC Act and the EPBC Act;
- unlikely to significantly affect any core or potential Koala habitat; and
- consistent with ESD principles with regards to fauna and would not adversely affect the local biodiversity irreversibly.

4.7 CULTURAL HERITAGE

4.7.1 Introduction

Indigenous and non-Indigenous heritage investigations of the proposed modification have been completed by Archaeological Surveys and Reports Pty Ltd (ASR, 2009a & 2009b). Complete copies of both reports are included as Part 6 (Indigenous heritage) and Part 7 (non-Indigenous heritage) in the *Specialist Consultant Studies Compendium*.

Both investigations involved a review of relevant literature and field work to assess the features of the existing environment and the potential for the proposed modification to impact upon the existing environment. Where practicable, operational safeguards and/or mitigation measures have been recommended and adopted to remove, reduce or compensate for the potential impact(s).

Both heritage assessments build upon a previous cultural heritage assessment completed by ASR to accompany the original development application and EIS for the Werris Creek Coal Mine. Where relevant, reference is drawn to the consultation, fieldwork or assessment of ASR (2004).



4.7.2 Indigenous Heritage

4.7.2.1 Study Area and Methodology

The area considered as part of the Indigenous heritage assessment has been restricted to those areas of the mine site that would be modified from the approved mining operations of DA 172-7-2004. Notably, this area was included as part of ASR (2004), which included pedestrian survey of the subject area by Mr John Appleton (ASR), accompanied by Messrs Peter Allan and Shane Allan, Sites Officers of the Nungaroo Local Aboriginal Land Council (LALC).

As the area to be disturbed by the proposed modification was included in the survey of ASR (2004), no further field survey has been completed as part of ASR (2009a).

4.7.2.2 Consultation

As reliance has been placed on the field survey conducted as part of the ASR (2004) investigation, at which time the Aboriginal community was consulted, no further consultation was undertaken.

4.7.2.3 Archaeological Context

Prior to the field survey undertaken for ASR (2004), a search was made on the Aboriginal Heritage Information Management System (AHIMS) Aboriginal Sites Register for all sites within a 10km by 10km square centred on the mine site, defined by Eastings: 270000-280000, Northings 6519000-6529000. The result of the search showed that three sites had been recorded within this area, of which only one occurred in close proximity to the mine site.

Prior to the completion of the field survey as part of ASR (2004), a predictive model for the type of sites likely to be found was developed. This predictive model for site distribution, which is reproduced in ASR (2009a), concluded the following.

- Isolated artefacts may be present and visible in erosion features.
- Low-density artefact scatters may be present and visible in erosion features, but it is unlikely that any debitage will be visible.
- There is a potential for trees more than 150 years old to exhibit scarred surfaces.
- There is a potential for any trees more than 150 years old to exhibit carved surfaces.
- There may be engravings, and/or grinding grooves wherever there is outcropping sandstone.
- There will be no shelters and therefore no art sites.
- There will be no shelters and therefore no intact occupation deposits.



- There will be no stone quarries.
- There will be no shell middens.
- There will be no visible evidence of burials.
- There will be no surviving Bora rings.
- There will be no surviving stone arrangements.
- There are no known cultural associations with the area.

One Indigenous site was identified during the field survey of ASR (2004). Based on the location of this site of 25 grinding grooves, it was concluded by ASR (2004) that this was likely to be the site referred to on the AHIMS register (which was plotted on a 1:250 000 map in 1964). As noted in Section 1.6.8.2, this site was relocated on 30 March 2007 (in consultation with the local Aboriginal community). The “Narrawolga Archaeological Site” area has been fenced off and is protected from degradation, decomposition or fracturing through placement on crusher dust.

Importantly, the comprehensive field survey of the mine site (ASR, 2004) did not identify any Indigenous sites or artefacts within the areas of additional disturbance associated with the proposed modification.

4.7.2.4 Constraint(s)

Given no sites or artefacts of Indigenous heritage significance have been identified, there are currently no constraints on the proposed modification related to Indigenous heritage. It is noted, however, that should a site or artefact be identified in the future, consultation with the Aboriginal community and the DECC would be required which may result in some constraints being placed over the subsequent development of the mine.

4.7.2.5 Operational Safeguards and Controls

Operational safeguards and controls that would continue to be implemented by the Applicant include the following.

- i) Known Indigenous heritage will be managed in accordance with the approved Cultural Heritage Management Plan, which will be regularly reviewed and updated as necessary.
- ii) If any further Aboriginal objects are uncovered at any time during the course of the proposed modification, work at the area would cease and Applicant must contact the NSW DECC for advice.
- iii) The Applicant already includes a Cultural Heritage Awareness component as part of the site induction process. This is to help raise awareness and ameliorate any impact on heritage sites during site establishment and subsequent mining activities. This includes making all staff and contractors aware of their responsibilities with respect to Aboriginal heritage under the *National Parks and Wildlife Act 1974*.



4.7.2.6 Assessment of Impacts

Given no sites or artefacts of Indigenous heritage significance would be affected, the impact of the proposed modification is assessed to be nil.

4.7.3 Non-Indigenous Heritage

4.7.3.1 Background, Study Area and Methodology

In August 2004, ASR undertook an archaeological investigation of the site of the then proposed Werris Creek Coal Mine. At that time, the focus of ASR (2004) was the assessment of sites of Indigenous cultural significance. During that investigation, however, coal loading chutes and other structural features of the abandoned Werris Creek Colliery were observed to the north of the then proposed area of open cut mining.

The proposed modification includes additional disturbance to the northeast of the approved open cut, extending towards the identified structures of the abandoned Werris Creek Colliery and as a consequence, a more detailed assessment of non-Indigenous heritage was undertaken (ASR, 2009).

The study area for the current investigation is restricted to the area of additional disturbance associated with the proposed modification and the area to the immediate north. An inspection of the study area was undertaken by Mr John Appleton (ASR) in December 2008 to document any relics or remnant structures of the abandoned Werris Creek Colliery that may be affected by the proposed modification.

4.7.3.2 The Archaeological Record (History of the Werris Creek Colliery)

ASR (2009b) notes that there is very little information has been recorded of the operations of the abandoned Werris Creek Colliery, which according to Pratt (1996) was commenced in 1925 by the Preston Coal Company and continued until 1963 when a cancellation of railway contracts for coal led to the closure of the colliery. There is very little further documented of the Werris Creek Colliery, which ASR (2009b) considers unfortunate given as many as three generations might have worked in the Werris Creek Colliery in its 38 years of operation.

4.7.3.3 Results of the Field Inspection

No sites or relics of heritage interest were identified on the surface of the areas to be disturbed as part of the modified project by ASR (2009b). It is worthy of note that the abandoned underground mine extend into the modified open cut area, however, as these are currently inundated with groundwater there is unlikely to be anything of heritage significance within these.



4.7.3.4 Impact Assessment

As described above, there were no structures or relics of heritage interest, or potential heritage significance above ground in the study area. However, there are abandoned underground workings of the former Werris Creek Colliery that intrude into the study area and which would be impacted upon by the proposed modification. While it could be argued that the workings were part of the mine complex and therefore should be assessed as a whole, in this instance it is reasonable to assume that truncating the workings of the modified open cut area would not significantly impact on the heritage significance of any surface “pit top” remains there might be beyond the study area. It is therefore only the heritage significance of the workings that ASR (2009b) considered.

The significance of the abandoned underground workings have been assessed by ASR (2009b) against the criteria for assessing heritage significance, issued by the NSW Heritage Office in 2001.

Criterion (a) – *an item is important in the course, or pattern, of NSW’s cultural or natural history (or the cultural or natural history of the local area).*

The workings do not meet this criterion. From the limited historical record and history of Werris Creek, there is no evidence that the Werris Creek Colliery was a significant commercial enterprise in the local economy, nor was it important in the development of the town, which depended on the railway and grain production for its existence.

Criterion (b) – *an item has a strong or special association with the life or works of a person, or group of persons, of importance in NSW’s cultural or natural history (or the cultural or natural history of the local area).*

The workings do not meet this criterion. There is no evidence that the workings had a strong association with the life or works of a person, or group of persons of importance.

Criterion (c) – *an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area).*

The workings do not meet this criterion. There is no evidence to show that there was either creative or technical achievement in the way the workings were developed.

Criterion (d) – *an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons.*

The workings do not meet this criterion.

Criterion (e) – *an item has potential to yield information that will contribute to an understanding of NSW’s cultural or natural history (or the cultural or natural history of the local area).*

The workings do not meet this criterion.

Criterion (f) – *an item possesses uncommon, rare or endangered aspects of NSW’s cultural or natural history (or the cultural or natural history of the local area).*

The workings do not meet this criterion.



Criterion (g) – *an item is important in demonstrating the principal characteristics of a class of NSW's:*

- *Cultural or natural places; or cultural or natural environments.*
- *(or a class of the local area's: cultural or natural places; or cultural or natural environments).*

The workings do not meet this criterion.

4.7.3.5 Conclusion

Based on the assessment against the NSW Heritage Office (2001) criteria, ASR (2009b) concludes that the underground workings of the former Werris Creek Colliery are of no heritage significance.

4.8 VISUAL AMENITY

4.8.1 Introduction

This sub-section outlines the existing visual amenity of the proposed modified operations on the mine site to surrounding landholders, residents of Werris Creek and the local area, and to motorists travelling along the Werris Creek – Quirindi Road. The proposed visual controls to be implemented as part of the proposed modification are presented and an assessment of the likely impact to the visual amenity provided.

4.8.2 Existing Visual Amenity

4.8.2.1 North and West of the Open Cut Mine

The current operations of the Werris Creek Coal Mine are situated to the south of a small ridge which rises to an elevation of 445m AHD. This ridge provides natural topographic shielding of the current operations to the properties to the north and the township of Werris Creek. The only visible aspect of the Werris Creek Coal Mine from some of these vantage points is the Coal Product Stockpile Area and Rail Load-out Facility.

The only residential vantage point to the west of the mine site is from the “Escott” residence which is now under contract for purchase by the Applicant. The mine site ridge also obscures the mining area from this vantage point, although the Coal Product Stockpile Area, Rail Load-out Facility and rail load-out road are visible.

Plates 4.1 to 4.4 present the visual amenity from several vantage points to the north of the mine looking southward (towards the Werris Creek Coal Mine). The plates illustrate that the exiting Werris Creek Coal Mine operations have minimal impact on visual amenity, with the outlook remaining one of agricultural land and remnant patches of native vegetation.





Plate 4.1 : View towards the mine site from 43 Kurrara Street (corner of Kurrara Street and Punyarra Street) (Ref: E623/007)

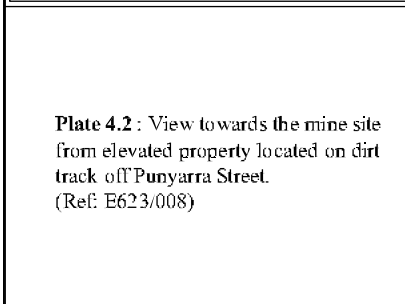


Plate 4.2 : View towards the mine site from elevated property located on dirt track off Punyarra Street. (Ref: E623/008)



Plate 4.3 : View towards the mine site from 26 Kurrara Street. (Ref: E623/023)



Plate 4.4 : View towards the mine site from "Escott" property (Ref: E623/027)



4.8.2.2 South and East of the Open Cut Mine

From vantage points to the south of the Werris Creek Coal Mine, the approved operations have altered the local visual amenity. The most obvious feature of the current operations is the overburden emplacement which rises up to 40m above the natural ground level. Anecdotal evidence provided by residents of Werris Creek suggest that the rehabilitation completed on the outer batters of the overburden emplacement has markedly reduced the visual impact of the structure, with the grassed slopes blending visually (especially when viewed from a distance) with the grassed area in the fore and background. This view of the overburden emplacement is also highly visible to traffic on the Werris Creek – Quirindi Road.

The current operations of the Werris Creek Coal Mine have altered the visual amenity from vantage points to the south and east of the mine site (although those properties to the east of the mine site, which have direct views of the overburden emplacement, are owned by the Applicant). The visual outlook of agricultural land and remnant patches of native vegetation has been replaced by the overburden emplacement which is gradually becoming less noticeable as the slopes are revegetated.

4.8.3 Constraint(s)

The proposed modification would not result in any change to the visual amenity currently available from vantage points surrounding the mine site. However, the scale of the visual impact may change, especially from vantage points to the south and on the Werris Creek – Quirindi Road, with the overburden emplacement to be increased in height to accommodate the increased production of overburden from the modified open cut. Without mitigation, this modification to the overburden emplacement may make it much more visible from local vantage points and therefore may pose some constraint on the development of the proposed modification

4.8.4 Operational Safeguards and Controls

The principal visual control at the Werris Creek Coal Mine involves the strategic placement of overburden material. In keeping with the original proposal, the modified overburden emplacement would create a visual barrier between vantage points to the south and east (notably the Werris Creek – Quirindi Road) and the workings of the open cut itself. The original design of the overburden emplacement was decided upon such that the final landform would appear as a continuation of the existing north-south oriented ridge located centrally within the mine site. The modified overburden emplacement continues this design theme, creating a horseshoe type hill shape around the open cut void. The most notable modification to the design and construction of the overburden emplacement would be the increased height of the landform (which would now reach a final height of approximately 435m AHD). Considering the design of the approved and modified overburden emplacement, only the Applicant-owned residences on the “Railway View” and “Hillview” properties would have views into parts of the open cut.



The increasing height of the overburden emplacement would be mitigated by the progressive rehabilitation program of the Applicant. That is, the overburden emplacement would be raised in 10m “lifts”, with each lift topsoiled and seeded with a cover crop following completion to convert the earth structure to a more natural grass covered slope.

The second rail load-out bin would be constructed with a similar green shade as the existing bin which is barely perceptible from vantage points surrounding the Coal Product Storage Area and Rail Load-out Facility. In fact, the existing bin is less noticeable from most vantage points than the processing equipment of the adjacent Zeolite processing facility. The Applicant would provide for additional planting of vegetation along the southern boundary of the “Tonsley Park” property to complete the visual screen for this property.

Consideration has been given by the Applicant to night-time light emissions which may affect surrounding residents and/or the Siding Spring Observatory near Coonabarabran. The proposed modification would not require any additional lighting plants to the maximum of seven which are already used for night-time activities. As is the current practice, floodlights would be positioned and directed to minimise emissions, with lighting not required at any given time would not be used. Where the use of floodlights is required in the open cut, on the overburden emplacements or within the coal handling and processing area, they would be directed downwards and towards the west.

Other more general safeguards and controls that would continue to be implemented by the Applicant include:

- minimising the extent of land disturbance/clearing in advance of mining;
- undertake progressive rehabilitation of all disturbed areas of the mine site using a combination of pasture species and tree plantings;
- implementation of air quality controls as identified in Section 4.5.4; and
- maintaining the mine and associated areas of disturbance in a clean and tidy condition at all times.

4.8.5 Assessment of Impacts

As illustrated by **Plates 4.1 to 4.4**, the mine site lies within a rural landscape where areas of land are disturbed seasonally for agriculture-related purposes. This landscape has been impacted by the current operations of the Werris Creek Coal Mine, especially from vantage points to the south and east of the mine site. The Applicant has demonstrated a commitment to minimising these visual impacts, firstly through the design of the overburden emplacement, which provides a visual barrier from most vantage points to the open cut mining operations and secondly through the progressive rehabilitation of the overburden emplacement. By March 2009, the eastern, and part of the southern face of the overburden emplacement had been profiled, covered with soil and revegetated with a cover crop of grasses with evidence of tubestock establishment and growth was also observed. These design and operational mitigation measures would be continued as part of the proposed modification, thereby continuing to limit the visual impact of the Werris Creek Coal Mine from local vantage points.



As noted in Section 4.8.3, the primary change to the current visual amenity would be the increased height of the overburden emplacement. When considering the potential impact of this increase in height, the following has been considered.

- The overburden emplacement would not become visible from any new residential vantage points. That is, while the increased height of the overburden emplacement may make it more evident to those residences to the south and east of the mine site which currently have views of the overburden emplacement, it would not become visible to any further residential receivers.
- The non-Applicant owned residences from which the overburden emplacement is visible are in excess of 2km from the toe of the emplacement. At this distance, and assuming progressive rehabilitation is completed, the vegetated slopes of the structure would tend to blend with the grassed agricultural lands in the fore- and background.
- The Applicant has proved successful in progressively rehabilitating the outer slopes of the overburden emplacement, and has committed to continuing the practice whereby sections of the overburden emplacement are covered with topsoil and seeded with a cover crop as soon as practicable after completion. The Applicant employs a full-time Environmental Officer, one of whose primary roles is ensuring that the rehabilitation schedules of the Applicant are met.

Therefore, given the Applicant's continued commitment to minimising the extent of surface disturbance in advance of mining, to implementing progressive rehabilitation, reducing dust emissions, and maintaining the mine site in a clean and tidy state, it is assessed that the increase in height of the overburden emplacement would not result in any unacceptable change to the current visual amenity.

With respect to other aspects of the proposed modification, the following assessment is made.

- Given the mine site is located approximately 130km from the Siding Spring Observatory, and night time lighting would not be increased as part of the proposed modification, ie. limited to a maximum of seven lighting plant/s, the impact on the viewing conditions of the observatory would be negligible and almost certainly immeasurable.
- The second rail load-out bin would be largely imperceptible given the proposed colour of the bin and its location within the existing rail load-out complex adjacent to the Zeolite processing facility. Impacts on the visual amenity of the nearest residence, "Tonsley Park", would be further mitigated by the proposal to complete the tree screen which is located along most of the southern boundary of the property.

It is concluded that the impact of the proposed modification on local visual amenity would be acceptable and largely mitigated by the proposed design and operational controls.



4.9 SOILS AND LAND CAPABILITY

4.9.1 Introduction

An understanding of the soils, land capability and agricultural suitability of the land to be affected by the proposed modification has been drawn from a detailed soils and land capability / agricultural suitability assessment of the Werris Creek Coal Mine conducted by Geoff Cunningham Natural Resource Consultants Pty Ltd in April 2004 (GCNRC, 2004b). The assessment included a review of published land capability and soil maps, stereoscopic aerial photo interpretation, field assessment and sampling, and laboratory analyses of soils over the majority of the mine site.

4.9.2 Regional Setting

The mine site is located within the area covered by the (former) Department of Infrastructure, Planning and Natural Resources (DIPNR) Soil Landscapes Mapping Program for the Tamworth 1:100 000 map sheet area. Based upon this mapping, three soil landscapes occur over the mine site (see **Figure 4.15**).

- i) The Escott Soil Landscape – in areas to the southwest, west and northwest of the north-south oriented ridge within the mine site.
- ii) The Siphon Soil Landscape – to the east and southeast of the north-south oriented ridge within the mine site.
- iii) The Narrawolga Soil Landscape – on the elevated land of the north-south oriented ridge within the mine site.

The 1:100 000 scale Tamworth Land Capability map sheet shows the mine site as incorporating Class IV land in the central ridge area, with the remainder being Class III.

No regional data on agricultural suitability was available for those areas of the mine site to be affected by the proposed modification. It is noted, however, that the DPI-Agriculture assessment of agricultural suitability within the former parry Shire classifies the area north of Escott Road as Class 3 land.

4.9.3 Mine Site Soils and Land Capability

4.9.3.1 Soils

GCNRC (2004b) assessed soil samples taken from 24 test pits within the mine site to assist in determining the boundaries of the soil types and assess the chemical and physical characteristics of the soils. With the exception of a small area within the approved open cut limit where the original soil had been removed and replaced with soil from another location, the soils of the mine site correspond to the soil landscapes described in Section 4.9.2 and identified on **Figure 4.15**. Small areas of all three soil units would be disturbed by the proposed modification and **Table 4.37** provides a description of each soil unit and the location of disturbance.



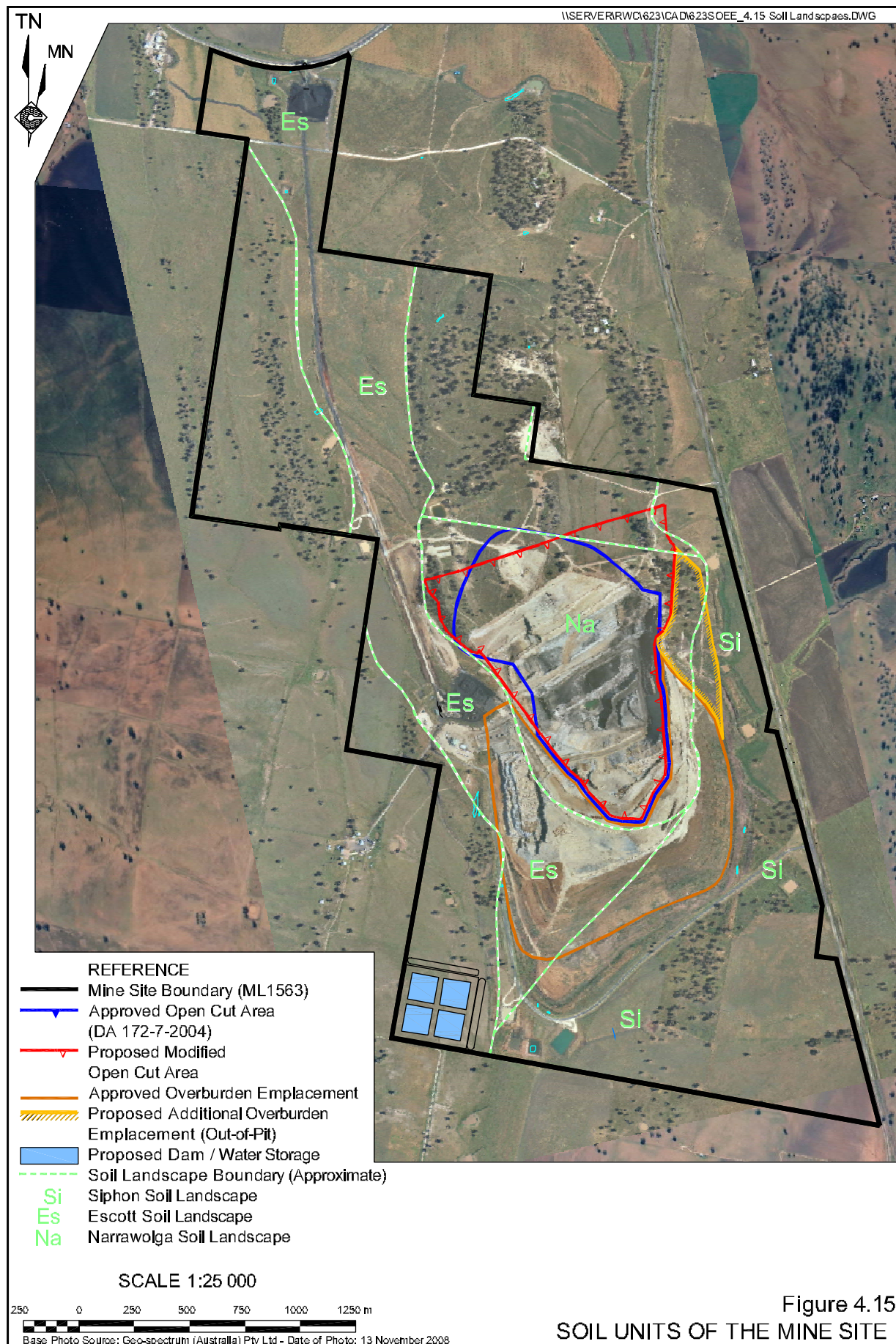


Figure 4.15
 SOIL UNITS OF THE MINE SITE



Table 4.37
Soil Units to be Disturbed by the Proposed Modification within the Mine Site

Soil Unit*	Area of Disturbance	General	Topsoil	Subsoil
Escott	Underground Water Storage Area (13.4ha)	<i>Soil depth:</i> 42 to 245cm. <i>Surface:</i> Usually self mulching and cracked, sometimes hard setting <i>Stones:</i> Present to varying degrees <i>Overlies:</i> Weathered rock or a continuation of the profile	<i>Horizons:</i> Single A horizon. <i>Texture:</i> Light, medium or heavy clay or sandy clay. <i>pH:</i> 6.0 – 8.5 <i>Colour:</i> Brown, reddish brown & reddish grey	<i>Horizons:</i> Two or three B horizons <i>Texture:</i> Clayey <i>pH:</i> 6.5 – 9.0 <i>Colour:</i> shades of grey, brown, yellow and red
The Siphon	Extension of the Overburden Emplacement as well as small area of the modified open cut (4.7ha)	<i>Soil depth:</i> 250+cm. <i>Surface:</i> Usually self mulching, loose or firm <i>Stones:</i> Absent or some present in both topsoil and subsoil <i>Overlies:</i> A continuation of the profile	<i>Horizons:</i> Single A horizon. <i>Texture:</i> Light, medium or heavy clay. <i>pH:</i> 6.0 – 8.0 <i>Colour:</i> brown, reddish brown, grey and reddish grey	<i>Horizons:</i> Three or four B horizons <i>Texture:</i> Light, medium or heavy clay. <i>pH:</i> 8.5 - 10.0 <i>Colour:</i> shades of grey, brown and red
Narrawolga	Predominantly within the modified open cut, as well as a small area of the modified overburden emplacement (21.1ha)	<i>Soil depth:</i> 56 to 250cm. <i>Surface:</i> loose or soft, sometimes firm to hard setting <i>Stones:</i> Surface stone absent or some present <i>Overlies:</i> A continuation of the profile or bedrock	<i>Horizons:</i> One or two A horizons <i>Texture:</i> loam fine sandy, sandy clay loam to clay loam <i>pH:</i> 5.5 – 7.0 <i>Colour:</i> brown to greyish brown or pale brown or pink	<i>Horizons:</i> Three B horizons <i>Texture:</i> light, medium or heavy clay textured <i>pH:</i> 6.0 - 10.0 <i>Colour:</i> shades of grey, brown yellow red and pink
Source: Modified after GCNRC (2004b) – Section 5			*See Figure 4.16	

Generally, the soils of the Escott and The Siphon soil units occur on the flatter areas, are deeper and have been identified as more suitable to agriculture. The Narrawolga soil unit appears less conducive to agriculture and as a result retains a greater proportion of uncleared or only partially cleared native vegetation.

None of the soils are saline or sodic and GCNRC (2004b) observed that in their current state, they are generally stable due to past soil erosion prevention works such as contour banks, dams and waterways. Soil data collected from representative samples of each soil unit was analysed using the SOILOSS computer program to determine erosion hazard. The program indicated that the Escott soil unit displays low erodibility, The Siphon soil unit displays low to moderate erodibility and the Narrawolga soil unit displays moderate erodibility.

4.9.3.2 Land Capability

GCNRC (2004b) identified that the land capability of the mine site largely corresponded to the soil units as follows.

- Escott = Class III.
- The Siphon = Class III.
- Narrawolga = Class V.



Table 4.38 presents relevant land capability class descriptions drawn from Houghton and Charman (1986).

Table 4.38
Land Capability Class Descriptions

Land Capability Class	Description
Class III	<i>"Land suitable for regular cultivation provided soil conservation works and adequate crop rotations are used".</i>
Class IV	<i>"Land suitable for grazing with occasional cultivation and requiring soil conservation practices such as stock control, application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture".</i>
Class V	<i>"Land suitable for grazing with occasional cultivation and requiring soil conservation practices such as absorption banks, diversion banks and contour ripping, together with the practices as in Class IV".</i>
Source: GCNRC (2004a) - Section 9	

4.9.4 Constraints

The soil units of Escott and The Siphon represent relatively high quality soils which are ideally suited to agriculture. The proposed modification would slightly increase the area covered by these soil units disturbed by the Werris Creek Coal Mine, thereby slightly reducing the availability of better quality agricultural land in the area. Providing for a return of equivalent areas of the final landform to the higher land capability of the Escott and The Siphon soil units could potentially constrain the development of the proposed modification, especially when the competing requirement for no net loss of biodiversity values is considered.

4.9.5 Soil Management Controls

The Applicant would continue to implement the following soil management controls and procedures, which are based on the recommendations of GCNRC (2004b).

- i) Topsoil would be stripped to a depth of between 15cm to 20cm over the modified areas of the open cut and overburden emplacement and deeper (up to 1m) over the Underground Water Storage Area and when practicable directly transferred onto sections of the final landform.
- ii) When required, topsoil stockpiles would not exceed 2m in height and, where practical, maintained as windrows in preference to larger structures. Any stockpiles likely to be retained for over 3 months would be immediately seeded (seasonal conditions allowing) with non-persistent pasture species to reduce erosion potential and maintain some biological activity within the soil.
- iii) Subsoils would be stripped and when practicable directly transferred onto sections of the final landform.
- iv) When required, subsoil stockpiles would not exceed 3m in height and would typically placed in larger stockpiles than the topsoil.



- v) An inventory of soil resources present on the mine site, both in stockpiles and awaiting stripping, would continue to be maintained and regularly reconciled with rehabilitation requirements.
- vi) Water management structures would be utilised to divert surface water flow away from soil stockpile areas, thus reducing the potential for erosion.

4.9.6 Assessment of Impact

The proposed modification would result in the additional disturbance of approximately 11ha of Class III Land Capability land. It has been the Applicant's objective to maximise the areas of land re-established to this capability of land to enable agricultural cropping to recommence (eventually) on the rehabilitated mine site. Notably, the approved Werris Creek Coal Mine provides for an area of 43ha to the re-establishment of Class III land (on the top of the rehabilitation overburden emplacement) to mitigate against the disturbance to 71ha of Class II land of the pre-mining landform.

The proposed modification to the overburden emplacement would, however, reduce the area of suitable land for the re-establishment of Class III land on the upper surface of the out-of-pit emplacement to 31ha. This reduction in the area to be re-established as Class III land is considered unavoidable given the competing requirement to ensure no net loss of biodiversity values (which has led to significant areas of the final landform being allocated to native vegetation establishment and conservation). It is noted, however, that the Applicant is considering a longer term extension of the Werris Creek Coal Mine to the north (see Section 1.4.3) and should this proceed, the area of re-established Class III land would be increased.

4.10 PLANNING CONSIDERATIONS

4.10.1 Introduction

This section considers the permissibility of the Project and compliance with the relevant State Environmental Planning Policies.

4.10.2 Permissibility

As noted in Section 3.1.1, mining and development for the purposes of mines are permissible within the relevant zones of the Quirindi LEP 1991 and Parry LEP 1987.

4.10.3 State Environmental Planning Policy (SEPP) (Mining, Petroleum Production and Extractive Industries) 2007

The SEPP specifies matters requiring consideration in the assessment of any mining, petroleum production and extractive industry development, as defined in NSW legislation. **Table 4.39** presents a summary of each element requiring consideration and a reference to the section in the *Environmental Assessment* where this is addressed.



Table 4.39

Application of SEPP (Mining, Petroleum Production and Extractive Industries) 2007

Relevant SEPP Clause	Description	EA Section
12: Compatibility with other land uses	Consideration is given to: - the existing uses and approved uses of land in the vicinity of the development; - the potential impact on the preferred land uses (as considered by the consent authority) in the vicinity of the development; and - any ways in which the development may be incompatible with any of those existing, approved or preferred land uses. The respective public benefits of the development and the existing, approved or preferred land uses are evaluated and compared. Measures proposed to avoid or minimise any incompatibility are considered.	3.4.3 4.9.6 4.9.4 & 4.9.6 4.9.6, 5.4 Throughout Section 4
13: Compatibility with mining, petroleum production or extractive industry	Consideration is given to whether the development is likely to have a significant impact on current or future mining, petroleum production or extractive industry and ways in which the development may be incompatible. Measures taken by the applicant to avoid or minimise any incompatibility are considered. The public benefits of the development and any existing or approved mining, petroleum production or extractive industry must be evaluated and compared.	1.4 n/a n/a
14: Natural resource and environmental management	Consideration is given to ensuring that the development is undertaken in an environmentally responsible manner, including conditions to ensure: - impacts on significant water resources, including surface and groundwater resources, are avoided or minimised; - impacts on threatened species and biodiversity are avoided or minimised; and - greenhouse gas emissions are minimised and an assessment of the greenhouse gas emissions (including downstream emissions) of the development is provided.	4.1 & 4.2 4.6 4.5.7
15: Resource recovery	The efficiency of resource recovery, including the reuse or recycling of material and minimisation of the creation of waste, is considered.	Section 2
16: Transportation	The following transport related issues are considered. - The transport of some or all of the materials from the site by means other than public road. - Limitation of the number of truck movements that occur on roads within residential areas or roads near to schools. - The preparation of a code of conduct for the transport of materials on public roads.	2.7 1.5.4.3 & 2.7.2 1.5.4.3
17: Rehabilitation	The rehabilitation of the land affected by the development is considered including: - the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated; - the appropriate management of development generated waste; - remediation of any soil contaminated by the development; and - the steps to be taken to ensure that the state of the land does not jeopardize public safety, while being rehabilitated or at the completion of rehabilitation.	2.11.3, 2.11.4 & 2.11.5 1.5.5, 2.4, 2.5.5 4.9.5 2.11



4.10.4 State Environmental Planning Policy No. 44 (SEPP 44) – Koala Habitat Protection

No sign of Koala habitation was found by either CES (2004) or Ecotone (2009). Therefore, due to the lack of a resident population on the mine site (determined by the absence of breeding females), recent sightings or historical records, the mine site does not form “core Koala habitat”. As the mine site is not core Koala habitat, no further assessment under SEPP 44 is required.

