ENVIRONMENTAL ASSESSMENT

Duralie Extension Project

SECTION 4
ENVIRONMENTAL ASSESSMENT

GLOUCESTER COAL

ResourceStrategies

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4 ENVIRONMENTAL ASSESSMENT

The following sub-sections present the environmental assessment for the Project including: a description of the existing environment (including a description of the existing components of the DCM where relevant); an assessment of the potential impacts of the Project on the environment; and a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the potential impacts of the Project and ongoing management and monitoring measures that would be implemented by DCPL.

The assessment of potential impacts of the Project was conducted in accordance with the EARs (Section 1.2 and Attachment 1), and in consideration of the outcomes of consultation with key stakeholders including the community (Section 3) and the results of the Environmental Risk Assessment (ERA) (Section 4.1 and Appendix M).

DCPL's Statement of Commitments for the Project is provided in Section 7.

4.1 ENVIRONMENTAL RISK ASSESSMENT

In accordance with the EARs for the Project (Attachment 1), an ERA was undertaken to identify key potential environmental issues for further assessment in the EA. The ERA was conducted on 22 October 2009 and was facilitated by a risk assessment specialist (SP Solutions, 2009). The risk assessment team consisted of representatives from:

- DCPL;
- Cenwest Environmental Services;
- Gilbert & Associates;
- Heritage Computing;
- Heggies; and
- Resource Strategies.

The ERA workshop was used to identify key potential environmental issues for further assessment in the EA. The key potential environmental issues identified during the ERA workshop are summarised in Table 4-1 and are addressed in Sections 4.2 to 4.17. Where relevant, the key potential environmental issues are also addressed in the various appendices to the EA.

Risk ranking of loss scenarios in consideration of existing DCM and proposed Project controls was also undertaken as part of the ERA workshop. All of the potential loss scenarios were ranked within the "Medium - As Low as Reasonably Practicable" or "Low" range by the ERA team (Appendix M). The ERA is provided in full as Appendix M.

4.2 LAND RESOURCES AND CLIMATE

A description of existing land resources and key climate parameters is provided in Section 4.2.1. Section 4.2.2 describes the potential impacts of the Project on land resources, and Section 4.2.3 outlines land resources mitigation and management measures as well as ongoing on-site meteorological monitoring.

4.2.1 Existing Environment

A description of land resources including land use, topography, soils and agricultural suitability within the Project area and surrounds is presented below. An overview of the local climate and bushfire regime in the vicinity of the Project is also provided.

Land Use

The Project is located in a rural area characterised by cattle grazing on native and improved pastures. Areas managed for forestry, conservation, poultry farming and other types of agricultural production also occur in the wider area.

GCL's local landholdings outside of ML 1427 (Figures 1-3a and 1-3b) are used for agricultural production (predominantly grazing). The majority of the Project area has been cleared as part of past rural land use practices and logging (Appendix E).

DCPL owns the land within ML 1427 and MLA 1 (Figure 1-3a). The majority of ML 1427 is currently subject to mining development, while the remainder of ML 1427 and MLA 1 is managed for pastoral/agricultural uses.

The DCM and the SCM (which is located approximately 20 km to the north of the DCM) are the main mining developments in the local area. There is also a range of other mining related exploration and development proposals in the greater Gloucester region, however, these are quite remote from the DCM.

Table 4-1
Key Potential Environmental Issues

Environmental Issue Subject Area	Key Potential Environmental Issues	EA Reference
Surface Water	Seepage of poor quality water from final void through waste rock emplacement to Coal Shaft Creek/Mammy Johnsons River	Appendices A and B and Sections 4.3 and 4.4
	Uncontrolled spill from the MWD or auxiliary dams to Mammy Johnsons River during mine life	
	Spill of poor quality water from the final voids	
	Re-mobilised irrigated solutes from irrigation areas reaching Mammy Johnsons River	
	Additional water storage - timing and adequacy	
	Poor quality runoff from waste rock emplacement reaching Mammy Johnsons River	
	Loss of base flow from Mammy Johnsons River	
	Rupture of irrigation pipelines leading to release of mine water to Mammy Johnsons River/Coal Shaft Creek	Appendix L and Section 4.17
Terrestrial Flora and Fauna	Loss of habitat for protected and threatened species	Appendix E and Sections 4.8 and 4.9
	Loss of native vegetation due to clearing associated with the Project	
	Loss of (or displacement) of native vertebrate fauna listed under the NSW *Threatened Species Conservation Act, 1995* (TSC Act)	
Waste Rock	Acid mine drainage (AMD) from PAF material	Appendix I and Section 4.4
Rehabilitation Concepts	Long-term stability of Coal Shaft Creek Diversion	Appendix N and Section 5
	Rehabilitation of the site	
Noise and Blasting	Night-time noise from the DCM shuttle train	Appendix C and Section 4.5
	The extent of the noise impact zone	
	Effects of blasting (vibration and overpressure)	
Air Quality	Dust (particulate matter less than 10 microns in size [PM_{10}]) impact to the north-west receivers	Appendix D and Section 4.6
Visual Amenity	Visual impacts from The Bucketts Way and nearby residential dwellings	Appendix O and Section 4.16

Source: Appendix M.

AGL holds Petroleum Exploration Licence (PEL) No. 285 that extends over an area of approximately 1,600 square kilometres (km^2) and extends from north of Gloucester to the south of Stroud including the general DCM area. AGL is the proponent of the proposed Gloucester Coal Seam Gas Project that would potentially include a range of proposed activities within PEL No. 285 including gas field development, a central processing facility located at Stratford and a pipeline from Stratford to Hexham. At the time of lodgement, the Gloucester Coal Seam Gas Project is being assessed by regulators and is not approved.

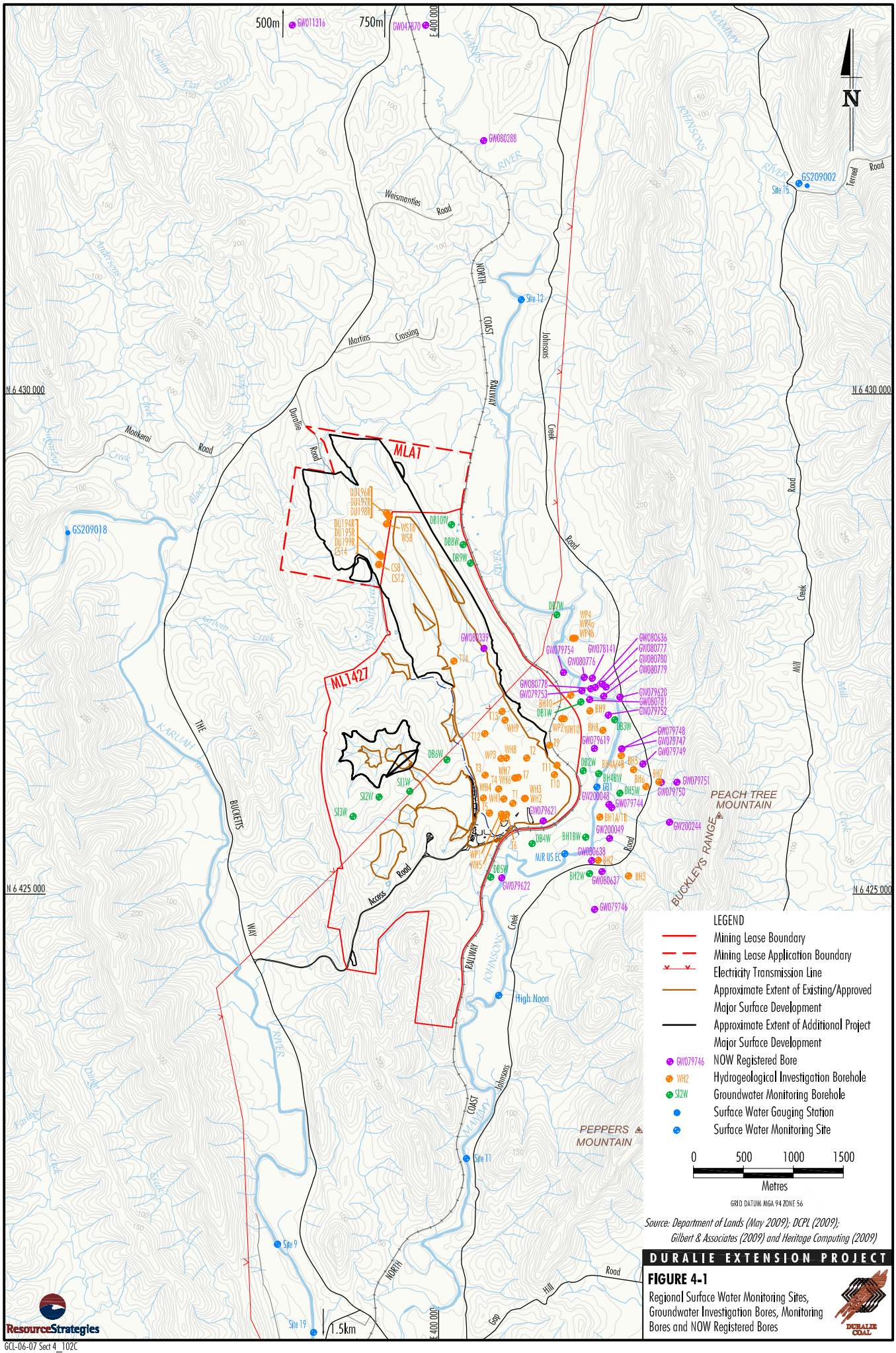
Landforms and Topography

The Project is situated in the Gloucester Valley which is bounded by Buckley's Range to the east and the Linger and Die Ridge to the west. The Mammy Johnsons River is located immediately to the east of the Project (Figure 4-1).

The existing DCM is situated mostly within the Coal Shaft Creek valley, which is a tributary of the Mammy Johnsons River.

There is significant topographic relief in the Project area, with elevations ranging from approximately RL 50 m along the river flats of the Mammy Johnsons River to approximately RL 150 m on the ridgelines to the west of ML 1427 (Figure 4-1). Within MLA 1, elevations range from approximately RL 70 m to RL 170 m and the topography is steeper in the west along a north-west to south-east oriented ridgeline, and more gently sloping in the north-east of MLA 1 (Figure 4-1).

The top of Tombstone Hill, a prominent hill which lies between the Weismantel open pit and the Mammy Johnsons River, is approximately RL 130 m.



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The development of the existing DCM has altered the pre-mining topography within the mining area, with the open pit and waste rock emplacement (up to RL 110 m) and water management structures being the primary alterations (Figure 2-1).

Soils

Soil landscapes in the vicinity of the Project have been broadly mapped by the Soil Conservation Service of NSW as described in the document *Soil Landscapes of the Dungog 1:100,000 Sheet* (Henderson, 2000). Four key soil landscapes have been mapped in the Project area, namely Wards River, Stroud Road, Gloucester Buckets and Gloucester River (landscape variant) soil landscapes.

Erosional soil landscapes cover the majority of the Project area, with the Wards River soil landscape occurring in the eastern portion of the area and the Stroud Road soil landscape occurring in the west. The Gloucester Buckets soil landscape occurs on the top of ridgelines in the southern portion of ML 1427 and in the north-west portion of MLA 1.

The Gloucester River soil landscape (alluvial) was also mapped in the valley of the original alignment of lower Coal Shaft Creek. However, this soil landscape has been largely removed by the existing DCM and is not present in the Project extension areas.

Table 4-2 summarises the key characteristics of the soil landscapes within the Project area, as well as the dominant soil materials within each soil landscape and where they are generally found within the soil profile.

A soil sampling programme was conducted by Veness & Associates (1996) for the existing DCM. Within the DCM disturbance areas Veness & Associates (1996) identified the following five soil mapping units based on geological formations:

- alluvial soils (restricted to lower Coal Shaft Creek – now removed);
- fine grained sandstone (lower) and coarse and medium grained sandstone with minor conglomerate (associated with the Dewrang Group);

Table 4-2
Soil Landscapes of the Existing DCM and Project Area

Soil Landscape	Characteristics	Dominant Soil Materials
Erosional Landscapes		
Stroud Road	• Rolling to undulating low hills on Permian Alum Mountain Volcanics. • Low limitation for grazing, moderate limitations for cultivation, with localised high limitations. • Limitations include high engineering hazard, gully erosion risk, mass movement hazard, steep slopes, seasonal waterlogging and sheet erosion risk.	• Brown crumbly clay loam (topsoil). • Brownish black polyhedral clay (topsoil). • Brownish black weak crumb ped loam (topsoil). • Gravelly brown earthy loam (subsoil). • Brown plastic sticky clay (subsoil). • Reddish brown polyhedral clay (subsoil). • Gravelly mottled pale clay (deep subsoil).
Wards River	• Rolling low hills on sediments of the Gloucester Coal Measures. • Generally moderate limitations for grazing and high limitations for cultivation. • Limitations include high gully erosion risk, high sheet erosion risk, rock outcrop, high run-on and seasonal waterlogging and steep slopes.	• Brownish black earthy loam (topsoil). • Brown hardsetting, bleached loam (topsoil). • Brown prismatic clay (subsoil). • Yellow prismatic clay (subsoil).
Colluvial Landscapes		
Gloucester Buckets	• Rolling to very steep hills on Permian basic and acidic volcanics and sediments. • Generally extreme limitations for cultivation and high limitations for grazing. • Limitations include steep slopes, mass movement hazard, rockfall hazard, high sheet erosion risk and rock outcrops.	• Dark weakly structured loam (topsoil). • Dark friable clay loam (topsoil). • Bleached earthy loam (topsoil). • Gravelly brown earthy loam (subsoil).

Source: After Henderson (2000).

- conglomerate with minor interbedded basalt and welded tuff, thin coals (associated with the Alum Mountain Volcanics);
- basalt intermediate and acid lavas and pyroclastics (associated with the Alum Mountain Volcanics); and
- undifferentiated Carboniferous sediments.

The geology of the Project area is shown on Figure 2-2. The same geological formations present in the existing/approved DCM development area also extend into the new areas to be disturbed by the Project.

Agricultural and Rural Suitability

The two methods currently used to evaluate the quality of rural land in NSW are agricultural land classification and rural land capability (NSW Agriculture, 2002). Agricultural land classification is a five class system that classifies the suitability of land by evaluating biophysical, social and economic factors that may constrain the use of land for agriculture (NSW Agriculture, 2002). Rural land capability is an eight class system based on assessment of biophysical characteristics categorising land in terms of general limitations such as erosion hazard, climate, and slope (Emery, 1985).

Regional agricultural land classification mapping (DII, 2009) and regional rural land capability mapping (DECCW, 2009a) were used to generally evaluate the values of rural lands within the Project area.

The agricultural land classification mapping classifies the majority of lower slopes of the Project area as Class 3 land, and the upper slopes as Class 4 (DII, 2009). The land in the far south of ML 1427 (outside of Project additional irrigation areas) is classified as Class 5 agricultural suitability.

Class 3 agricultural suitability is defined (NSW Agriculture, 2002) as:

> *Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with sown pasture. The overall production level is moderate because of edaphic or environmental constraints. Erosion hazard, soil structural breakdown or other factors, including climate, may limit the capacity for cultivation and soil conservation or drainage works may be required.*

Class 4 agricultural suitability is defined (NSW Agriculture, 2002) as:

> *Land suitable for grazing but not for cultivation. Agriculture is based on native pastures or improved pastures established using minimum tillage techniques. Production may be seasonally high by the overall production level is low as a result of major environmental constraints.*

Class 5 agricultural suitability is defined as (NSW Agriculture, 2002) as:

> *Land unsuitable for agriculture, or at best suited to only light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors which prevent land improvement.*

The majority of land within the existing DCM and Project area is classified as Class IV using the rural land capability classification (after DECCW, 2009a).

Class IV rural capability is defined as land not capable of being regularly cultivated but suitable for grazing with occasional cultivation, with soil conservation practices such as pasture improvement, stock control, application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture (Cunningham *et al*., 1988).

The steeper slopes on Tombstone Hill and in the south and west of ML 1427 and MLA 1 are mapped as Class VI rural capability.

Class VI rural capability is defined as land not capable of being cultivated but suitable for grazing, with soil conservation practices including limitation of stock, broadcasting of seed and fertiliser, prevention of fire and destruction of vermin. This class may require some structural works (Cunningham *et al*., 1988).

The top of the ridgelines in the far south of ML 1427 and in the far west of MLA 1 are classified as Class VII rural capability, which is land best protected by green timber (Cunningham *et al*., 1988).

Meteorology

Regional and local meteorological data is available from the on-site weather station at the DCM and Commonwealth Bureau of Meteorology (BoM) weather stations.

The DCM weather station is operated in accordance with the Development Consent and EPL 11701 and monitors rainfall, temperature, evaporation and wind speed and direction. In accordance with recent changes to the DCM Development Consent, the weather station is currently being upgraded to also calculate sigma theta. Rainfall data is also available from the Stroud Post Office, Wards River (Moana) and Monkerai Upper (Redleaf) rainfall gauges in close proximity to the Project area. Regional temperature, evaporation and relative humidity records are available from the Paterson (Tocal) station. Details of relevant meteorological stations are provided in Table 4-3. Meteorological data collected from these sources is summarised in Table 4-4 and discussed below.

SCPL also maintains a weather station at the SCM, some 20 km to the north of the DCM. Review of data indicates general agreement between the two mine weather stations (Appendix D).

Rainfall

The Project area generally experiences a temperate climate (Appendix A). The average annual rainfall at nearby stations varies from approximately 1,054 millimetres (mm) at the DCM weather station to 1,287 mm at Monkerai Upper (Redleaf) (Table 4-4). Rainfall records show an east-west variation in mean annual rainfall associated with topographic elevation but little north-south variation (Appendix A).

Generally the rainfall records indicate moderate seasonality, with higher rainfall being recorded in late summer and autumn and lower rainfall in the winter and spring (Table 4-4).

Temperature

The data presented in Table 4-4 indicates that temperatures are warmest from November to March and coolest in the winter months of June, July and August. Average daily maximum temperatures are highest in January (29.6 degrees Celsius [°C]) and average daily minimum temperatures are lowest in July (6.1°C) at Paterson (Tocal) (Table 4-4). DCM temperature records from 2003 onwards indicate that in the summer months maximum temperatures range from 20 to 44^{o}C, while during winter months temperatures can fall as low as -3^{o}C (DCPL, 2009a).

Relative Humidity

Relative humidity records exhibit a relatively uniform seasonal pattern (Table 4-4). The lowest morning (9.00 am) average monthly relative humidity is recorded in October (63 percent [%]) and the highest recorded in February, March and May (80%) (Table 4-4). The lowest afternoon (3.00 pm) average monthly relative humidity is recorded in August and September (46%) and the highest recorded in June (59%) (Table 4-4).

Evaporation

Evaporation records are available from the Paterson (Tocal) station and the DCM weather station recording an annual average evaporation of 1,574 mm and 1,507 mm, respectively (Table 4-4). Evaporation is highest during spring and summer months with evaporation exceeding rainfall during these months (Table 4-4). The highest monthly average evaporation is in December (210.8 mm and 192.5 mm for Paterson [Tocal] and the DCM weather station, respectively) and the lowest monthly average evaporation is in June (66.0 mm and 59.7 mm for Paterson [Tocal] and the DCM weather station, respectively) (Table 4-4).

Table 4-3
Meteorological Station Locations and Recording Periods

Station Name	Station Number	Approximate Distance and Direction from DCM	Easting (m) (MGA)	Northing (m) (MGA)	Elevation (RL m)	Period of Record
DCM Weather Station	-	-	399893	6426520	121	1995 to present
Stroud Post Office	061071	10 km south	403133	6414759	44	1889 to present
Wards River (Moana)	060089	5 km north-east	403916	6431397	15	1968 to 1979
Monkerai Upper (Redleaf)	061045	8 km west	389821	6427927	100	1914 to 1970
Paterson (Tocal)	061250	50 km south-west	403133	6414759	44	1967 to present

Source: BoM (2009).

Table 4-4
Relevant Meteorological Information

Month	Relative Humidity Monthly Average (%)[1]		Average Daily Temperature (°C)[1]		Average Monthly Rainfall (mm)[2]				Average Monthly Evaporation (mm)[2]	
	Paterson (Tocal)		Paterson (Tocal)		Stroud Post Office	Wards River (Moana)	Monkerai Upper (Redleaf)	DCM Station	Paterson (Tocal)	DCM Station
	9.00 am	3.00 pm	Min.	Max.						
January	74	52	17.5	29.6	119.6	182.4	156.0	77.4	192.2	179.7
February	80	56	17.5	28.7	129.7	128.9	150.4	147.6	148.4	146.4
March	80	58	15.6	26.9	153.6	167.9	146.2	117.2	130.2	123.6
April	77	57	12.4	24.2	105.5	61.3	118.1	111.1	99.0	89.9
May	80	58	9.7	20.7	94.0	68.1	79.2	71.9	74.4	73.4
June	78	59	7.5	17.8	104.7	137.8	99.6	84.3	66.0	59.7
July	76	55	6.1	17.3	76.9	31.4	71.6	44.8	77.5	73.6
August	69	46	6.5	19.4	65.8	53.7	70.7	53.1	105.4	102.9
September	64	46	8.9	22.3	63.9	46.3	75.3	80.7	132.0	142.1
October	63	49	11.4	25.0	80.7	81.2	90.2	60.5	161.2	159.5
November	68	50	13.8	26.6	84.6	108.4	92.4	112.8	177.0	163.4
December	69	49	16.2	29.1	105.1	100.8	137.0	92.7	210.8	192.5
Annual Average Monthly	73	53	11.9	24.0	-	-	-	-	-	-
Annual Average Total					1,184	1,168	1,287	1,054	1,574	1,507

[1] Source: BoM (2009).

[2] Source: Appendix A.

Wind Speed and Direction

On an annual basis, the most common winds are from a northerly and north-northwesterly direction with predominantly light to fresh wind speeds (Appendix D). Wind speeds are generally higher in winter months with predominantly westerly to south-westerly winds occurring (Appendix D). During the other months, winds tend to be from a north-west to north-northeasterly direction.

Bushfire Regime

The Project is located within the jurisdiction of the Great Lakes Bush Fire Management Committee. The frequency of fire in the Project area is considered to be relatively low and this may be in part due to the relatively high rainfall and mosaic nature of existing native vegetation. Flora surveys noted no evidence of recent fires in the Project area (Appendix E).

4.2.2 Potential Impacts

Land Use

The use of existing DCM infrastructure for the Project and the implementation of progressive rehabilitation strategies (Section 5) would minimise the area of land to be disturbed at any one time during construction and operation of the Project.

Potential impacts would be primarily restricted to the (largely temporary) loss of existing pastoral/agricultural lands associated with the development of the:

- Project open pits and waste rock emplacements;
- augmented water management system (e.g. increased size of Auxiliary Dam No. 2, additional up-catchment diversion drains and sediment dams); and
- roads, soil stockpiles, laydown areas and other ancillary infrastructure.

Project disturbance areas would be progressively rehabilitated as described in Appendix N and Section 5. The rehabilitation and revegetation of the Project would result in a range of final land use in Project disturbance areas including grazing and woodland habitat. The Project would also lead to permanent restrictions on future land uses in the Project offset area, as use of these lands would be largely restricted to conservation (Section 4.8.3).

Excess site water would continue to be used for beneficial pastoral/agricultural production via controlled irrigation. The Project would involve continued utilisation of the approved DCM irrigation areas (Figure 2-11) as well as the development of new irrigation areas. The potential impacts of irrigation are assessed in Appendix A and summarised in Section 4.4.2 and below.

As described in Section 2.10.2, two existing minor public roads (Cheerup Road and approximately 1 km of Durallie Road) in MLA 1 would be closed as a component of the Project. This would result in the loss of existing public road access for one privately owned lot.

Topography

The main modifications to topography that would result from the Project include:

- removal of existing topographic features within the Weismantel Extension and Clareval North West open pits;
- an extension of the existing waste rock emplacement mine landform to the north-west (maximum height RL 110 m);
- remaining Project final voids in the Clareval North West and Weismantel Extension open pits;
- the increased height of the Auxiliary Dam No. 2 embankment;
- development of the final Coal Shaft Creek alignment; and
- other minor landform alterations associated with construction of roads, water management and erosion and sediment control features.

Potential visual impacts associated with the major Project topographical alterations are assessed in Appendix O and summarised in Section 4.16. The final waste rock emplacement landform would be rehabilitated as described in Section 5.

Soils and Erosion Potential

As described in Section 4.2.1, a number of the soil landscapes within the Project area are susceptible to erosion (i.e. Wards River, Stroud Road and Gloucester Buckets soil landscapes).

Potential impacts of the Project on soils would relate primarily to:

- disturbance of *in-situ* soil resources within additional disturbance areas (e.g. the Weismantel Extension open pit, Clareval North West open pit and the additional inundation area of the raised Auxiliary Dam No. 2 and associated ancillary structures);
- alteration of soil structure beneath infrastructure items, hardstand areas and roads;
- possible soil contamination resulting from spillage of fuels, lubricants and other chemicals;
- increased erosion and sediment movement due to exposure of soils during construction of mine infrastructure; and
- alteration of physical and chemical soil properties (e.g. structure, fertility, permeability and microbial activity) due to Project irrigation and soil stripping and stockpiling operations.

An assessment of the potential salinity implications of irrigation of mine water was undertaken by Agricultural Water Management (2009) (Attachment AB of Appendix A). Agricultural Water Management (2009) concluded there was no evidence that irrigation with water from the MWD would significantly affect soil properties and their suitability for future agricultural use. Accordingly water from the MWD is considered suitable for irrigation in accordance with the approved IMP.

Agricultural and Rural Suitability

The potential impacts of the Project on water resources are described in Sections 4.3 and 4.4 and the potential impacts on land use, soils and erosion potential and land contamination potential are described in the sub-sections above and below.

The Project would result in the temporary loss of primarily grazing lands (associated with the development of the Clareval North West open pit and Weismantel Extension open pit and associated infrastructure). Pastoral land uses within the proposed Project offset area would also be restricted in the long-term as this land would be reserved for conservation.

The Project disturbance areas would be progressively rehabilitated and revegetated to include a combination of final land uses including grazing and woodland habitat (Section 5).

Land Contamination Potential

Potential land contamination risks were identified as part of the Preliminary Hazard Analysis (PHA) (Section 4.17) and include leaks/spills, fires and explosions associated with the transport, storage and usage of fuels, chemicals and explosives.

Bushfire Hazard

Any uncontrolled fires originating from Project activities may present potentially serious impacts to nearby villages, rural properties and surrounding lands.

Similarly, fires originating in nearby rural areas could pose a significant risk to Project infrastructure and DCPL staff, contractors and equipment. Smoke from bushfires can also have adverse impacts on transportation routes and tourism.

The degree of potential impacts of a bushfire would vary with climatic conditions (e.g. temperature and wind) and the quantity of available fuel.

The continuation and expansion of DCM operations for the Project could increase the potential for fire generation. However, given the relatively low frequency of fire in the Project area (Section 4.2.1) and the range of management measures in place to manage the behaviour of people in the Project area, it is unlikely that there would be an increase in fire frequency resulting from the Project.

The PHA (Appendix L) included consideration of the potential for bushfire.

4.2.3 Mitigation Measures, Management and Monitoring

Land Use

Land ownership in the Project area and surrounds is shown on Figures 1-3a and 1-3b. DCPL-owned land not required for mining operations would continue to be managed for ongoing rural enterprise during the life of the Project.

Section 5 describes the rehabilitation principles for land disturbance areas. Project rehabilitation works would include activities that are to be undertaken progressively (e.g. rehabilitation of the waste rock emplacement) and that would be undertaken at the cessation of the Project (e.g. the decommissioning and rehabilitation of administration and workshop areas).

Rehabilitation activities would be undertaken in consultation with relevant statutory authorities and in accordance with the MOP.

Current irrigation management measures would be employed in additional Project irrigation areas, including the continued implementation of the first flush protocol (Section 2.8.1). The existing IMP (DCPL, 2008a) would be reviewed and revised to incorporate the additional Project irrigation areas, subject to the conditions of any Project Approval.

DCPL would negotiate an agreement or alternatively fund the provision of alternative land access in consultation with the relevant landholder and GLC at the one lot that would lose public road access due to the closure of Cheerup Road and Durallie Road (part of).

Soils and Erosion Potential

The existing DCM Erosion and Sediment Control Plan (ESCP) (DCPL, 2002a) would be updated and revised to include the additional Project disturbance areas, subject to the conditions of any Project Approval. The primary objectives of the ESCP are to:

- minimise and control soil erosion and sediment generation in areas disturbed by construction activities during the development of the Project; and
- minimise the potential for construction activities to adversely affect the water quality of the Mammy Johnsons River or the Karuah River.

Specific control strategies outlined in the ESCP for soil erosion and sediment migration include (DCPL, 2002a):

- Maximum separation of runoff from disturbed and undisturbed areas.
- Construction of sediment dams downstream of disturbed areas to contain runoff up to specified design criteria.
- Subsequent priority use of these waters in Project related activities and/or gradual controlled release to grassed buffer zones.
- Selective use of benign flocculants such as gypsum to assist in the settlement of suspended solids if required.
- Construction of surface drains to facilitate the efficient transport of surface runoff.
- Construction of silt fences downslope of disturbed sites.
- Rapid and progressive stabilisation of disturbed surfaces, including:
  - the use of contour banks and furrows;
  - the use of hydromulching techniques;
  - creation of erosion-stable drainage paths taking into account the principles presented in the *Draft Guidelines for the Design of Stable Drainage Lines on Rehabilitated Minesites in the Hunter Coalfields* (NSW Department of Land and Water Conservation Council [DLWC], 2002); and
  - early revegetation or armouring (i.e. jute mesh and/or compacted rock) of disturbed surfaces.

Erosion and sediment control structures would be regularly inspected and maintained and would be left in place until the potential for erosion and sedimentation is minimal.

Disturbance areas would be stripped progressively in order to reduce sediment generation and the extent of topsoil stockpiles, and to enable utilisation of stripped topsoil as soon as possible for rehabilitation. Topsoil stripping at the existing DCM is undertaken in accordance with the Topsoil Stripping Management Plan (DCPL, 2003b). The Topsoil Stripping Management Plan would be reviewed and revised to incorporate the Project, subject to the conditions of any Project Approval.

Any long-term soil stockpiles would be managed in accordance with the ESCP and DCM topsoil stripping procedures to maintain long-term soil viability through the implementation of the following management practices:

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

A preliminary soil material balance calculation is presented in Appendix N and indicates there is sufficient soil available to meet the Project rehabilitation requirements. Detail with respect to the quantification of soil resources, stripping and reapplication schedules and stockpiling inventories would be included as part of the MOP and would be reported in the Annual Environmental Management Report (AEMR).

The existing soil monitoring programme for irrigation areas described in the approved IMP (DCPL, 2008a) would be expanded to include the new irrigation areas. Two additional reference sites would also be established. The reference sites would be matched with similar irrigation areas before irrigation commences by testing the soils at the proposed reference sites and at a number of irrigation sites before any irrigation is applied. The chemical testing of soil at irrigation sites would also be expanded to include EC.

Ongoing monitoring would be used to determine if soil or irrigation contingency measures would be required. Such measures include (Appendix A):

- soil rejuvenation by light cultivation (in the event of reduced infiltration);
- application of additional lime in the open pits (to rectify soil pH changes);
- acid treatment of irrigation water (to rectify soil pH changes);
- application of lime to soil (to rectify soil pH changes); and
- application of leaching irrigations (to flush salt loads from soils).

Land Contamination

A number of hazard treatment and control measures are described in the following existing DCM management documents and systems:

- Emergency Management Plan;
- Fitness for Work Management Plan;
- Contractor Management Plan;
- Explosives Management Plan; and
- Inspection Program Scheme.

These documents would be reviewed and revised to incorporate the Project, subject to the conditions of any Project Approval.

General measures to reduce the potential for contamination of land would include the following:

- Contractors carrying dangerous goods loads would be appropriately licensed in accordance with the provisions of the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code) (National Transport Commission, 2007). Contractors would be required to operate under the provisions of the DCPL Contractor Management Plan (to meet statutory requirements where relevant).
- On-site consumable storages would be designed with appropriate bunding and would be operated, where applicable, in compliance with the requirements of AS 1940 *The Storage and Handling of Flammable and Combustible Liquids* and AS 2187.1 *Explosives – Storage, Transport and Use – Storage*. Fuel and explosive storage areas would be regularly inspected and maintained.

In addition, during construction and exploration activities fuels, oils and other hydrocarbons would be managed to minimise the risk of spills which could cause soil contamination.

Bushfire Hazard

The Rehabilitation Management Plan (DCPL, 2007a) outlines the bushfire management measures in place at the DCM, including:

- Controlled grazing – cattle are grazed on portions of ML 1427 where active mining operations are not occurring and appropriate fencing is available. Sustainable stocking levels result in low residual fuel loads.
- Hazard reduction burns – in areas where controlled grazing is not possible or appropriate and fuel loads are high (e.g. Project offset areas), hazard reduction burns may be undertaken.
- Firefighting equipment – if a significant bushfire was to occur on the Project MLs the local Rural Fire Service (RFS) would be called for assistance. The RFS, if required, could be assisted by mine personnel and mine resources. The mine has a water cart with a water canon and fire suppressant foam, trailer mounted fire fighting equipment and dozers.
- Reporting – an annual report on bushfire management is provided to the Great Lakes RFS.

The Rehabilitation Management Plan would be reviewed and revised to incorporate the Project, subject to the conditions of any Project Approval.

Meteorological Monitoring

On-site meteorological monitoring would continue to be conducted at the DCM weather station (Section 4.2.1) in accordance with Project Approval and EPL conditions. Meteorological monitoring would form an integral component of the Project environmental monitoring programme and results from this station (or an alternative station) would be used in conjunction with operational noise monitoring (Section 4.5) and air quality monitoring (Section 4.6).

4.3 GROUNDWATER

A Groundwater Assessment for the Project was conducted by Heritage Computing (2009) and is presented in Appendix B. The Groundwater Assessment was peer reviewed by Kalf and Associates (Dr Frans Kalf).

A description of existing groundwater resources in the Project area and surrounds, including the existing effects of the DCM is provided in Section 4.3.1. Section 4.3.2 describes the potential impacts of the Project on groundwater resources, while Section 4.3.3 outlines mitigation measures, management and monitoring.

4.3.1 Existing Environment

Hydrogeological Data

A number of groundwater studies and monitoring programmes have been undertaken in the Project area and surrounds. Existing hydrogeological data utilised in the Groundwater Assessment (Appendix B) included:

- Gloucester Basin geological mapping;
- local and regional geological logs;
- relevant data from the NOW register on the Natural Resources Atlas (NSW Government, 2009);
- geological and hydrogeological assessments undertaken for the DCM, SCM and Hunter Valley mining operations; and
- groundwater level and quality monitoring data from bores in the vicinity of the Project area (Figure 4-1).

Past hydrogeological investigations and assessments in the Project area were undertaken by Golder Associates (1982) and Woodward-Clyde (1996a).

As a component of the Groundwater Assessment, pump and slug testing was carried out between April and July 2009 to supplement existing data on the hydraulic permeabilities of stratum in the Project area. Results of these tests are provided in Appendix B. Additional piezometric monitoring data and geological information was also gathered from hydrogeological investigation boreholes (Figure 4-1).

Examination of the hydrogeological data has facilitated an understanding of the existing groundwater systems and the scale and nature of the effects of the existing DCM on local and regional groundwater systems.

Hydrogeological Regime

The various sedimentary rocks in the Project area have low permeability due to their fine grained nature, the predominance of cemented lithic sandstones and the common occurrence of a clayey matrix in the sandstones and conglomerates (Appendix B). The permeability of the aquifer system is therefore related to the spacing of fissures and the degree of opening of individual fissures. Permeability of the aquifer generally decreases with depth as the fissures tighten and become less frequent, however, relatively higher permeabilities are encountered in the coal seams (Appendix B).

A conceptual model of the hydrogeological regime was developed based on review of the available hydrogeological data. The data supports two separate groundwater systems including (Appendix B):

- shallow groundwater system – associated with alluvium (restricted in extent) and regolith; and
- deeper groundwater system, including:
  - the Weismantel and Clareval coal seams; and
  - low permeability/disconnected fractured rock/coal measures of the Mammy Johnsons, Weismantels and Durallie Road Formations (Figure 2-2).

Alluvial deposits are associated with Mammy Johnsons River to the east of the Project area (Figure 2-2). The alluvium consists of silty sands and silts with lenses of gravelly sands and sandy, coarse gravel with an average thickness of approximately 9 m (Appendix B).

Recharge to the groundwater system is from rainfall and from lateral groundwater flow at the boundaries of the study area. Although groundwater levels are sustained by rainfall infiltration, they are controlled by topography, geology and surface water levels. Local groundwater mounds develop beneath hills and ridgelines. Groundwater moves from these higher elevations toward incised creeks and waterbodies. Groundwater is also lost to evapotranspiration through outcropping sandstone/shales and vegetation where the watertable is within a few metres of the ground surface (Appendix B).

In areas where the groundwater level is lower than the water level of streams or other waterbodies, water can flow from these streams and waterbodies into the underlying aquifer (i.e. leakage). In situations where groundwater levels are higher than the water level in adjacent streams or other waterbodies, water will flow in the other direction toward the surface water system (i.e. a component of stream baseflow).

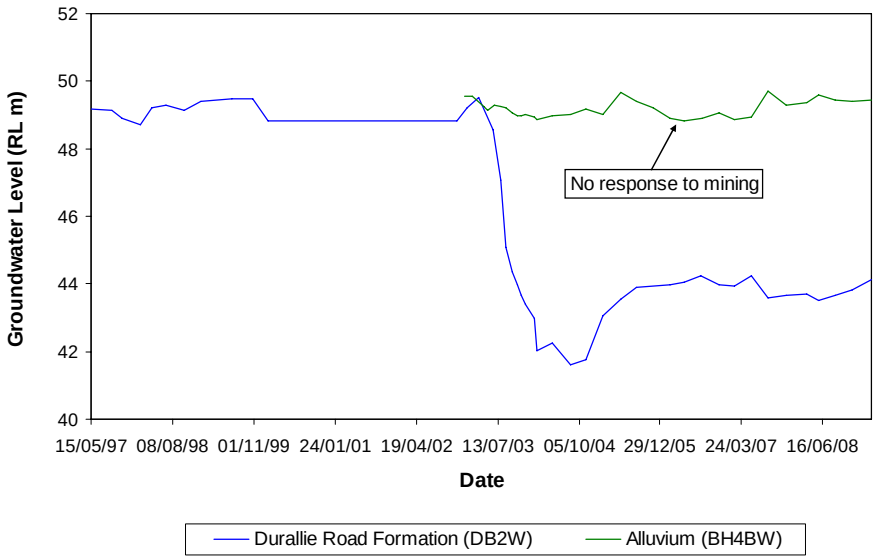
Groundwater recharge is focused into the coal seams where the seams subcrop or outcrop. The deeper groundwater system is of low to very low permeability. The Weismantel and Clareval coal seams are the more permeable layers of the deeper groundwater system.

Existing Influence of the DCM

Groundwater levels have been monitored at bores at the DCM since 1997. A series of additional groundwater monitoring sites were also installed in January 2003, prior to the commencement of open pit mining.

The DCM open pit acts as a groundwater sink, and groundwater nearby maintains a flow direction towards the pit. As shown on Chart 4-1, the groundwater levels in bores in the sandstones of the Durallie Road Formation (i.e. bore DB2W) responded to mining soon after its commencement and monitoring bores in the Mammy Johnsons River Alluvium (i.e. bore BH4BW) did not respond to mining (Appendix B).

Chart 4-1
Groundwater Hydrographs Illustrating Comparative Mining Effects on the Durallie Road Formation and Mammy Johnsons River Alluvium



Groundwater Use

Groundwater use in the Project area is predominantly related to DCM mine dewatering. The number of privately held bores in the Project area and surrounds is low due to the high rainfall and subsequent high rates of runoff and widespread use of surface water storages.

According to the NOW Natural Resources Atlas (NSW Government, 2009), there are 31 registered bores in the vicinity of the Project, three of which are registered production bores located on privately owned land located at least approximately 3 km to the north of the Project (Figure 4-1) (Appendix B). The licensed use of these bores is stock watering, irrigation and industrial.

A supplementary bore census was undertaken by DCPL in October 2009 to locate any unregistered bores that may also be located on adjacent private properties and obtain additional data on the depth and use of local bores. No unregistered bores were identified by the bore census, however, one spring located on privately owned land in the vicinity of the Project was recorded west of the groundwater divide described by Woodward-Clyde (1996a) (Appendix B).

Groundwater Quality

Table 4-5 summarises the water quality attributes of groundwater samples taken by groundwater specialists as a component of various hydrogeological investigations between 1981 and 1996 and those taken between May 1997 and August 2009 by DCPL (Appendix B). The locations of DCM groundwater monitoring bores are shown on Figure 4-1.

Groundwater salinity in the Project area ranges from approximately 100 µS/cm to 7,600 µS/cm and has a median EC of 1,874 µS/cm (Table 4-5). The measured salinity in the alluvium is lower, generally less than 1,000 µS/cm, reflecting the higher rates of recharge and shorter residence times compared with the underlying strata (Appendix B).

The pH of groundwater at the DCM is generally within the 6 to 8 range (Appendix B).

Concentrations of trace metals in the local groundwater are generally below the Australian and New Zealand Environmental and Conservation Council (ANZECC) criteria for irrigation and stock uses although in some locations dissolved iron concentrations have exceeded the recommended ANZECC agricultural irrigation 'short-term trigger values' (Appendix B).

Table 4-5
Summary of Water Quality Data at DCM Groundwater Monitoring Sites
(July 1981 to August 2009)

Analyte	Unit	Median	Minimum	Maximum	Average
pH	-	6.7	4.4	9.6	6.8
EC	µS/cm	1,874.0	100.0	7,600.0	2,387.1
Sulphate	mg/L	129.0	0.1	813.0	143.3
Calcium	mg/L	83.0	1.0	700.0	138.3
Magnesium	mg/L	53.0	0.4	244.0	62.0
Sodium	mg/L	243.5	15.0	841.0	333.6
Potassium	mg/L	2.35	<0.5	22.0	4.3
Chloride	mg/L	510.0	<5.0	2,400.0	720.7
Iron	mg/L	1.4	0.0	190.0	14.5
Aluminium	mg/L	0.07	<0.01	190.0	6.67
Manganese	mg/L	0.7	<0.001	10.0	0.9
Zinc	mg/L	0.04	<0.005	0.57	0.07
Alkalinity as $CaCO_3$	mg/L	190.0	0.0	710.0	230.5
Total Dissolved Solids	mg/L	1,480.0	156.0	4,110.0	1,416.0

Source: Appendix B.
mg/L = milligrams per litre.
$CaCO_3$ = calcium carbonate.

4.3.2 Potential Impacts

The Groundwater Assessment (Appendix B) has assessed the potential impacts of the Project on groundwater resources. The assessment included:

- the collation of existing geological and hydrogeological data;
- a hydrogeological investigation and groundwater monitoring programme;
- a bore census; and
- the development of a numerical groundwater flow model.

The groundwater flow model was used to simulate the potential effects of the Project on the local aquifer systems and to estimate the potential quantity of groundwater inflow to the Project open pits. A summary of the potential impacts on local groundwater aquifers, surface water resources (i.e. Mammy Johnsons River) and on existing groundwater users is presented below.

Shallow (Alluvial) Groundwater System

The analysis of the conceptual groundwater system and modelling results supports the assessment that the shallow alluvial groundwater system in which the Mammy Johnsons River sits, is hydraulically disconnected from the deeper groundwater system. Dewatering of the deeper groundwater system by mining is not predicted to affect the shallow alluvial groundwater system (Appendix B).

Deeper Groundwater System

The deeper groundwater system would be partially dewatered/depressurised by the Project. The results of the numerical model indicate that groundwater flow would move toward the open pit as mining progresses. The numerical model shows substantial reduction in potentiometric head in the aquifers of the deeper groundwater system to the east and north of the Project area (Appendix B). The numerical model also shows negligible impacts on surface stream baseflows (Appendix B).

The numerical model indicates inflows to the open pits would range from approximately 0.2 megalitres per day (ML/day) to 1 ML/day over the nine years of mining and final pit inflows would be expected in the order of 0.3 ML/day at the completion of mining (Appendix B).

Numerical modelling of the post-mining groundwater levels shows slow but complete recovery of the groundwater system over many decades and that the final voids, once filled with water, would act as flow-through lake systems, with groundwater flow expected to be restored to a dominant southerly direction due to the higher permeability of the waste rock emplacement (Appendix B).

Due to the existing poor quality of groundwater in the deeper groundwater system, there would be a negligible reduction in groundwater quality as a result of mining, including long-term groundwater quality (Appendix B).

Surface Water Resources

The Groundwater Assessment concluded that the coal seams and the alluvium of the Mammy Johnsons River are hydraulically disconnected. Numerical modelling indicates that there would be negligible effect on water levels in the alluvials of the Mammy Johnsons River, on river leakage or on groundwater contribution to baseflow as a result of the Project (Appendix B).

The spring identified during the bore census is located west of the groundwater divide, which lies to the west of the ridgeline that effectively screens the DCM from The Bucketts Way (Appendix B). The Groundwater Assessment concluded that the spring is unlikely to be affected by the Project (Appendix B).

Given the localised disturbance of open pit mining, and the negligible effects on river leakage, baseflow and groundwater quality, inconsequential effects on the Mammy Johnsons River are anticipated (Appendix B).

Registered Production Bores

Depressurisation in the deeper groundwater system as a result of the development of the Project open pits would be naturally limited to the east, west and south by outcropping volcanics (Appendix B). Depressurisation in the aquifers of the deeper groundwater system is therefore expected to propagate only to the north (Appendix B).

Three relatively shallow (<60 m depth) private production bores are located to the north of the Project area. The maximum predicted drawdown in the Weismantel coal seam varies from 4 to 7 m at the three bores, but the potentiometric level would remain close to ground level (Appendix B). Therefore, the predicted drawdown in the water level in each bore is expected to be negligible (Appendix B).

Cumulative Impacts

The groundwater assessment included consideration of the cumulative impacts of the Project and existing DCM on groundwater drawdown and water quality. Groundwater monitoring results show no effect from mining on alluvium associated with the Mammy Johnsons River (Section 4.3.1).

The number of other groundwater users in the Project area and surrounds is low due to the high rainfall and subsequent high rates of runoff and widespread use of surface water storages. Drawdown in the water level in the registered production bores is expected to be negligible (Appendix B).

The groundwater and surface water assessments conducted for the Project have been completed in an integrated manner. The assessment of potential groundwater impacts included consideration of surface water flows and the post-mining water level in the final voids determined by the surface water assessment (Appendix A).

The SCM is the nearest mining operation and is located some 20 km to the north of the DCM within Avon River catchment. No significant cumulative groundwater or surface water impacts have been identified with respect to the operation of the SCM or any other mining operations in the Gloucester Valley.

AGL conducts coal bed methane exploration activities within the region in its petroleum exploration tenement that stretches from north of Gloucester to the south of Stroud (Section 6.4.1). Exploration works undertaken by AGL in accordance with DII-Minerals & Energy environmental management requirements are considered unlikely to give rise to significant cumulative surface or groundwater impacts at the DCM. Any future development proposals by AGL would be subject to separate environmental assessment and approval (Section 6.4.1).

Climate Change and Groundwater

Climate change and greenhouse gas emissions associated with the Project are discussed in Appendix B, including the potential groundwater impacts of the Project in the context of global climate change.

4.3.3 Mitigation Measures, Management and Monitoring

Waste Rock Emplacement – Seepage Control

Consistent with the Duralie Coal EIS, DCPL would construct clay cut-off walls along the southern end of the waste rock emplacement toe at Coal Shaft Creek to impede potential groundwater seepage from the toe of the emplacement to lower Coal Shaft Creek and Mammy Johnsons River.

Groundwater Monitoring

The existing DCM groundwater monitoring programme would be updated to address the Project extensions. The extended groundwater monitoring programme would be designed to detect changes as a result of mining, improve knowledge of aquifer definition and interactions, strata hydraulic properties, expected drawdown extent and groundwater quality.

The existing groundwater monitoring programme for the DCM would be supplemented with additional piezometers located in the in-pit waste rock emplacement to provide information on groundwater recharge rates and permeability (Section 7). The groundwater monitoring programme would be designed to comply with the *Murray-Darling Basin Groundwater Quality Sampling Guidelines* (Murray-Darling Basin Commission, 1997). Further information on the proposed groundwater monitoring programme is provided in Appendix B.

Numerical Model and Water Balance Review

The numerical model developed as part of the groundwater assessment would be used as a management tool for the review and calibration of the prediction of groundwater impacts throughout the Project life.

The results of the groundwater monitoring programme would inform progressive refinement of the numerical model. Revised outputs from the numerical model would be reported periodically over the life of the Project and used to inform the site water balance review as described in Appendix A.

4.4 SURFACE WATER

A Surface Water Assessment for the Project was conducted by Gilbert & Associates (2009) and was peer reviewed by Dr Tom McMahon (Emeritus Professor of the Department of Civil and Environmental Engineering at The University of Melbourne [Attachment 3]). The Surface Water Assessment is presented in Appendix A.

A description of existing local and regional surface water resources is provided in Section 4.4.1. Section 4.4.2 describes the potential impacts of the Project on surface water resources, and Section 4.4.3 outlines mitigation measures, management and monitoring. The existing DCM and proposed Project water management systems are described in Section 2.8.

4.4.1 Existing Environment

The surface water quality and flow regimes in the Project area are influenced by the existing DCM and historical extensive clearing for grazing on native and improved pastures and other agricultural activities in the surrounding rural lands.

The sub-sections below present a description of the regional and local hydrology surrounding the Project and a summary of the water quality data collected as part of the DCM environmental monitoring programme. A description of the existing ARD management measures is also provided.

Surface Water Data Sources

The Surface Water Assessment (Appendix A) analysed DCPL databases and datasets made available by Federal and State government departments and agencies including:

- rainfall and evaporation records from the BoM and the DCPL weather station;
- DECCW gauging station flow data on the Mammy Johnsons River (GS209002) and the Karuah River (GS209018) (Figure 4-1);
- water quality data from existing and historic DCPL monitoring sites (Figures 4-1 and 4-2);
- data from DCPL irrigation areas including daily recorded hours of irrigation and soil moisture measurements; and
- water movement and usage data from the DCM water management system including haul road water usage and movement of water to/from mine storages, the Weismantel open pit and the MWD.

Regional Hydrology

The Project area is situated within the Mammy Johnsons River catchment, a tributary of the Karuah River. The Karuah River, which rises in the Chichester State Forest, drains to Port Stephens some 40 km south of the DCM. The Karuah River is located to the north-west and south of the Project Area (Figure 1-1).

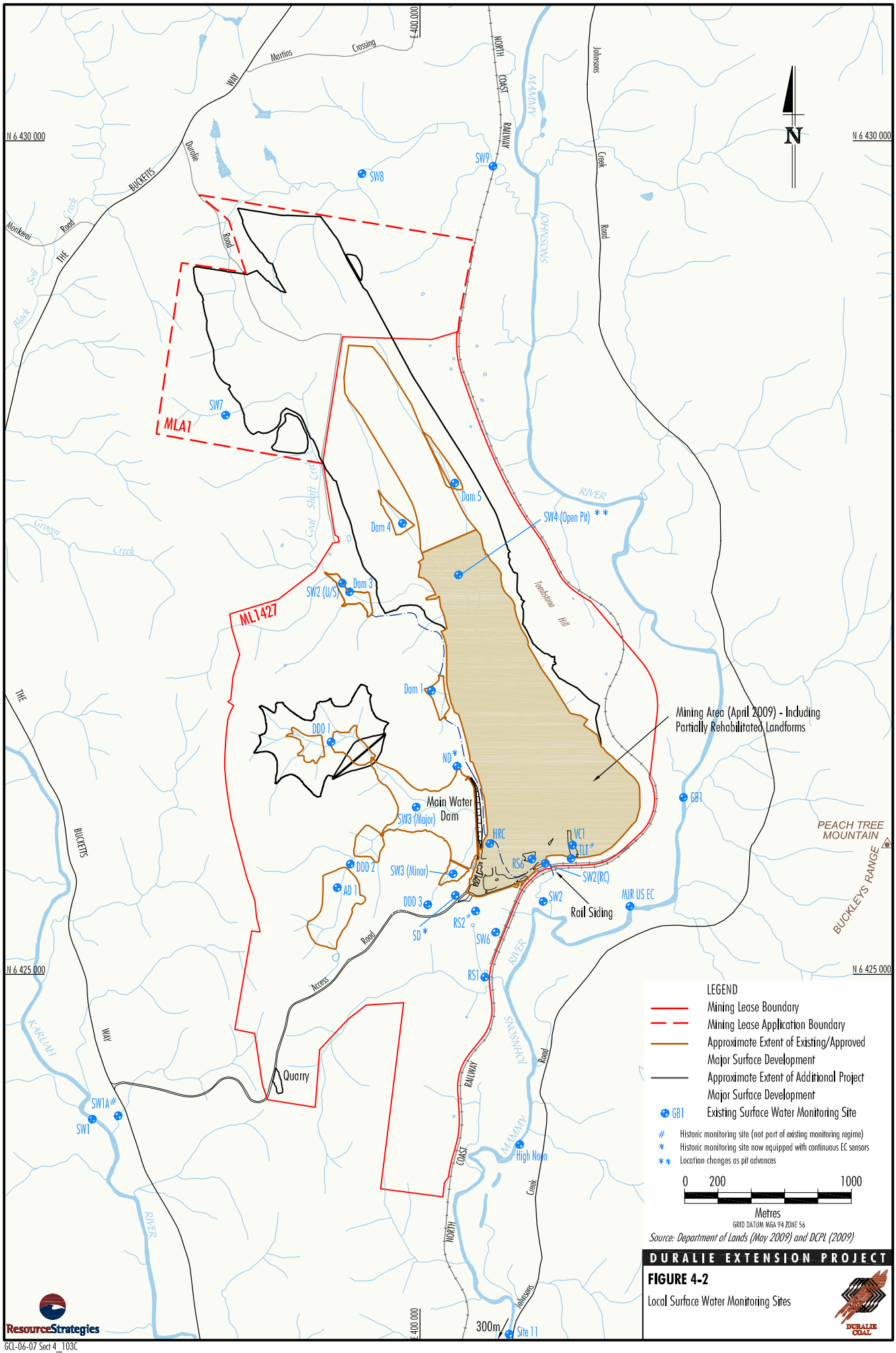
Mammy Johnsons River has a similar catchment area and length to the Karuah River above their confluence near the village of Stroud Road (Appendix A). The Mammy Johnsons River rises in the Myall State Forest to the east of the Project and flows generally north out of the State Forest area and then west through the locality of Tereel to its confluence with Wards River some 2.5 km south-east of the township of the same name. From the Wards River confluence the Mammy Johnsons River then flows in a generally southerly direction through an undulating landscape which has been extensively cleared for cattle grazing.

The nearest operational streamflow gauging station on the Mammy Johnsons River is located to the north-east of the Project (GS209002 – Pikes Crossing) and has operated since 1973 (Appendix A). An operating gauging station also exists on the Karuah River to the west of the Project (GS209018) which has operated since 1979 (Appendix A). The locations of these gauging stations relative to the Project are shown on Figure 4-1.

Streamflows in the Karuah River and Mammy Johnsons River are characterised by low to moderate flows for long periods, with periods of higher discharge following heavy rains, typical of small and medium sized upland catchments (Appendix A). The Karuah River appears to have stronger low flow persistence than Mammy Johnsons River, with zero flow recorded only on 0.8% of days, compared to 5.3% of days for the Mammy Johnsons River (Appendix A).

Local Hydrology

The existing DCM is situated in the catchment of Coal Shaft Creek, a small tributary which flows into the lower reaches of Mammy Johnsons River. Coal Shaft Creek has been diverted around the current DCM workings (Section 2.8.1). Tombstone Hill, at an elevation of approximately RL 130 m, and its associated ridgeline divides the Coal Shaft Creek catchment from the Mammy Johnsons River to the east.


N 6 430 000
N 6 425 000
E 400 000
N
MLA1
ML1427
SW1
SW1A #
SW2 (U/S)
SW2(RC)
SW2
SW3 (Major)
SW3 (Minor)
SW4 (Open Pir) **
SW6
SW7
SW8
SW9
RS1
RS2 *
RS3
SD *
ND *
HRC
VC1
TLT #
MJR US EC
GB1
Site 11
Dam 1
Dam 3
Dam 4
Dam 5
DDD 1
DDD 2
DDD 3
AD 1
Main Water Dam
Rail Siding
Quarry
Mining Area (April 2009) - Including Partially Rehabilitated Landforms
BUCKETTS WAY
Martins Crossing
Duralie Road
Monkerai Road
THE
Groom Creek
Coal Shaft Creek
Tombstone Hill
MAMMY
JOHNSONS
Johnsons Creek Road
NORTH COAST RAILWAY
PEACH TREE MOUNTAIN
BUCKLEY'S RANGE
KARUAH
Across Road
LEGEND
Mining Lease Boundary
Mining Lease Application Boundary
Approximate Extent of Existing/Approved Major Surface Development
Approximate Extent of Additional Project Major Surface Development
GB1 Existing Surface Water Monitoring Site
Historic monitoring site (not part of existing monitoring regime)
* Historic monitoring site now equipped with continuous EC sensors
** Location changes as pit advances
0 200 1000
Metres
GRID DATUM: MGA 94 ZONE 56
Source: Department of Lands (May 2009) and DCPL (2009)
DURALIE EXTENSION PROJECT
FIGURE 4-2
Local Surface Water Monitoring Sites
ResourceStrategies
DURALIE COAL
GCL-06-07 Sect 4_103C

The Coal Shaft Creek Diversion comprises an approved, purpose-built diversion channel, which rejoins the original Coal Shaft Creek alignment near the DCM rail spur. The confluence of Coal Shaft Creek with the Mammy Johnsons River is south of the DCM rail loading infrastructure (Figure 4-2) and approximately 10 km upstream of the Mammy Johnsons River/Karuah River confluence.

The Project would involve further extension of mining in the Coal Shaft Creek catchment and into the catchment of an unnamed minor tributary stream that flows north and east to join the Mammy Johnsons River approximately 4 km upstream of the Coal Shaft Creek confluence (Figure 4-2).

The upper reaches of Coal Shaft Creek are ephemeral and baseflow contributions in these portions of the creek are likely to be small (Appendix A).

A summary of the catchments within the Project area and surrounds is provided in Table 4-6.

Table 4-6
Catchment Area Summary

Stream	Location	Catchment Area (km^2)
Coal Shaft Creek (following existing diversion [Figure 2-1])	Within existing DCM disturbance area and additional Project disturbance areas	5.7
Unnamed Tributary to Mammy Johnsons River	Partly within additional Project disturbance areas	2.9
Mammy Johnsons River	To the north-east and south of the Project area	320
Karuah River	To the north-west and south of the Project area	1,470

Source: After Appendix A.

Surface Water Quality

The Duralie Coal EIS indicated that water quality in Mammy Johnsons River was variable, but was generally good (Woodward-Clyde, 1996b). It was also found that the salinity of the stream was higher during periods of low flow and generally showed a relative reduction in EC during higher flow periods (Gilbert, 1997). The pre-mining salinity levels in Coal Shaft Creek were markedly higher than the salinity of the Mammy Johnsons River (Gilbert, 1997).

Figures 4-1 and 4-2 show the existing regional and local surface water monitoring locations at the DCM. Table 4-7 presents a summary of the pH and EC monitoring data collected at the DCM since the commencement of mining.

The water quality monitoring data indicates that Coal Shaft Creek is generally more saline than the Mammy Johnsons River and the Karuah River (Table 4-7). The EC data presented in the Duralie Coal EIS showed similar trends to the data collected since mining operations began at the DCM.

It is considered that Coal Shaft Creek is generally more saline due to its ephemeral nature and the outcropping of coal seams within the catchment (Appendix A). As shown on Chart 4-2, comparison of the salinity of Mammy Johnsons River upstream and downstream of the DCM (i.e. High Noon) in the period 2006 to 2008 indicates that there has been a gradual reduction in salinity downstream of the DCM, relative to the upstream site. This is considered to be due to the removal of outcropping coal from the contributing catchment of Coal Shaft Creek and the effectiveness of the current first flush protocol in capturing initial elevated salt runoff from DCM irrigation areas during rainfall events (Appendix A).

Table 4-7
Summary of pH and Electrical Conductivity Monitoring Results

Watercourse	No. of Samples	pH			EC (µS/cm)		
		Min.	Median	Max.	Min.	Median	Max.
Coal Shaft Creek (including diversion)[1]	191	5.9	7.5	8.5	40	370	1,840
Unnamed Tributary to Mammy Johnsons River[2]	11	7.1	7.4	7.8	70	170	740
Mammy Johnsons River[3]	329	6.3	7.5	8.9	80	290	600
Karuah River[4]	236	6.1	7.6	8.9	70	190	790

Source: After Appendix A.

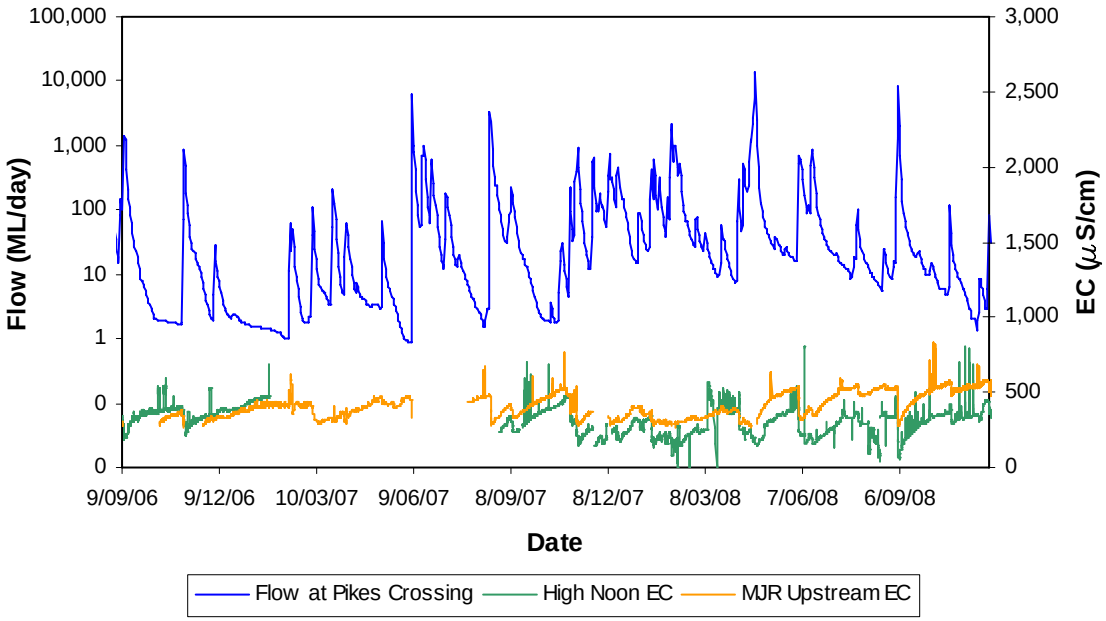
1 Summary of data from SW2, SW2 (U/S), SW2 (RC), SW7 and HRC.

2 Summary of data from SW8 and SW9.

3 Summary of data from GB1, Site 11, Site 12 and Site 15.

4 Summary of data from SW1, Site 9 and Site 19.

Chart 4-2
Streamflow and Comparison of Upstream and Downstream Salinity in Mammy Johnsons River



Source: After Appendix A.

Near neutral to slightly alkaline pH has been recorded at Coal Shaft Creek, Mammy Johnsons River and Karuah River (Appendix A).

Elevated zinc concentrations are regularly recorded in the Karuah River, Mammy Johnsons River, Coal Shaft Creek and the unnamed tributary to Mammy Johnsons River (SW8 and SW9), including sites both upstream and downstream of the mine (Appendix A). Concentrations of copper and chromium have also been recorded above the ANZECC aquatic ecosystems guideline in these watercourses (Appendix A).

The majority of the other metals monitored have been below the detection limit on most sampling occasions (Appendix A).

DCM Potentially Acid Forming Material Management

Management of PAF materials at the DCM is currently conducted in accordance with the PAFMMP (DCPL, 2003a). A description of the existing PAF material management at the DCM is provided in Section 2.1.4.

Monitoring results indicate that the existing operational controls described in Section 2.1.4 have been successful in controlling the release of acid from PAF material (Appendix I).

Flooding

The Mammy Johnsons River in the vicinity of the Project is located at an elevation of approximately RL 45 m, while the extent of the floodplain is at approximately RL 52 m (Appendix A).

The North Coast Railway embankment was constructed in the 1890s and is located between the DCM and Mammy Johnson River (Figure 4-2). There is no record of the railway embankment being overtopped in this time which suggests that areas higher than this are unlikely to be affected by flooding in Mammy Johnsons River (Appendix A).

4.4.2 Potential Impacts

The following sub-sections describe the potential operational and post-mining impacts of the Project on surface water flow regimes and surface water quality.

Surface Water Flow Regimes

The Project would result in changes to flows in local creeks due to the expansion of DCM disturbance areas and associated subsequent capture and re-use of drainage from operational catchment areas, as well as additional rainfall runoff generated in irrigation areas due to higher antecedent soil moisture (i.e. irrigation would decrease the capacity of soils to absorb incident rainfall).

Potential impacts on the surface water flow regime in Mammy Johnsons River may potentially occur as a result of the Project due to changes in runoff and flows in contributing catchments, and changes to groundwater baseflow contributions to local streams. These potential impacts of the Project on surface water flow regimes are discussed in the sub-sections below. The potential impacts on flow regimes in the Mammy Johnsons River as a result of these Project impacts are expected to be insignificant (Appendix A).

Changes in Contributing Catchment

The surface water flow regimes in Coal Shaft Creek and the unnamed tributary to Mammy Johnsons River would be affected by changes in catchment area as a result of runoff capture in Project disturbance areas. Table 4-8 summarises the potential changes in catchment area in these creeks as a result of the Project.

Table 4-8
Changes to Contributing Catchment of Local Creeks

Catchment	Total Pre-mining Catchment Area (km^2)	Area Captured in Water Management System (km^2)	
		Existing DCM	Maximum (including the Project)
Coal Shaft Creek	9	3.3	5.2
Unnamed Tributary to Mammy Johnsons River	2.9	0	0.8

Source: Appendix A.

The existing catchment area of Coal Shaft Creek and the unnamed tributary to Mammy Johnsons River contribute approximately 2.7% of the total catchment area of Mammy Johnsons River. The loss of a further 2.7 km^2 total catchment as part of the Project (Table 4-8), represents approximately 0.8% of the total catchment of Mammy Johnsons River. The cumulative loss (with the existing DCM) of 6 km^2 total catchment represents approximately 1.9% of the total catchment of Mammy Johnsons River and approximately 0.4% of the catchment of the Karuah River (Appendix A).

It should be noted that the catchments of Coal Shaft Creek and the unnamed tributary to Mammy Johnsons River would be progressively reinstated as the waste rock emplacements are rehabilitated and become free draining.

Following the completion of rehabilitation post-mining, only the catchment areas of the final voids would remain excised from the catchment (approximately 0.75 km^2, or 0.2% of the total catchment of Mammy Johnsons River and approximately 0.05% of the catchment of the Karuah River).

Runoff from Irrigation Areas

Direct runoff of irrigation water would be avoided by strict management of irrigation, including the continued use of soil moisture monitors as is currently undertaken at DCM in accordance with the approved IMP (DCPL, 2008a).

It is expected that incident rainfall runoff rates from Project irrigation areas would increase as a result of higher antecedent moisture conditions in the irrigated soils (Appendix A). Combined with the progressive re-instatement of free drainage from rehabilitated landforms (Section 5) it is anticipated that this would limit the volume of water lost to the Mammy Johnsons River catchment during the operation of the Project.

The approved IMP (DCPL, 2008a) first flush protocol would continue to be implemented to capture any initial runoff with elevated salinity levels from Project irrigation areas during rainfall events (Section 2.8.1).

Potential Impacts on Groundwater Baseflow Contributions

Appendix B concluded that potential impacts on the Mammy Johnsons River as a result of the Project would be negligible (Section 4.3.2).

Surface Water Quality

Potential impacts of the Project on surface water quality include the reduction of surface water quality due to uncontrolled runoff from disturbed areas and/or release of contaminants, saline runoff from Project irrigation areas and groundwater contamination. These potential impacts are discussed in the sub-sections below.

Runoff and Contaminants

Surface water runoff from disturbed areas could potentially contain sediments, dissolved solids, oil, grease, metals and salts. DCM erosion and sediment and land contamination controls that would be applied to the Project are described in Section 4.2.3.

DCPL would operate the DCM site in accordance with the requirements of EPL 11701 and would maintain the current approach of the beneficial use of water collected from operational areas for on-site irrigation. The operational catchment area would vary over time as successfully rehabilitated areas would be excised from the operational water management area and become free draining.

The Project water management system is described in Section 2.8. The risk of overflow from the MWD and the open pits was evaluated as part of the site water balance (Appendix A). There was no overflow from the MWD and open pits during the 1,000 climatic sequences simulated.

Acid Rock Drainage

A Geochemical Assessment was conducted by EGi (2009) and is presented in Appendix I. The Geochemical Assessment included consideration of geochemical testing undertaken for the Duralie Coal EIS and the Project, as well as experience and performance results from the existing DCM.

Geochemical testing results indicate that PAF and NAF materials from Weismantel Seam overburden and Clareval Seam overburden are geochemically similar, and hence the existing management approaches used for Weismantel Seam overburden at the current DCM (Section 4.4.1) are expected to be applicable to Clareval Seam overburden (Appendix I).

Irrigation

A salt balance simulation for the MWD and Auxiliary Dams was undertaken as part of the Surface Water Assessment (Appendix A). Modelled irrigation water quality over the life of the Project under dry, median and wet rainfall sequences are shown on Chart 4-3.

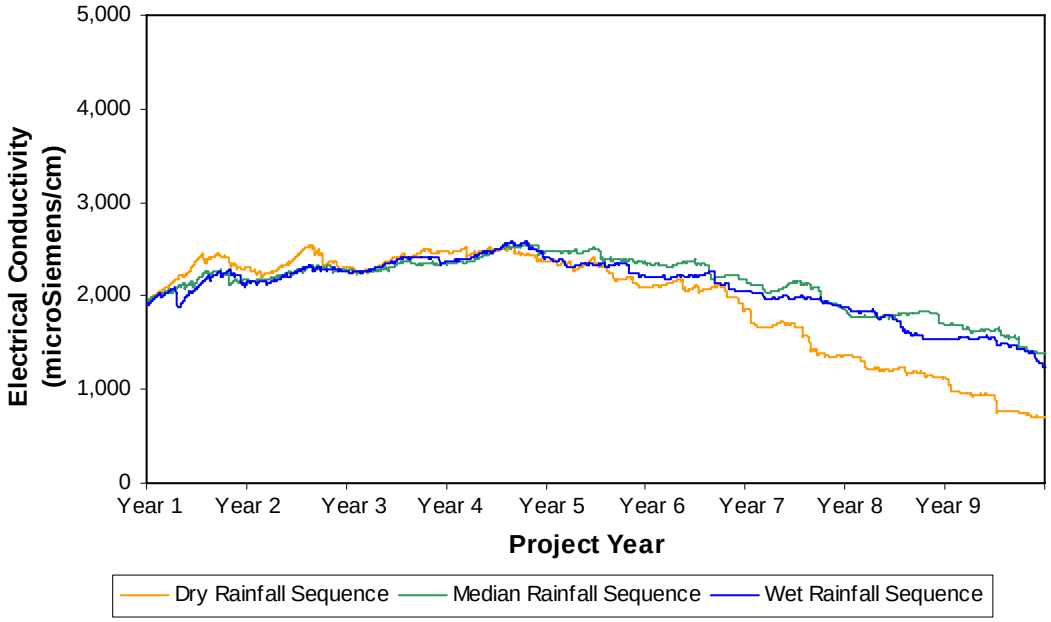
The first flush protocol would continue to be implemented for irrigation areas throughout the life of the Project. This would include the continued application of the current EC triggers (i.e. 1,326 µS/cm for first flush runoff and 400 µS/cm in the Mammy Johnsons River downstream of the DCM). How these triggers are applied is described in detail in Appendix A and Section 2.8.1.

Runoff from irrigation areas which is not captured by the first flush system is expected to be of similar quality to the pre-mining water quality of Coal Shaft Creek (Appendix A).

Alteration to Groundwater Quality

There is not expected to be any changes in the quality of groundwater as a consequence of mining and therefore there would be negligible impact on water quality in the Mammy Johnsons River due to interaction with groundwater (Appendix A).

Chart 4-3
Simulated Salinity of the Main Water Dam and Auxiliary Dams



Source: After Appendix A.

Flooding

The Project mining areas are located further away from Mammy Johnsons River and at a higher elevation than the existing DCM mining area and therefore are very unlikely to be exposed to flooding in Mammy Johnsons River (Appendix A).

Coal Shaft Creek commands a relatively small catchment upstream of the Project area and has been extensively diverted around the DCM. The diversion has been designed to safely pass flows up to the 1 in 100 year ARI and the majority of the diversion would be retained for the Project life (Appendix A).

Post-Mining Surface Water Impacts

Post-mining inflows to the Clareval North West and Weismantel Extension final voids would comprise incident rainfall, runoff and seepage from the sides of the voids and their adjacent contributing catchment, seepage from coal seam groundwater and waste rock emplacement infiltration. Water would be lost from the voids through evaporation.

The final voids would not overflow to downstream watercourses (Appendix A). A final void water balance, including a water quality analysis was conducted as part of the Surface Water Assessment (Appendix A) and is summarised in Section 5.2.1.

Seepage management measures at the southern toe of the existing Weismantel waste rock emplacement to minimise the potential for groundwater seepage to adversely affect local surface water quality are described in Section 4.4.3.

Without the application of management measures, the reconstructed section of Coal Shaft Creek that would overly the waste rock emplacement could lose water into the waste rock material. The channel would include an engineered low permeability liner which would restrict the movement of water between Coal Shaft Creek and groundwater within the waste rock emplacement. The post-mining alignment of Coal Shaft Creek and the low permeability liner is discussed in Section 5.2.3.

As described further in Section 5.2.2, the existing sediment dams downstream of the waste rock emplacement would be retained until the revegetated surface of the waste rock emplacement is stable and runoff water quality is acceptable, at which time the sediment dams would be removed and these areas would be free-draining.

Cumulative Impacts

The surface water assessment included consideration of the cumulative impacts of the Project and existing DCM which indicate a maximum cumulative loss of catchment from the Karuah River of some 0.4% during mining and 0.05% post-mining.

In addition, the groundwater and surface water assessments conducted for the Project have been completed in an integrated manner. Potential surface water impacts of the Project have been considered in the context of potential alterations to groundwater baseflow contributions to the Mammy Johnsons River (Section 4.3.2).

As described in Section 4.4.1, monitoring of Mammy Johnsons River salinity above and below the DCM indicates a net reduction in salinity has occurred downstream of the DCM.

As discussed in Section 4.3.2, no significant surface water impacts have been identified with respect to the operation of the SCM, other mining operations in the Gloucester Valley and coal bed methane exploration activities.

4.4.3 Mitigation Measures, Management and Monitoring

Site Water Management Plan

The existing Site Water Management Plan would be reviewed and revised to incorporate the Project. The Site Water Management Plan would describe the operational site water management system and would provide provisions for review of the site water balance, erosion and sediment control measures, surface water and groundwater monitoring and a Surface Water and Groundwater Response Plan.

The Site Water Management Plan would describe the water transfer protocols and response procedures for the site water management system that would be adhered to throughout the operation of the Project. The water transfer protocols are described in Appendix A and include minimum dam freeboard requirements and procedures for transferring water between the MWD, Auxiliary Dams and open pits.

The IMP is currently a separate management document to the Site Water Management Plan. It is proposed that when the Site Water Management Plan and IMP are updated to address the Project extensions, that the IMP would be integrated as a sub-component of the Site Water Management Plan, subject to the conditions of any Project Approval.

Water Balance

A site water balance review would continue to be undertaken on an annual basis to monitor the status of inflows, storage and consumption (irrigation, dust suppression, vehicle washdown) and be used to optimise water management performance. The results of the water balance reviews would be reported in the AEMR.

Surface Water Monitoring

The existing surface water monitoring programme (Figures 4-1 and 4-2) would be augmented throughout the life of the Project. The monitoring programme would be expanded to include:

- water quality monitoring in Auxiliary Dams Nos. 2 and 3;
- water quality monitoring in sediment dams constructed to control runoff draining from the expanded waste rock emplacement area;
- water quality monitoring in first flush capture dams downslope of proposed Type V (rehabilitation) irrigation areas;
- water quality and storage capacity monitoring in the Weismantel Extension final void (once it becomes available for water storage);
- flow monitoring on Coal Shaft Creek; and
- flow monitoring at the proposed Mammy Johnsons River downstream flow gauging station (High Noon).

Monitoring of irrigation areas is described in the irrigation sub-section below. On-site meteorological monitoring would also continue and is discussed in Section 4.2.3.

Water Quality Management Measures

Drainage Management

The existing ESCP would be reviewed and revised to include the additional Project disturbance areas, subject to the conditions of any Project Approval. The Project water management system would control runoff generated from surface development areas while minimising the capture of surface water runoff by diverting upslope water around such areas.

The water management system would include a combination of permanent structures that may continue to operate post-mine closure, and temporary structures that would only be required until the completion of rehabilitation works (e.g. sediment control structures). Temporary and permanent upslope diversion bunds/drains and temporary interception dams would continue to be constructed over the life of the Project to divert runoff from undisturbed areas around the open pits and waste rock emplacement. The Project surface water management system would include continued diversion of runoff via the Coal Shaft Creek Diversion (Appendix A).

Upslope diversion works would be designed in consultation with the DECCW. The design capacity of these upslope diversion works would depend on:

- the size of the upslope catchment;
- the design life of the upslope diversion; and
- the potential consequences of a breach.

Depending on the above, the design capacity would range from the peak flow generated by the 1 in 2 year ARI event through to that generated by the 1 in 100 year ARI event.

Sediment dams and other containment storages would be sized to contain runoff from rainfall events between a 1 in 20 year and 1 in 100 year ARI, depending on the function of the storage and the potential consequences of the spill. Sediment dams would be constructed downslope of the eastern batter of the Weismantel waste rock emplacement (Appendix A).

Upslope diversions would be designed to be stable (non-eroding) at design flows. Stabilisation of the upslope diversion works would be achieved by design of appropriate channel cross-sections and gradients and the use of channel lining with grass or rock fill.

Permanent upslope diversion bunds/drains would remain around the final voids (Section 5.2.1).

Water structures (including the Coal Shaft Creek Diversion and MWD diversion drain) would continue to be inspected on a regular basis for the duration of the Project. For example the Coal Shaft Creek Diversion is inspected for structural integrity, blockages or other faults after a rain event of >50 mm in seven days or at least every three months. The MWD diversion drain is inspected at least twice per year or following a significant rain event (typically of the order of 100 mm). In addition, upon completion of the reconstructed Coal Shaft Creek, monitoring of geomorphic stability would be undertaken by similar event-based inspections and annual cross-section and long-section surveys in representative locations.

DCM erosion and sediment migration measures are discussed further in Section 4.2.3.

In addition to the above measures, the management of water quality of rainfall runoff from irrigation areas is described below.

Potentially Acid Forming Material Management

The existing PAFMMP would be reviewed and revised to incorporate the Project, subject to the conditions of any Project Approval. The Geochemical Assessment (Appendix I) determined that the existing management controls used at the current DCM (Section 4.4.1) are expected to be applicable to the Project with some modifications.

The geochemical testing included in the Geochemical Assessment provided an overall indication of the relative ARD potential of the Project. Notwithstanding the above, additional geochemical testing would be conducted in the Weismantel and Clareval Seams overburden to improve knowledge of the occurrence of PAF materials. The results of this geochemical testing would be included in the PAFMMP and would be used to improve PAF material selection and placement locations.

The following contingent PAF material operational controls would be available and could be implemented for the Project in the event that ongoing geochemical testing indicates that the volume of PAF material is higher than anticipated, or if additional controls are required (Appendix I):

- Limestone treatment of the Clareval North West open pit floor.
- Alternative waste rock handling techniques (e.g. paddock dump and traffic compacting PAF material) to minimise the risk of accelerated oxidation through convection would be considered if the proportion of PAF waste rock is greater than anticipated.

The following modifications could also be made to the existing long-term controls for the Project (Appendix I):

- The level at which PAF material is placed in-pit could be raised to reflect an increase in the predicted groundwater recovery level.
- If additional geochemical testwork and mine scheduling indicate PAF material would need to be placed above the predicted groundwater recovery level, suitable PAF cells could be developed above the post-mining watertable.

In addition to the above, routine sampling and geochemical testing would be conducted during operations to monitor variation in acid potential and to reconcile the predicted distribution of ARD rock types. Routine water quality monitoring would continue to be conducted to monitor the performance of operational and long-term controls.

Irrigation Management

The existing IMP (DCPL, 2008a) would be reviewed and revised to include the additional irrigation areas for the Project, subject to the conditions of any Project Approval. The current irrigation monitoring protocols which are contained in the IMP would be expanded to cover the new irrigation areas as they are developed. The existing irrigation protocols for retaining an appropriate soil moisture deficit and capture of first flush runoff would be continued for the Project. Soil moisture sensors would continue to be used to determine application rates.

The volume and salinity of water applied to the various irrigation areas, the salinity and volumes of water draining off irrigation areas and the soil moisture and salinity in actively irrigated areas would be monitored. Water quality samples from the MWD would be analysed for pH, EC, residual sodium carbonate (bicarbonate) (RSC) and sodium adsorption ratio (SAR).

The continued effective performance of the irrigation system would be influenced by the quality of contained water used for irrigation. The quality of irrigation water would be expected to vary as a result of the natural variability of rainfall and other water balance variables (e.g. quality of open pit inflows) and would continue to be monitored as described above.

Post-Mining Surface Water Management

The management of surface water resources post-mining, including final void management and the reconstruction of Coal Shaft Creek are discussed in Section 5.

Where it overlies the waste rock emplacement, the finalised alignment of the Coal Shaft Creek channel would include an engineered low permeability liner which would restrict the movement of water from Coal Shaft Creek to groundwater in the waste rock emplacement (Section 5.2.3).

In addition, a clay seal would be constructed at the southern toe of the Weismantel open pit waste rock emplacement to impede potential groundwater seepage from the toe of the emplacement to lower Coal Shaft Creek and Mammy Johnsons River (Section 4.3.3).

4.5 NOISE AND BLASTING

A Noise and Blasting Impact Assessment for the Project (Appendix C) was undertaken by Heggies (2009a) and included assessment of the following potential impacts:

- on-site construction and operational noise;
- blasting impacts;
- off-site rail noise; and
- off-site road traffic noise.

The Noise and Blasting Impact Assessment was conducted in accordance with the *NSW Industrial Noise Policy* (INP) (NSW Environment Protection Authority [EPA], 2000), *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZECC, 1990), *NSW Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA, 1999) and *Interim Construction Noise Guideline* (DECCW, 2009b).

Section 4.5.1 provides a description of the existing noise environment including a description of the existing DCM noise and blasting management and monitoring regime. Section 4.5.2 describes the potential impacts of the Project with respect to noise and blasting. Section 4.5.3 outlines mitigation measures, management and monitoring.

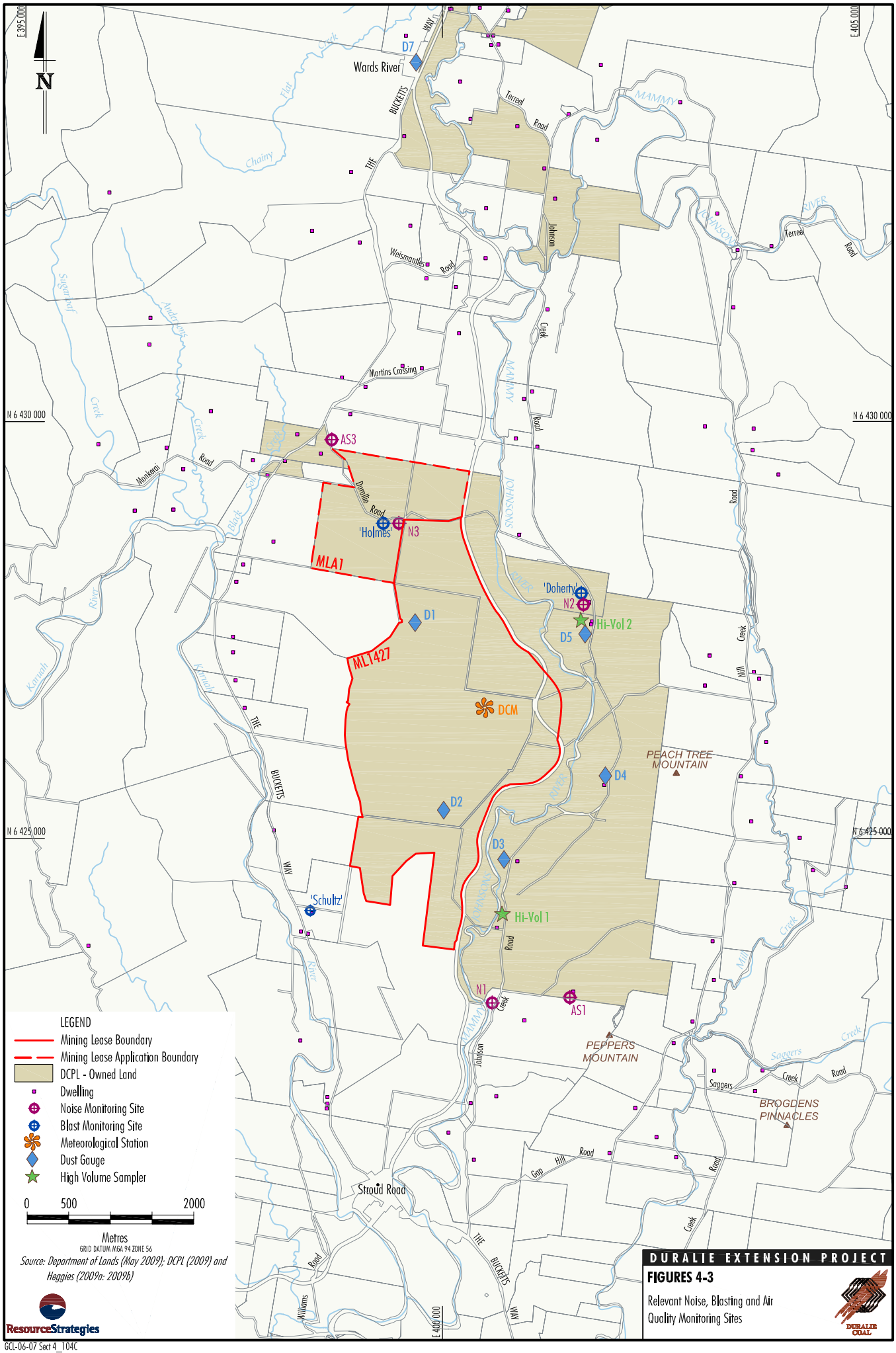
4.5.1 Existing Environment

Noise and Blasting Management and Monitoring Regime

Noise and blasting management and monitoring is conducted at the DCM in accordance with the Noise Monitoring Program (NMP) (DCPL, 2007b) and the Blast Monitoring Program (BMP) (DCPL, 2007c). The NMP includes noise monitoring requirements, noise mitigation measures, noise complaint response procedures and stakeholder consultation requirements. The NMP describes general noise management and mitigation measures that are implemented at the DCM including (DCPL, 2007b):

- Awareness and understanding of noise issues through site inductions for all staff and contractors at the DCM.
- Avoiding the simultaneous use of significant noise generating equipment, where practicable.
- Scheduling noisy activities to the least sensitive times of the day, where practicable.
- Monitoring weather conditions and modifying operations to reduce noise impacts, where practicable.
- Regular maintenance of machinery and plant used on-site and dedicated locomotives and rolling stock used off-site.
- Strategic placement of waste rock in order to provide an acoustic barrier, where practicable.
- Reducing the volume of reversing sirens and start-up alarms to the minimum practicable level in accordance with coal mine safety regulations and use of less intrusive reversing alarms.
- Use of low noise mobile and fixed plant equipment where practicably achievable.
- Conduct of bi-annual acoustic surveys to ascertain the sound power levels of individual items of plant and equipment.

Noise monitoring is conducted on a quarterly basis at the locations shown on Figure 4-3.


E 395 000
E 405 000
N 6 430 000
N 6 425 000
E 400 000
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D7
Wards River
WAY
BUCKETTS
THE
Terreel Road
MAMMY
Chainy
Flat Creek
Johnson
Weismantles Road
Martins Crossing
Creek
Sugarloaf
Anderleys
Monkerai Road
Black Swamp Creek
AS3
Duralie Road
'Holmes'
N3
MLA1
SNOWHOLE
'Doherty'
N2
Hi-Vol 2
D5
D1
ML1427
DCM
Kanah
Kennedy
River
PEACH TREE MOUNTAIN
D4
D2
D3
'Schultz'
Hi-Vol 1
N1
AS1
PEPPERS MOUNTAIN
Saggers Creek
BROGDENS PINNACLES
Stroud Road
Gap Hill Road
Williams Road
LEGEND
Mining Lease Boundary
Mining Lease Application Boundary
DCPL - Owned Land
Dwelling
Noise Monitoring Site
Blast Monitoring Site
Meteorological Station
Dust Gauge
High Volume Sampler
0 500 2000
Metres
GRID DATUM: MGA 94 ZONE 56
Source: Department of Lands (May 2009); DCPL (2009) and Heggies (2009a; 2009b)
ResourceStrategies
DURALIE EXTENSION PROJECT
FIGURES 4-3
Relevant Noise, Blasting and Air Quality Monitoring Sites
DURALIE COAL
GCL-06-07 Sect 4_104C

Temperature Inversion Measurement

The current noise limits stipulated in the existing DCM Development Consent (DA 168/99) (Consent Condition 2 of Schedule 3) with respect to temperature inversions, state:

> *The noise emission limits … apply under all meteorological conditions except for:*
>
> *… temperature inversions with a strength of greater than 3°C/100 m for all receivers…*

During attended night-time noise monitoring DCPL undertake direct temperature measurements at heights above ground level of approximately 10 m and 60 m at two locations (one to the north and one south of the DCM) to determine the strength of any temperature inversion that may be present. Direct temperature inversion measurements are undertaken in all seasons. For the purposes of determining noise compliance the results of the temperature inversion monitoring are converted to a temperature gradient (^{o}C/100 m) for comparison to the inversion strength conditions stipulated in the Development Consent.

The BMP (DCPL, 2007c) includes blast monitoring requirements, management measures and blasting notification requirements. The BMP describes general blasting management and mitigation measures that are implemented at the DCM including (DCPL, 2007c):

- Appropriate blast design addressing aspects including total charge size, instantaneous charge size, delay between hole explosive initiation, direction of initiation (taking into account potentially affected receivers), type and quantity of stemming material and geology.
- Evaluation of the overpressure enhancing potential offered by adverse prevailing weather conditions, particularly low, dense cloud cover and strong winds.
- Adequate preparation of the blast floor (by dozing or grading) to provide an even surface for drilling.
- Inspection of the blast floor to ensure that there is no significant geological weakness (e.g. fracturing from a previous blast) that may contribute to inadequate containment of explosive energy during blasting.
- Maintaining the integrity of the stemming material such that it is not contaminated with foreign matter such as clay which may result in the explosive materials being insufficiently stemmed.

DCM monitoring of ground vibration and airblast overpressure is undertaken at the locations shown on Figure 4-3.

DCM Compliance and Complaints

DCPL maintains a complaints register in accordance with the DCM Development Consent and the Environmental Management Strategy (DCPL, 2007d). Since 2003 operational noise complaints have varied from zero complaints in 2004 to a maximum of 24 in 2006. Some 20 operational noise complaints were received in 2008. To date in 2009 some 15 operational noise complaints have been received from five complainants.

Only a limited number of rail noise-related and blasting-related complaints have been received at the DCM (totals of 14 and six complaints respectively, over seven years) (Appendix C).

Monitoring undertaken since 2003 has demonstrated general compliance with noise and blasting criteria, with only occasional exceedances being recorded (Appendix C).

Noise Measurement and Description

The assessed noise levels presented in Appendix C and summarised in this section are expressed in A-weighted decibels (dBA). The logarithmic dBA scale simulates the response of the human ear, which is more sensitive to mid to high frequency sounds and relatively less sensitive to lower frequency sounds. Table 4-9 provides information on common noise sources in dBA for comparative reference.

Hearing "nuisance" for most people begins at noise levels of about 70 dBA, while sustained (i.e. eight hours) noise levels of 85 dBA can cause hearing damage.

Measured or predicted noise levels are expressed as statistical noise exceedance levels (L_{AN}) which are the levels exceeded for a specified percentage (N) of the interval period. For example, L_{A10} is the noise level that is exceeded for 10% of the sampling period and is considered to be the average maximum noise level.

The equivalent continuous noise level (L_{Aeq}) refers to the steady sound level, which is equal in energy to the fluctuating levels recorded over the sampling period.

Table 4-9
Relative Scale of Various Noise Sources

Noise Level (dBA)	Relative Loudness	Common Indoor Noise Levels	Common Outdoor Noise Levels
110 to 130	Extremely noisy	Rock band	Jet flyover at 1,000 m
100	Very noisy	Internal demolition work (jackhammer)	Petrol engine lawn mower at 1 m
90	Very noisy	Food blender at 1 m	Diesel truck at 15 m
80	Loud	Garbage disposal at 1 m, shouting at 1 m	Urban daytime noise
70	Loud	Vacuum cleaner at 3 m, normal speech at 1 m	Commercial area heavy traffic at 100 m
60	Moderate to quiet	Large business office	-
50	Moderate to quiet	Dishwasher next room, wind in trees	Quiet urban daytime
40	Quiet to very quiet	Small theatre, large conference room (background), library	Quiet urban night-time
30	Quiet to very quiet	Bedroom at night, concert hall (background)	Quiet rural night-time
20	Almost silent	Broadcast and recording studio	-
0 to 10	Silent	Threshold of hearing	-

Source: After United States Department of the Interior (1994) and Richard Heggie Associates (1995).

Blasting Measurement and Description

Overpressure (or airblast) is reported in linear decibels (dBL) and is the measurable effect of a blast on air pressure, including generated energy that is below the limit of human hearing. Ground vibration is the measurable movement of the ground surface caused by a blast and is measured in millimetres per second (mm/s) as Peak Vector Sum (PVS) vibration velocity.

Discernible blast emission effects can be divided into the three categories listed below:

1. Occupants of a building can be inconvenienced or disturbed (i.e. temporary amenity effects).
2. Contents of a building can be affected.
3. Integrity of a building structure can be affected.

An individual's response to blasting vibration and overpressure is highly dependent on previous experience and expectations.

Background Noise Levels - Operations

Baseline noise surveys were conducted in the winter of 1995 for the Duralie Coal EIS by Richard Heggie Associates (1996) prior to the commencement of mining operations at the DCM.

Supplementary noise surveys were conducted in November 2007 to quantify ambient noise levels (i.e. all noise sources) and to estimate industrial noise only (i.e. in the absence of transport, natural and domestic noise). The measurement methodology and analysis procedures are described in Appendix C.

Rating Background Level

The rating background level (RBL) is a calculated median background level representing each assessment period (day/evening/night) over the whole monitoring period. The RBL measurement methodology and analytical procedures are described in further detail in Appendix C. The RBLs are presented in Table 4-10 and form the basis of establishing the Project-specific noise assessment criteria (Section 4.5.2).

Background Noise Levels - Rail Traffic

A rail traffic noise survey was conducted in November 2007 to quantify rail traffic noise adjacent to the North Coast Railway. Monitored daytime/evening $L_{Aeq(15hour)}$, night-time $L_{Aeq(9hour)}$ and maximum pass-by rail noise levels are provided in Table 4-11.

The intrusive and average maximum pass-by noise measurement results for the four train types are within the expected variation for rail traffic (Appendix C). The surveys indicated that the existing DCM train is noisier than other trains measured on the North Coast Railway (Table 4-11).

Table 4-10
Background Noise and Amenity Levels for Assessment Purposes (dBA)

Receiver	Estimated RBL All Noise Sources[1]			Estimated $L_{Aeq(period)}$ Industrial Noise Only[1]		
	Daytime	Evening	Night-time	Daytime	Evening	Night-time
All residential receivers	30	30	30	<44	<39	<34

Source: Appendix C.

[1] Daytime – 7.00 am to 6.00 pm; evening – 6.00 pm to 10.00 pm; and night-time – 10.00 pm to 7.00 am.

Table 4-11
Unattended Rail Traffic Noise Monitoring Results

Offset Distance from Railway	Train Type	Pass-by Intrusive $L_{Aeq(15minute)}$	Pass-by Average Maximum	Pass-by 5% Exceedance Maximum	Daytime/ Evening $L_{Aeq(15hour)}$	Night-time $L_{Aeq(9hour)}$
12 m	Passenger	65 dBA	90 dBA	95 dBA	64 dBA	57 dBA
	General Freight	68 dBA	92 dBA	97 dBA		
	DCM[1]	69 dBA	95 dBA	101 dBA		
	SCM[2]	67 dBA	92 dBA	96 dBA		

Source: Appendix C.

1 Locomotives class QR423, 1,120 kW, built 1967/69.

2 Locomotives class 82, 2,260 kW, built 1994/95.

4.5.2 Potential Impacts

Operational Noise

Noise Criteria

The INP assessment procedure for industrial noise sources has two components (EPA, 2000):

- controlling potential intrusive noise impacts in the short-term for residences; and
- maintaining noise level amenity for particular land uses, for residences and other land uses.

The INP prescribes detailed calculation routines for establishing Project-specific $L_{Aeq(15minute)}$ intrusive criteria and $L_{Aeq(period)}$ amenity criteria. The INP Project-specific intrusive and amenity assessment criteria for the Project are presented in Table 4-12.

As the applicable Project-specific intrusive criteria are the most stringent, Appendix C assesses noise levels against the intrusive criteria.

In those cases where the INP Project-specific assessment criteria are exceeded, it does not automatically follow that all people exposed to the noise would find the noise noticeable or unacceptable.

In subjective terms, exceedances of the INP Project-specific assessment criteria can be generally described as follows (Appendix C):

- negligible noise level exceedance (less than 1 dBA) (not noticeable by all people);
- marginal noise level exceedance (between 1 and 2 dBA) (not noticeable by most people);
- moderate noise level exceedance (between 3 and 5 dBA) (not noticeable by some people but may be noticeable by others); and
- appreciable noise level exceedance (greater than 5 dBA) (noticeable by most people).

For the purposes of assessing potential noise impacts, exceedances can be separated into a Noise Management Zone (i.e. 1 to 5 dBA above the criteria) and a Noise Affectation Zone (i.e. greater than 5 dBA above the criteria). Table 4-13 presents the methodology used for assessing operational noise against the INP Project-specific noise assessment criteria (Table 4-12).

Table 4-12
INP Project-specific Intrusive and Amenity Assessment Criteria (dBA)

Receiver	Land Use	Intrusive $L_{Aeq(15minute)}$ [1]			Amenity $L_{Aeq(period)}$ [1]		
		Day	Evening	Night	Day	Evening	Night
All residential receivers	Rural Residential	35	35	35	50	45	40

Source: Appendix C.

[1] Daytime – 7.00 am to 6.00 pm; evening – 6.00 pm to 10.00 pm; and night-time – 10.00 pm to 7.00 am.

Table 4-13
Project-specific Noise Assessment Methodology

Assessment Criteria	Project-specific Criteria	Noise Management Zone		Noise Affectation Zone
		Marginal	Moderate	
Intrusive $L_{Aeq(15minute)}$	35 dBA	1 to 2 dBA above Project-specific criteria	3 to 5 dBA above Project-specific criteria	> 5 dBA above Project-specific criteria

Source: Appendix C.

Construction Noise

Construction works for the Project would be limited, but would include raising of Auxiliary Dam No. 2. Other construction works for the Project would include development of new haul roads and internal roads and infrastructure upgrades. Construction activities would be generally carried-out during the daytime throughout the Project life (Appendix C).

In accordance with the DECCW (2009b) *Interim Construction Noise Guideline*, mine construction activities are generally considered integral with the general mining operations. Therefore the construction works associated with Auxiliary Dam No. 2 embankment lift have been modelled as a component of Project daytime operational activities in Year 3.

Noise Modelling

An acoustic model was developed that simulates the Project components using noise source information (i.e. sound levels and locations) and predicts noise levels at relevant receiver locations. The model considers meteorological effects, surrounding terrain, distance from source to receiver and noise attenuation (Appendix C).

The locations of modelled receivers (dwellings) are shown on Figure 4-4.

Noise Modelling Scenarios

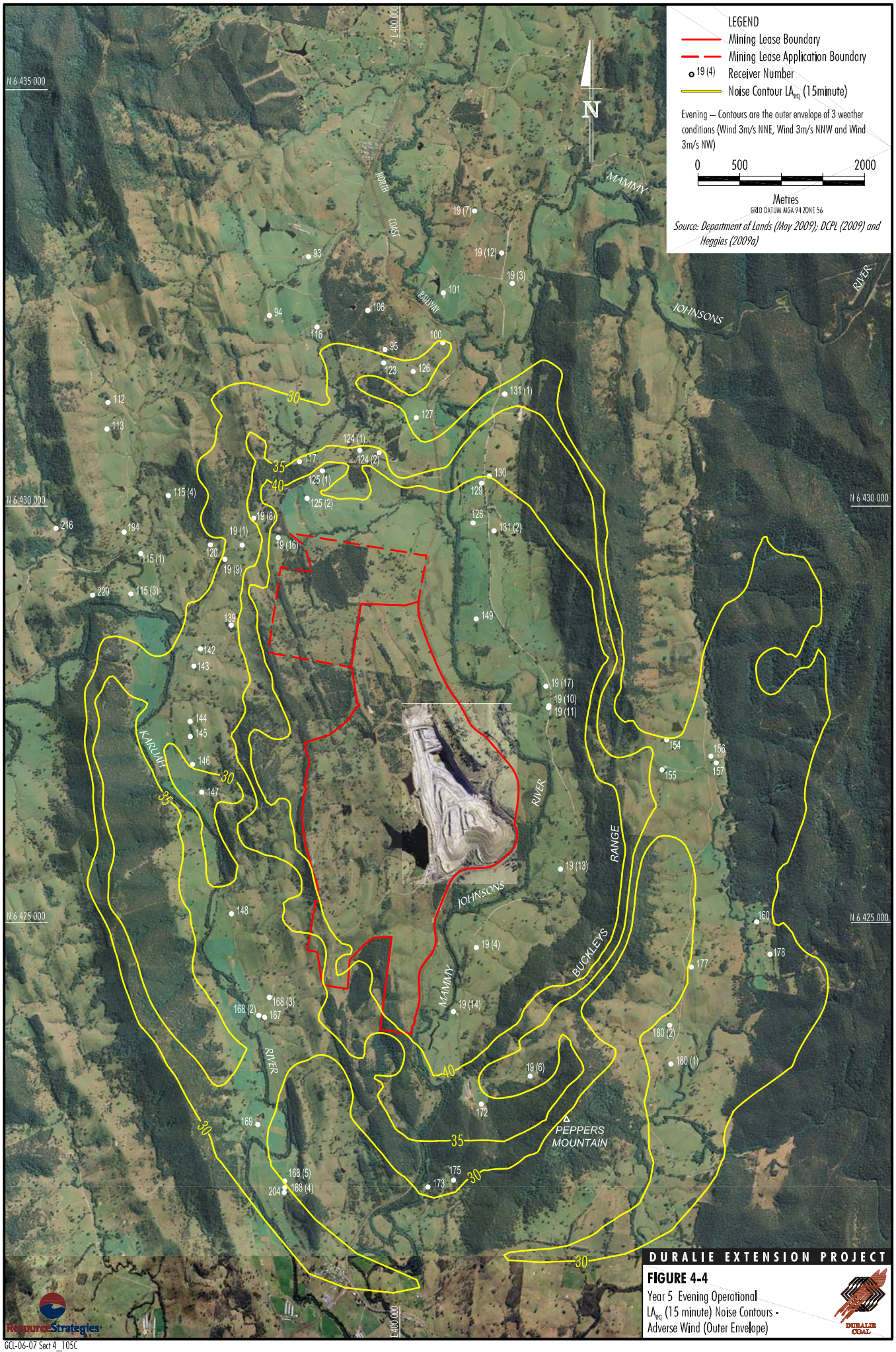
Three scenarios based on the progressive development of the Project were assessed:

- Year 3 operations including mining in the northern extremity of the Weismantel Extension open pit plus the early stages of mining in the Clareval North West open pit (Figure 2-5).
- Year 5 operations including mining in the Clareval North West open pit (Figure 2-6) plus peak ROM coal and waste rock production (Table 2-1).
- Year 8 including mining in the northern extremity of the Clareval North West open pit (Figure 2-7).

Assessment of Feasible and Reasonable Noise Mitigation Measures

Heggies (2009a) conducted an investigation of feasible and reasonable noise mitigation measures, particularly in relation to night-time operations. A number of iterative steps were undertaken to develop noise mitigation measures for the Project, including (Appendix C):

1. Preliminary noise modelling of scenarios representative of the maximum noise emissions from the Project to identify the potential for noise exceedances.
2. Evaluation of various combinations of noise management and mitigation measures to assess their relative effectiveness.



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3. Review of the effectiveness of these measures and assessment of their feasibility by DCPL.

4. Adoption by DCPL of a range of noise management and mitigation measures (including low noise equipment and operational controls) to appreciably reduce noise emissions associated with the Project, including:

   - additional mobile equipment necessary to meet Project increased ROM coal production to be low noise emission standard, including up to 16 new CAT 785XQ haul trucks and attenuation of other new plant items (i.e. dozer, excavator, drill and grader);
   - restriction of use of two existing CAT 789 haul trucks to daytime operations only;
   - waste rock emplacement activities on elevated/exposed portions of the waste rock emplacement to occur during daytime only; and
   - restriction of the height of the waste rock emplacement to RL 110 m (consistent with the existing/approved maximum height).

These feasible and reasonable mitigation measures were included in noise modelling for the Project.

Assessment of Meteorological Conditions

In accordance with the INP, Appendix C assessed meteorological data collected at the DCM to determine the prevailing meteorological conditions for noise modelling. These prevailing conditions generally have the effect of increasing noise levels at receivers relative to calm conditions. Details of the analysis and the prevailing meteorological conditions modelled are provided in Appendix C.

Predicted Noise Emissions

Table 4-14 presents a summary of privately owned receivers with predicted Project noise levels that exceed Project-specific criteria.

In summary, the operational noise assessment indicates the following (Appendix C):

- Due to the noise enhancing meteorological conditions, the number of predicted exceedances is highest at night.
- A total of 32 privately owned receivers exceed the Project-specific criteria, including 17 receivers within the Noise Management Zone (1 to 5 dBA above criteria), and 15 receivers in the Noise Affectation Zone (> 5 dBA above criteria) (Table 4-14).

Table 4-14
Privately owned Receivers with Predicted Project-specific Criteria Exceedances

Noise Management Zone[1]		Noise Affection Zone[1]
1 to 2 dBA Exceedance	**3 to 5 dBA Exceedance**	**> 5 dBA Exceedance**
94 Howard	95 Smith & Ramsey	116 Weismantel
101 Holloway	100 Richards	117 Holmes[3]
146 Bragg	106 James	123 Oleksiuk & Carmody
155 Guberina	144 Wielgosinski	124 (1) Bailey[2]
156 Hope	172 Lyall[3]	124 (2) Bailey[2]
157 Stephenson		125 (1) Zulumovski
167 Ravagnani		125 (2) Zulumovski[2]
169 Williams		126 Hamann-Pixalu PL
173 Trigg & Holland		127 Fisher-Webster
177 Thompson		128 Hare-Scott[2]
180 (1) Thompson		129 Weismantel[2]
220 Lindfield & Associates PL		130 Giudice[2]
		131 (1) Relton
		131 (2) Relton[2]
		149 Hattam PL[3]

Source: After Appendix C.

1 Receivers shown on Figure 4-4.

2 Properties identified in the existing DCM Development Consent (DA 168/99) as being in the Noise Management Zone (in accordance with the definition provided above).

3 Properties identified in the existing DCM Development Consent (DA 168/99) as being in the Noise Affectation Zone (in accordance with the definition provided above).

- Ten of the 32 private receivers listed in Table 4-14 are already identified in the existing Development Consent as within existing/approved DCM noise management or noise affectation zones.
- The majority of exceedances occur during Year 5, when peak ROM coal production would occur and peak mobile fleet numbers would be required.

Private vacant land was also assessed against the Project-specific noise assessment criteria. Privately owned vacant land where Project-specific noise assessment criteria are predicted to be exceeded over more than 25% of the property area are identified in Table 4-15.

Table 4-15
Vacant Land with Project-specific Noise Level Exceedances

Noise Management Zone[1]		Noise Affection Zone[1]
1 to 2 dBA Exceedance	**3 to 5 dBA Exceedance**	**> 5 dBA Exceedance**
140 Bennett & Stark 158 Gilbert	-	104 Mudford[2] 118 Moylan 122 White

Source: After Appendix C.

1 Lands shown on Figures 1-3a and 1-3b.

2 Property identified in the existing DCM Development Consent (DA 168/99) as being in the Noise Affectation Zone.

Year 5 evening $L_{Aeq(15minute)}$ intrusive noise contours during adverse wind conditions are presented on Figure 4-4. Year 5 night-time $L_{Aeq(15minute)}$ intrusive noise contours during adverse temperature inversion and drainage flow conditions are presented on Figure 4-5. The development of the noise contours involves interpolation. In some cases the contours presented on Figures 4-4 and 4-5 will vary from the point-source calculations presented in Appendix C, particularly where topographic effects are prominent (Appendix C).

Rail Noise

Rail Noise Criteria

The DECCW's rail noise assessment trigger levels are presented in Table 4-16. An assessment of rail noise impacts against the ARTC's EPL is presented in Appendix C.

Predicted Rail Noise Emissions

A description of the existing DCM and proposed Project rail movements is provided in Section 2.6. As a component of the Project the existing locomotives that service the DCM would be replaced by GL class locomotives (or equivalent) from Year 2 (or sooner, subject to contract arrangements). The GL class locomotives are quieter than the existing DCM trains (Table 4-11). Upon their introduction, rail operating hours would be extended to 2.00 am. Prior to the introduction of the GL class locomotives, the existing locomotives would continue to be used during the existing/approved hours (i.e. no DCM rail movements would occur between 10.00 pm and 7.00 am).

The predicted daytime/evening $L_{Aeq(15hour)}$ and night-time $L_{Aeq(9hour)}$ noise levels for cumulative existing/approved rail traffic with Project average and peak train movements are presented in Table 4-17.

Comparison of the predicted rail traffic noise levels (Table 4-17) with the applicable DECCW criteria (Table 4-16) indicates (Appendix C):

- Prior to the replacement of the current DCM train locomotives with GL class locomotives, rail noise from peak rail traffic is predicted to meet the $L_{Aeq(24hour)}$ 60 dBA criterion at a distance of 60 m (and greater).
- Following the introduction of GL class locomotives, the cumulative peak $L_{Aeq(24hour)}$ rail noise would be the same as the existing/approved situation. This is because whilst two additional train pass-bys would be introduced, 'GL' class locomotives (or equivalent) would be used which are relatively quieter than the existing DCM trains.
- The existing/approved maximum rail pass-by noise is predicted to meet the DECCW criterion of 85 dBA (Table 4-16) at a distance of 70 m (and greater) (Appendix C). Approximately 22 receivers are located within 70 m of the railway. This would remain unchanged prior to the introduction of the GL class locomotives.
- With the introduction of the GL class locomotives, maximum pass-by rail noise would decrease and would meet the 85 dBA criterion at a distance of 50 m (and greater). The existing situation where this criteria is currently exceeded is predicted to improve at fifteen residences (i.e. exceedances would no longer occur) as a result of replacing the existing DCM locomotive with the GL class locomotive.

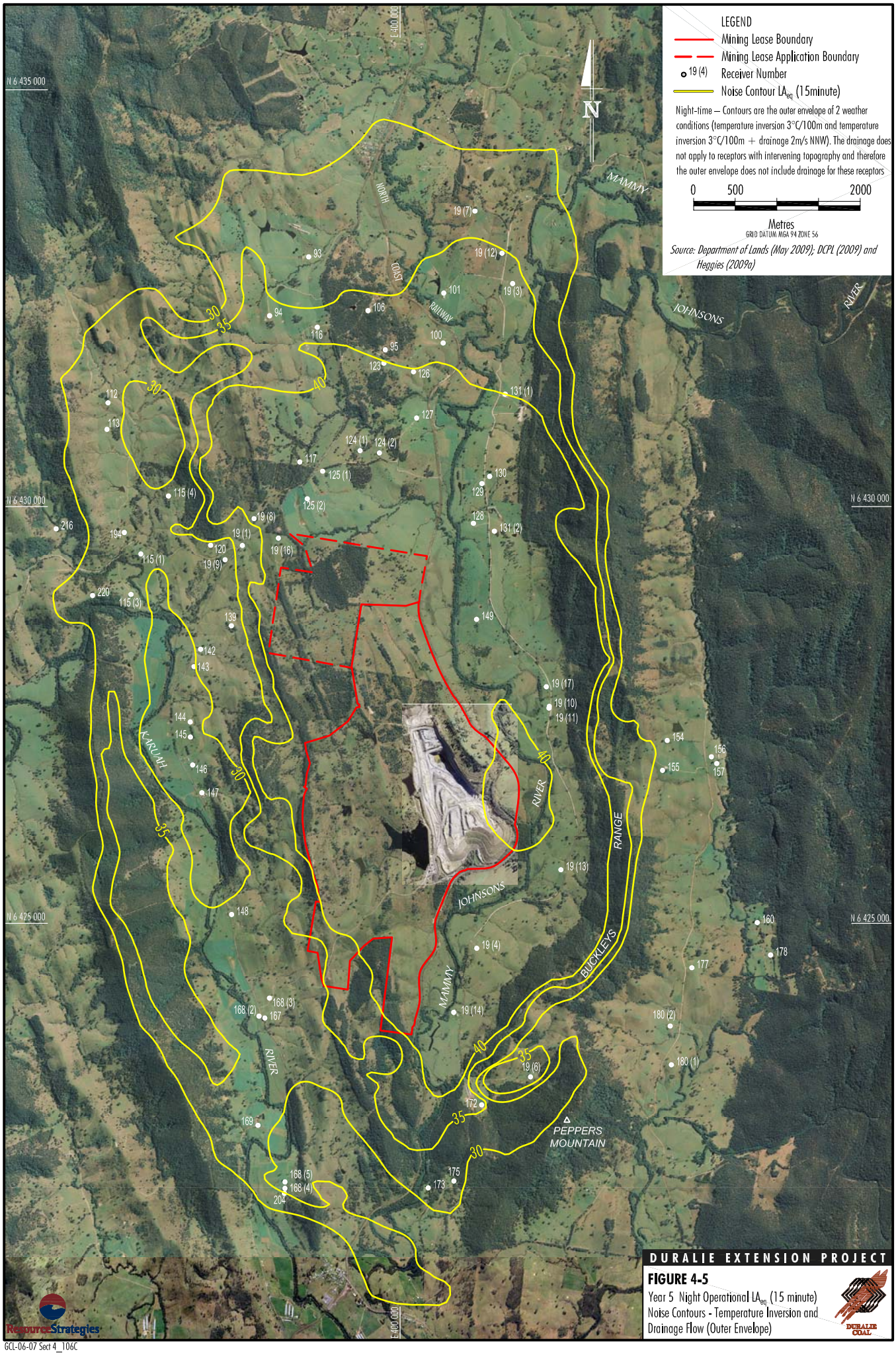

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Table 4-16
North Coast Railway Noise Assessment Criteria

Descriptor	Rail Traffic Goal
LAeq(24hour)	60 dBA
Maximum Pass-by LAmax (95th percentile)	85 dBA

Source: Appendix C.

Table 4-17
Predicted Rail Noise Emissions (dBA)

Distance to Receiver (m)	No. of Receivers	Combined Existing/Approved and Project Rail Movements - Year 1			Combined Existing/Approved and Project Rail Movements – Year 2 Onwards		
		Average LAeq(24hour)	Peak LAeq(24hour)	Pass-by Maximum	Average LAeq(24hour)	Peak LAeq(24hour)	Pass-by Maximum
0-20 m	Nil	64	65	96	64	65	93
20-40 m	3	61	62	90	61	62	87
40-60 m	9	59	60	87	59	60	83
60-80 m	21	58	59	84	58	59	81
80-100 m	2	57	58	82	57	58	79

Source: After Appendix C.

The existing/approved maximum rail pass-by noise is predicted to meet the DECCW criterion of 85 dBA (Table 4-16) at a distance of 70 m (and greater) (Appendix C). Approximately 22 receivers are located within 70 m of the railway. This would remain unchanged prior to the introduction of the GL class locomotives.

With the introduction of the GL class locomotives, maximum pass-by rail noise would decrease and would meet the 85 dBA criterion at a distance of 50 m (and greater). Fifteen receivers where the 85 dBA maximum pass-by criterion is currently exceeeded are predicted to meet the criterion as a result of the adoption of the GL class locomotives for the DCM train (Appendix C).

Road Traffic Noise

The Project has potential to generate additional traffic on public roads as a result of the additional workforce and deliveries.

The ECRTN establishes that where the nominated criteria are already exceeded (as is the case at many roads in NSW), traffic associated with the Project should not be permitted to lead to an increase in the existing traffic noise levels of more than 2 dBA (EPA, 1999). Appendix C uses the methodology that any increase in traffic movements of less than 60% would not result in a corresponding increase in road traffic noise of greater than 2 dBA.

The anticipated Project increases in vehicle movements on The Bucketts Way and Durallie Road are much less than 60% and therefore the corresponding increase in traffic noise would be well within 2 dBA, hence any traffic noise impacts that do arise are likely to be acceptable (Appendix C).

Blasting

Blasting Criteria

Ground vibration and airblast levels which cause human discomfort are generally lower than the recommended structural damage limits. Therefore, compliance with the lowest applicable human comfort criteria generally ensures that the potential to cause structural damage to buildings is minimal.

The DECCW currently adopts the ANZECC (1990) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* for assessing potential annoyance from blast emissions during daytime hours, as follows:

- The recommended maximum level for airblast is 115 dBL.
- The level of 115 dBL may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 120 dBL at any time.

- The recommended maximum for ground vibration is 5 mm/s, PVS vibration velocity.
- The PVS level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/s at any time.

AS 2187: Part 2-2006 *Explosives - Storage and Use - Part 2: Use of Explosives* provides guidance in assessing blast-induced ground (and structural) vibration and airblast effects on buildings and their occupants. In relation to building damage airblast criteria, AS 2187 recommends a maximum airblast of 133 decibels (dB) (peak linear [pkLinear]). In accordance with AS 2187, Appendix C adopts 10 mm/s as the building damage vibration criterion.

The Former Weismantels Inn is of heritage significance (Section 4.12.1) and is located approximately 600 m from the Clareval North West open pit. The building is owned by DCPL and is in good condition (Appendix K). A vibration damage criterion of 10 mm/s (Peak Component Particle Velocity) would be applicable to the Former Weismantels Inn (Appendix C).

The Mammy Johnson's Grave is a site of Aboriginal heritage significance (Section 4.11.1), located some 2.5 km south-east of the closest blasting activities in the Weismantel open pit. In accordance with Condition 8, Schedule 3 of the DCM Development Consent (DA 168/99), the applicable vibration limit for Mammy Johnson's Grave is 5 mm/s (with an allowable exceedance of 5% of the total number of blasts over a period of 12 months).

Predicted Blasting Emission Levels and Mitigation Measures

Consistent with the BMP, appropriate blast designs addressing aspects including total charge size, instantaneous charge size, delay between hole explosive initiation, direction of initiation, type and quantity of stemming material and geology would be undertaken for the Project (Section 4.5.3).

DCPL would vary the Maximum Instantaneous Charge (MIC) (or other relevant blasting parameters) of blasts over the life of the Project according to the location of the blast and the proximity of nearby private receivers, to minimise blasting effects at nearby receivers. MICs for the Project would range from 400 kilograms (kg) to 1,500 kg.

Preliminary blasting predictions indicated that the ANZECC human comfort vibration and airblast criteria (5 mm/s and 115 dBL, respectively) would be exceeded at a number of receivers without the application of blast management techniques. The primary management technique that would be employed is reducing the MIC of a blast.

Project blast vibration and airblast emissions were calculated at the nearest residential receivers for MICs of 1,500 kg and 400 kg to examine the effectiveness of MIC reduction in achieving applicable building damage and human comfort criteria. Point-source calculations for individual receivers are provided in Appendix C.

Building Damage Criteria

With a MIC of 400 kg, the blast emission levels are predicted to be below the building damage criteria of 10 mm/s (vibration) and 133 dB pkLinear (airblast) at all private receivers (Appendix C).

Human Comfort Criteria

With a MIC of 400 kg, the vibration velocities are predicted to be below the 5 mm/s human comfort criterion at all private receivers and airblast levels are predicted to be equal to or below the 115 dB pkLinear criteria at all except six nearest privately owned receivers, *viz.* (Figure 4-4) (Appendix C):

- Zulumovski (two dwellings 125[1][2]);
- Juttner (139);
- Mahony (120);
- Holmes (117); and
- Madden (142).

The blasting predictions presented above indicate that with the implementation of suitable blasting management measures (e.g. reduction of blast MIC to 400 kg) blasting emissions would generally comply with the most stringent human comfort criteria (i.e. airblast criterion of 115 dBL) at nearby private receivers, with the exception of the six nearest privately owned receivers.

Additional analysis of potential blasting impacts by Heggies indicated that significant further reductions of MICs would be required to achieve the human comfort airblast criterion. These further reductions are not considered to be feasible by DCPL.

Relevant Heritage Sites

Predicted Project blasting vibration velocities are below current DCM Development Consent criteria of 5 mm/s at Mammy Johnson's Grave for all Project blasts modelled (Appendix C).

With an MIC of 400 kg, blasting emission levels at the Former Weismantels Inn are predicted to comply with the vibration damage criterion of 10 mm/s (Peak Component Particle Velocity) and 133 dB pkLinear (airblast).

Flyrock

Flyrock is any material ejected from the blast site by the force of the blast. Operational experience indicates that the majority of blasts result in either no flyrock or limited flyrock distributed less than 50 m from the blast (Appendix C). Flyrock would be managed through appropriate blast design in accordance with the BMP (Section 4.5.3). When blasts are undertaken within 500 m of Durallie Road, the relevant section of the road would be temporarily closed (Section 4.5.3).

4.5.3 Mitigation Measures, Management and Monitoring

Noise and blasting mitigation and management measures for the existing DCM are described in the NMP and the BMP (Section 4.5.1). These plans would be reviewed and updated to address the Project, subject to the conditions of any Project Approval.

Noise Mitigation Measures

The private receivers where noise emissions are predicted to exceed the Project-specific criteria can be divided into a Noise Management Zone and a Noise Affectation Zone (Table 4-13). Proposed management procedures for receivers in these zones are described below.

Noise Management Zone

Depending on the degree of exceedance of the Project-specific criteria, potential noise impacts in the Noise Management Zone could range from marginal to moderate (in terms of the perceived noise level increase). In addition to the noise mitigation measures included in the predictive modelling, noise management procedures would include:

- noise monitoring on-site and within the community;
- prompt response to any community issues of concern and complaints;
- refinement of on-site noise mitigation measures and operating procedures where practicable; and
- implementation of reasonable and feasible acoustical mitigation at receivers (which may include measures such as enhanced glazing, insulation and/or air-conditioning), in consultation with the relevant landowner, where noise monitoring shows noise levels which are 3 to 5 dBA above Project-specific noise criteria.

Noise Affectation Zone

Exposure to noise levels greater than 5 dBA above Project-specific criteria may be considered unacceptable by some landowners. Management procedures for the Noise Affectation Zone would include:

- discussions with relevant landowners to assess concerns and define responses;
- implementation of reasonable and feasible acoustical mitigation at receivers (which may include measures such as enhanced glazing, insulation and/or air-conditioning), in consultation with the relevant landowner, where noise monitoring shows noise levels from the mine which are greater than 5 dBA above Project-specific noise criteria; and
- negotiated agreements with landowners where required.

The NMP would be revised for the Project, subject to the conditions of any Project Approval, to include the following:

- The feasible and reasonable noise mitigation and operational management measures included in the Project noise model (Section 4.5.2).
- Revised private locations for operator attended compliance monitoring (i.e. a greater focus on receivers to the north-west) as mining progresses.
- Methodology for measuring temperature inversions, including direct measurement of temperature lapse rate during periods of attended compliance monitoring (Section 4.5.1).

- Comparison of stability class categories calculated from sigma-theta data measured at the DCM meteorological station and the results from direct measurement of temperature inversions. Over time, a relationship may emerge between calculated stability classes and measured temperature inversion strength that would assist with responding to night-time operational noise complaints.
- Establish reference location(s) for continuous operational noise monitoring to assist with mine noise management.

Rail Noise

The existing locomotives that provide DCM ROM coal transport would be replaced by quieter GL class locomotives (or equivalent) from Year 2 of the Project (or sooner, subject to contract arrangements).

Blasting Mitigation Measures

As discussed in Section 4.5.2, appropriate blast design (as described in the existing BMP) would be undertaken to reduce the potential effects of blasting at nearby receivers. The existing BMP would be revised for the Project, subject to the conditions of any Project Approval, to include the following:

- Review of vibration and airblast monitoring locations, including provision of vibration monitoring at the Former Weismantels Inn.
- Development and ongoing review of "site laws" (i.e. site based prediction equations) for ground vibration and airblast overpressure to allow refinement of blasting parameters and management measures.
- Safety control measures and notification/closure procedures in relation to blasting within 500 m of Durallie Road and nearby residential receivers as appropriate.
- Establishment of an exclusion zone around blast events, including the positioning of sentries on public access points for privately owned properties within 500 m of a blast event.
- Procedures for notification of the occupants of residential receivers within 2 km of a proposed blast prior to the blast occurring.
- A commitment to notify the occupants of residential receivers within 2 km of Project active mining areas that they are entitled to a structural property inspection by a suitably qualified, experienced and independent person.

4.6 AIR QUALITY

An Air Quality Assessment for the Project was undertaken by Heggies (2009b) and is presented as Appendix D. The assessment was conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005b).

A description of the existing environment relating to air quality is provided in Section 4.6.1. Section 4.6.2 describes the potential impacts of the Project on air quality, while Section 4.6.3 outlines air quality mitigation, management and monitoring measures.

4.6.1 Existing Environment

Air Quality Management Regime

The existing Air Quality Monitoring Program (AQMP) (DCPL, 2007e) describes the air quality management and monitoring regime at the DCM. The AQMP includes air quality monitoring requirements, air quality management protocols (including a complaint response protocol), management measures and stakeholder consultation requirements (DCPL, 2007e).

Current DCM air quality mitigation and management measures include:

- watering of haul routes;
- water spraying of coal in train wagons prior to departure from the DCM to the SCM;
- rehabilitation of the waste rock emplacement;
- irrigation of the waste rock emplacement with a travelling and fixed sprinkler irrigation system in accordance with the IMP (DCPL, 2008a);
- scheduling blasting events to avoid poor dispersion conditions (e.g. early mornings);
- watering regularly used minor roads;
- revegetating obsolete roads;

- revegetation of long-term topsoil stockpiles with a cover crop;
- dust aprons on drill rigs are lowered during drilling; and
- water sprays are used on the ROM coal hopper, all coal transfer points between the hopper and the train loading bin, including the rotary breaker.

Since the commencement of operations at the DCM in 2003, six air quality-related complaints have been received by DCPL. These complaints related to dust from DCM trains, odour from DCM trains and blast related odour and dust. No air quality-related complaints have been received in relation to general mining activities (e.g. movement of coal or waste rock) (Appendix D).

In accordance with the AQMP, DCPL collects air quality monitoring data from the existing dust monitoring network which includes two high volume air samplers (HVAS) and six dust deposition gauges (Figure 4-3). The following sub-sections describe relevant air quality criteria and provide an overview of background air quality in the vicinity of the Project.

Air Quality Criteria

Dust Deposition

The DECCW amenity criteria for dust deposition seeks to limit the maximum increase in the mean annual rate of dust deposition from a new development to 2 grams per square metre per month (g/m^2/month) and total dust deposition (i.e. including background air quality) to 4 g/m^2/month.

Concentrations of Suspended Particulate Matter

Exposure to suspended particulate matter can lead to health and amenity impacts. The likely risk of these impacts depends on a range of factors including the size, chemical make-up and concentration of the particulate matter and the general health of the person (NSW Health and NSW Minerals Council, 2006).

Such particles (referred to as total suspended particles [TSP]) are typically less than 50 micrometres (µm) in size and can be as small as 0.1 µm. Fine particles less than 10 µm are referred to as PM_{10}.

Suspended particulate matter criteria, standards and goals used in the assessment include (Appendix D):

- The DECCW 24-hour PM_{10} assessment criterion of 50 micrograms per cubic metre ($\mu g/m^3$) (for concentrations due to the Project alone).
- The DECCW annual assessment criterion for PM_{10} of 30 $\mu g/m^3$ as a concentration that should be met within the region (concentrations due to the Project plus background air quality).
- The National Health and Medical Research Council's (NHMRC's) annual goal for TSP of 90 $\mu g/m^3$ (concentrations due to the Project plus background air quality).

Details of the air quality criteria for concentrations of suspended particulate matter are provided in Table 4-18.

Table 4-18
Air Quality Assessment Criteria for Suspended Particulate Matter Concentrations

Pollutant	Criterion/Goal	Agency
TSP Matter	90 $\mu g/m^3$ (annual mean)	NHMRC
PM_{10}	50 $\mu g/m^3$ (24-hour average – maximum)*	DECCW assessment criterion
	30 $\mu g/m^3$ (annual mean)	DECCW assessment criterion

Source: After Appendix D.

* Project only emissions.

Dust Deposition

The dust deposition monitoring network at the DCM currently consists of six dust deposition gauges (Figure 4-3).

Annual averages from data collected between May 2006 and April 2009 are presented in Table 4-19. The monitoring results presented in Table 4-19 show that the area generally experiences annual average dust deposition levels well below 4 g/m^2/month.

Table 4-19
Annual Average Dust Deposition Rates (g/m^2/month)

Year	Dust Monitoring Site (Figure 4-3)					
	D1	D2	D3	D4	D5	D7
May 2006 to April 2007	1.2	1.2	1.1	0.6	0.8	-
May 2007 to April 2008	0.7	0.7	1.0	1.5	0.4	0.5
May 2008 to April 2009	0.9	0.9	0.8	1.1	0.8	0.6

Source: After Appendix D.

Monthly dust deposition levels exceeded the DECCW criterion (4 g/m^2/month) on five occasions between May 2006 and April 2009. These exceedances were attributed to sample contamination (e.g. insects, plant material) (Appendix D). These contaminated samples were excluded from the averages presented in Table 4-19.

For the purposes of the Air Quality Assessment, a value of 1.5 g/m^2/month (highest annual average recorded at the six dust deposition gauges between 2006 and 2009 – Table 4-19) was conservatively taken to be the background dust deposition level that would apply at all receivers in the vicinity of the Project (Appendix D).

Suspended Particulates

PM_{10}

PM_{10} data were obtained from the two HVAS (Hi-Vol 1 and Hi-Vol 2 - Figure 4-3) for the period September 2003 to April 2009. The monitors measure the contribution from a range of particulate matter sources, including the particulate contributions of the existing DCM.

In the past six years, the inferred annual average PM_{10} concentrations have been well below the DECCW's annual average criterion of 30 µg/m^3 at both HVAS (Table 4-20).

Table 4-20
Annual Average PM_{10} Concentrations (µg/m^3)

Year	PM_{10} Monitoring Site (Figure 4-3)	
	Hi-Vol 1	Hi-Vol 2
2003	11.4	12.8
2004	10.4	12.1
2005	12.2	12.7
2006	12.0	11.6
2007	12.5	14.5
2008	10.7	12.5

Source: After Appendix D.

The monitoring results show that the 24-hour average PM_{10} concentrations have been above the DECCW's 24-hour maximum assessment criterion of 50 µg/m^3 on one occasion at Hi-Vol 1 and two occasions at Hi-Vol 2 over the monitoring period. Following review of regional PM_{10} concentrations on these occasions, these exceedances were attributed to regional (i.e. non-DCM) sources (Appendix D).

For the purposes of the Air Quality Assessment, a value of 14.5 µg/m^3 (highest annual average recorded at the two HVAS between 2003 and 2009 – Table 4-20) was conservatively taken to be the annual average PM_{10} background concentration that would apply at all potential receivers in the vicinity of the Project (Appendix D).

TSP

TSP concentrations can be inferred from the PM_{10} monitoring data, by assuming that 40% of the TSP is PM_{10}. This relationship was obtained from data collected from co-located TSP and PM_{10} monitors that were operated for periods of time in the Hunter Valley (NSW Minerals Council, 2000).

Based on inferred concentrations, it has been assumed that the annual average TSP background concentration is 36.3 µg/m^3, which is well below the DECCW assessment criterion of 90 µg/m^3 (Appendix D).

4.6.2 Potential Impacts

Appendix D predicts the air quality emissions likely to be generated by the Project and the predicted impact of these emissions in combination with existing background air quality in the vicinity of the Project.

The background levels adopted for the Air Quality Assessment (Appendix D) included contributions of dust emissions from the existing DCM. The predicted cumulative air quality levels would therefore double-count some of the current DCM emissions (since they are also included in the predicted Project emissions), which would add further conservatism to the assessment.

The majority of the potential air quality-related impacts due to the Project are related to dust and suspended particulate emissions from the extension of open pit mining activities (primarily from the haulage of materials within the Project area and wind blown emissions from exposed surfaces).

Modelling Scenarios

Potential Project dust deposition levels and suspended particulates concentrations were modelled for three scenarios over the life of the Project, *viz*:

- Year 3 operations including mining in the northern extremity of the Weismantel Extension open pit plus the early stages of mining in the Clareval North West open pit (Figure 2-5).
- Year 5 operations including mining in the Clareval North West open pit (Figure 2-6) plus peak ROM coal and waste rock production (Table 2-1).
- Year 8 including mining in the northern extremity of the Clareval North West open pit (Figure 2-7).

The provisional Project production schedule is presented in Table 2-1. A full description of the dispersion model, emissions inventory (including the locations of dust sources) and modelling outputs is provided in Appendix D.

Dust Deposition

In accordance with the DECCW's dust deposition criteria, dust deposition from the Project in isolation and including background air quality were assessed for Years 3, 5 and 8.

Project only incremental increases in annual average dust deposition were not predicted to exceed the applicable 2 g/m^2/month DECCW amenity criterion at any receiver (Appendix D).

Annual average dust deposition due to the Project plus the assumed background level (1.5 g/m^2/month) was also not predicted to exceed the applicable 4 g/m^2/month DECCW amenity criterion at any receiver (Appendix D).

Suspended Particulates

Annual Average PM_{10}

Predicted annual average PM_{10} (Project plus background) concentrations were not predicted to exceed the 30 µg/m^3 DECCW assessment criterion at any receiver (Appendix D).

24-Hour PM_{10}

Project-only predicted 24-hour PM_{10} concentrations modelled for Years 3, 5 and 8 were not predicted to be above the 50 µg/m^3 DECCW assessment criterion at any privately owned receivers with the exception of one private receiver (Hattam [149]) that is located in close proximity to the mining operations (Figure 4-6) (Appendix D).

Figure 4-6 shows the predicted maximum 24-hour PM_{10} contours (Project only) in Years 3, 5 and 8. The development of the particulate emission contours involves interpolation and in some cases the contours presented on Figure 4-6 will vary from the point-source calculations presented in Appendix D.

Annual Average TSP

Annual average TSP (Project plus background) concentrations modelled for Years 3, 5 and 8 were not predicted to be above the DECCW assessment criterion of 90 µg/m^3 at any receiver (Appendix D).

Rail Transport Emissions

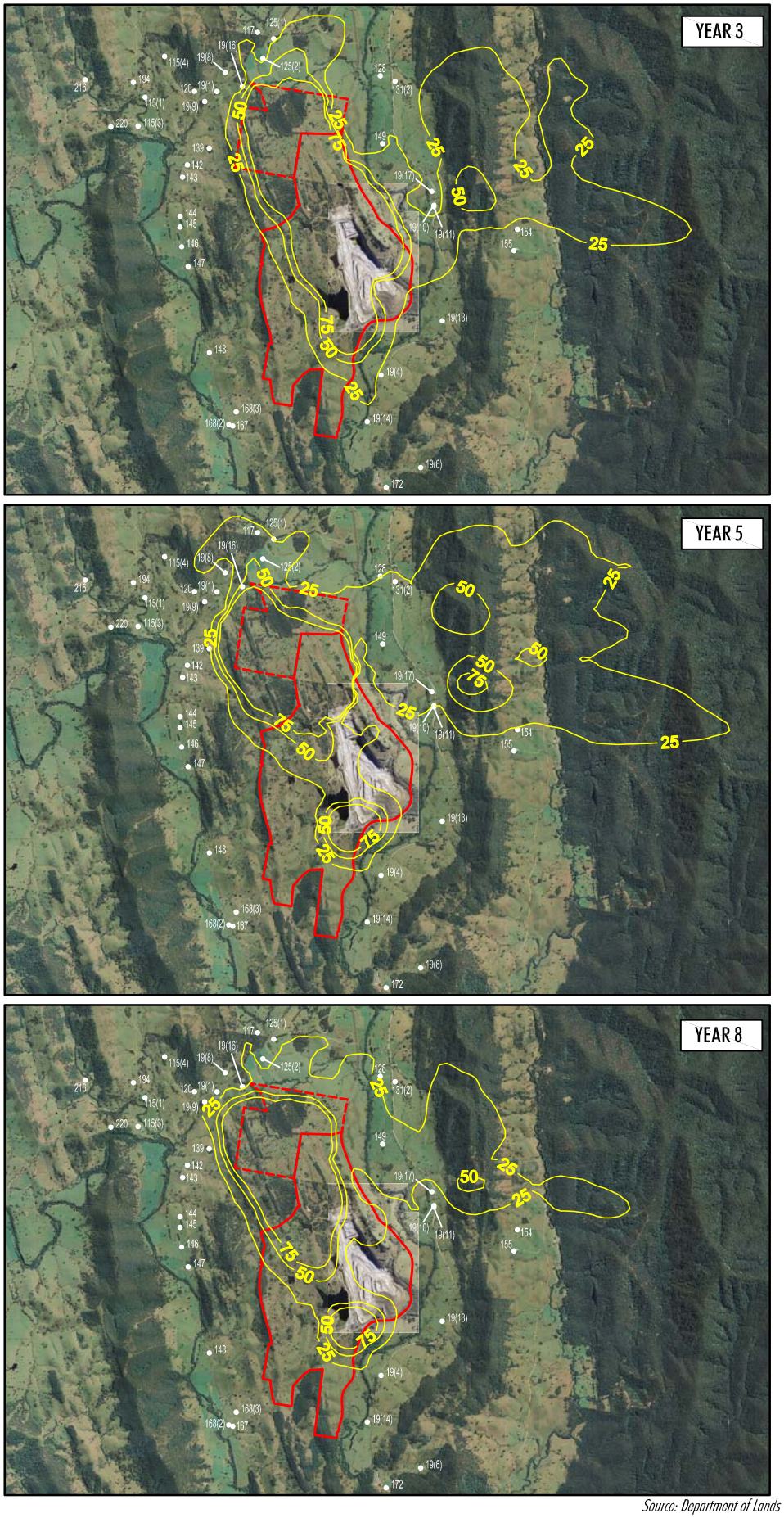
The Air Quality Assessment (Appendix D) also considered the potential air quality emissions associated with the transportation of DCM ROM coal to the SCM on the North Coast Railway and the predicted impact of these emissions in combination with background air quality in the vicinity of the rail line.

No exceedances of the annual average or 24 hour PM_{10} DECCW criterion are predicted to arise at receivers located adjacent to the North Coast Railway due to DCM ROM coal rail movements (Appendix D).

Cumulative Impacts

No exceedances of the DECCW's annual average PM_{10} or TSP assessment criteria (i.e. Project and background) were predicted (Appendix D).

Consideration was also given to potential cumulative impacts associated with mining operations at the SCM and pass-by of other (non-DCM) coal trains on the North Coast Railway (Appendix D). No material potential cumulative impacts were identified.



Source: Department of Lands (May 2009); DCPL (2009) and Heggies (2009b)

DURALIE EXTENSION PROJECT

FIGURE 4-6

24 Hour PM_{10} Contours - Years 3, 5 and 8

ResourceStrategies

DURALIE COAL

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4.6.3 Mitigation Measures, Management and Monitoring

Air quality management measures are currently implemented at the DCM in accordance with the AQMP to minimise the generation of wind blown and mine generated dust. The AQMP would be revised and updated for the Project, subject to the conditions of any Project Approval.

As described in Section 4.6.1, the AQMP includes air quality monitoring requirements, air quality management protocols (including a complaint response protocol), management measures and stakeholder consultation requirements. These management measures would continue to be implemented for the Project.

The existing air quality monitoring network would continue to be used at the Project. To reflect the northern extension of mining, additional air quality monitoring sites would be established (Section 7).

4.7 GREENHOUSE GAS EMISSIONS

The EARs (Section 1.2) for the Project require the EA to include an assessment of greenhouse gas emissions, as follows:

> ***Greenhouse Gases*** *– including:*
>
> - *a quantitative assessment of the potential scope 1, 2 and 3 greenhouse gas emissions of the project and qualitative assessment of the potential impacts of these emissions on the environment;*
> - *identify which of these emissions would be covered by the Federal Government's proposed Carbon Pollution Reduction Scheme (CPRS);*
> - *a detailed description of the measures that would be implemented on site to minimise the greenhouse gas emissions of the project, concentrating on those emissions that would not be covered by the proposed CPRS;*

Section 4.7.1 provides background to the international, national and state framework for climate change and greenhouse gas emissions. Section 4.7.2 provides a quantitative and qualitative assessment of the greenhouse gas emissions of the Project. Section 4.7.3 provides measures to minimise on-site greenhouse gas emissions from the Project.

4.7.1 Framework for Assessment

International Framework

United Nations Framework Convention on Climate Change

The *United Nations Framework Convention on Climate Change* (UNFCCC) sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change (United Nations, 2009). The UNFCCC was adopted in May 1992 and came into force in March 1994. Australia ratified the Convention in December 1992. Parties to the Convention have agreed to work towards achieving the Convention's ultimate objective of stabilising *greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system* (United Nations, 1992).

Under the UNFCCC, governments (United Nations, 2009):

- gather and share information on greenhouse gas emissions, national policies and best practices;
- launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and
- co-operate in preparing for adaptation to the impacts of climate change.

The obligations contained in the UNFCCC are overarching framework principles and objectives. Detailed commitments regarding greenhouse gas emissions reduction are contained in the Kyoto Protocol as described below.

Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the UNFCCC and was adopted by UNFCCC members in 1997 (United Nations, 2009). The Kyoto Protocol came into force in February 2005.

The Kyoto Protocol builds upon the UNFCCC by committing Annex I parties to individual, legally-binding targets to limit or reduce their greenhouse gas emissions for the following greenhouse gases (United Nations, 2009):

- carbon dioxide (CO_2);
- methane (CH_4);

- nitrous oxide (N_2O);
- hydrofluorocarbons (HFCs);
- perfluorocarbons (PFCs); and
- sulphur hexafluoride (SF_6).

The emission reduction targets are calculated based on a party's domestic emissions (such as land use change and forestry clearing, transportation, stationary energy, etc.). As an additional means of meeting these targets, the Kyoto Protocol introduced three market-based mechanisms (now known as the "carbon market"), namely Emissions Trading, the Clean Development Mechanism and Joint Implementation.

Australia signed the instrument of ratification of the Kyoto Protocol in December 2007, and on 11 March 2008 Australia's ratification came into effect (Commonwealth Department of Climate Change [DCC], 2009a). Australia is committed to ensuring its greenhouse gas emissions over 2008 to 2012 are no more than 8% above 1990 levels.

The first commitment period for the Kyoto Protocol ends in 2012, and a new international framework to deliver more stringent emissions reductions is in the process of being negotiated and developed (United Nations, 2009).

Greenhouse Gas Protocol

The Greenhouse Gas Protocol (GHG Protocol) contains methodologies for assessing and calculating greenhouse gas emissions (World Business Council for Sustainable Development [WBCSD] and World Resources Institute [WRI], 2004). The GHG Protocol provides standards and guidance for companies and other types of organisations preparing a greenhouse gas emissions inventory. It covers the accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol.

Under the GHG Protocol the establishment of operational boundaries involves identifying emissions associated with an entity's operations, categorising them as direct or indirect emissions, and identifying the scope of accounting and reporting for indirect emissions.

Three "Scopes" of emissions (Scope 1, Scope 2 and Scope 3) are defined for greenhouse gas accounting and reporting purposes. Scopes 1 and 2 have been carefully defined to ensure that two or more entities would not account for emissions in the same Scope.

Scope 1: Direct Greenhouse Gas Emissions

Direct greenhouse gas emissions are defined as those emissions that occur from sources that are owned or controlled by the entity (WBCSD and WRI, 2004). Direct greenhouse gas emissions are those emissions that are principally the result of the following types of activities undertaken by an entity:

- Generation of electricity, heat or steam. These emissions result from combustion of fuels in stationary sources (e.g. boilers, furnaces, turbines).
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials (e.g. the manufacture of cement, aluminium, adipic acid and ammonia, or waste processing).
- Transportation of materials, products, waste, and employees. These emissions result from the combustion of fuels in entity owned/controlled mobile combustion sources (e.g. trucks, trains, ships, aeroplanes, buses and cars).
- Fugitive emissions. These emissions result from intentional or unintentional releases (e.g. equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; HFC emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport) (WBCSD and WRI, 2004).

Scope 2: Electricity Indirect Greenhouse Gas Emissions

Scope 2 emissions are a category of indirect emissions that accounts for greenhouse gas emissions from the generation of purchased electricity consumed by the entity.

Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity (WBCSD and WRI, 2004). Scope 2 emissions physically occur at the facility where electricity is generated (WBCSD and WRI, 2004). Entities report the emissions from the generation of purchased electricity that is consumed in its owned or controlled equipment or operations as Scope 2.

Scope 3: Other Indirect Greenhouse Gas Emissions

Under the GHG Protocol, Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions.

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of Scope 3 activities provided in the GHG Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services (WBCSD and WRI, 2004).

The GHG Protocol provides that reporting Scope 3 emissions is optional (WBCSD and WRI, 2004). If an organisation believes that Scope 3 emissions are a significant component of the total emissions inventory, these can be reported along with Scope 1 and 2. However, the GHG Protocol notes that reporting Scope 3 emissions can result in double counting of emissions and can also make comparisons between organisations and/or projects difficult because reporting is voluntary.

Double counting needs to be avoided when compiling national (country) inventories under the Kyoto Protocol. The GHG Protocol also recognises that compliance regimes are more likely to focus on the "point of release" of emissions (i.e. direct emissions) and/or indirect emissions from the use of electricity.

Scope 1, 2 and 3 greenhouse gas emissions have been estimated for the Project and are provided in Section 4.7.2.

Commonwealth and NSW Framework

The Commonwealth Government's strategy for tackling climate change is built on 'three pillars' (Commonwealth of Australia, 2008):

- reducing Australia's greenhouse gas emissions;
- adapting to climate change that we cannot avoid; and
- helping to shape a global solution.

Garnaut Climate Change Review

The Garnaut Climate Change Review (Garnaut, 2008) is an independent study by Dr Ross Garnaut, which was commissioned by Australia's Commonwealth, State and Territory governments to examine the impacts of climate change on the Australian economy, and recommend medium to long-term policies and policy frameworks to improve the prospects for sustainable prosperity. The Garnaut Climate Change Review presented its final report on 30 September 2008.

The Garnaut Climate Change Review reports on:

1. The likely effect of human induced climate change on Australia's economy, environment and water resources in the absence of effective national and international efforts to substantially cut greenhouse gas emissions.
2. The possible ameliorating effects of international policy reform on climate change, and the costs and benefits of various international and Australian policy interventions on Australian economic activity.
3. The role that Australia can play in the development and implementation of effective international policies on climate change.
4. In light of 1 to 3, recommends medium to long-term policy options for Australia, and the time path for their implementation which, taking the costs and benefits of domestic and international policies on climate change into account, will produce the best possible outcomes for Australia.

The Government accepted the key findings of the Garnaut Climate Change Review Final Report that (Commonwealth of Australia, 2008):

- a fair and effective global agreement delivering deep cuts in emissions consistent with stabilising concentrations of greenhouse gases at around 450 parts per million or lower would be in Australia's interests;
- achieving global commitment to emissions reductions of this order appears unlikely in the next commitment period; and
- the most prospective pathway to this goal is to embark on global action that reduces the risks of dangerous climate change and builds confidence that deep cuts in emissions are compatible with continuing economic growth and improved living standards.

Carbon Pollution Reduction Scheme

The Commonwealth Government's proposed Carbon Pollution Reduction Scheme (CPRS) aims to reduce carbon pollution while sustaining strong economic growth and securing our future prosperity (Commonwealth of Australia, 2008). The scheme will place a limit or cap on the amount of carbon pollution industry can emit and will require affected businesses and industry to buy a 'pollution permit' for each tonne of carbon they contribute to the atmosphere. The scheme would involve all greenhouse gases listed under the Kyoto Protocol and, in general, direct obligations would apply to entities with a facility that has direct (Scope 1) emissions of 25,000 t of carbon dioxide equivalent (CO_2-e) a year or more (Commonwealth of Australia, 2008).

The Project direct emissions are predicted to be greater than 25,000 t of CO_2-e (Appendix D), therefore, it is anticipated that the CPRS would apply to the Project.

The start date of the CPRS is scheduled for 1 July 2011. The CPRS will include a commitment to reduce carbon pollution by 25% of 2000 levels by 2020, contingent on a global agreement to stabilise levels of CO_2-e in the atmosphere at 450 parts per million (Minister for Climate Change and Water, 2009).

The chronological progress of the CPRS to date is summarised below (DCC, 2009a):

- July 2008 – the Green Paper was released which canvassed options and preferred approaches on possible CPRS issues. It also included ways to address the impacts on Australian households, emissions-intensive trade-exposed industries and other strongly affected sectors.
- December 2008 – the White Paper was released which provided the final design of the CPRS and the medium-term target range for the proposed CPRS.
- May 2009 – the Government introduced a CPRS legislative package into the House of Representatives through a number of Bills on 14 May 2009 and was passed by the House on 4 June 2009.
- August 2009 – the Senate voted against the Bills on 13 August 2009.
- November 2009 – the Bills were reintroduced to the Senate, for possible passage in November 2009.

As noted above, the CPRS has not yet passed through the Senate. Therefore, there may be additional amendments to the Bills currently before Parliament. Section 4.7.2 identifies Project emissions that would be covered by the CPRS, on the basis of the CPRS description provided in the White Paper (Commonwealth of Australia, 2008).

National Greenhouse Accounts Factors

The *National Greenhouse Accounts Factors* (NGA Factors) (DCC, 2009b) contains methodologies for assessing and calculating greenhouse gas emissions. The NGA Factors largely adopt the methodology set out in the GHG Protocol described above and replaces the *AGO Factors and Methods Workbook* (Australian Greenhouse Office [AGO], 2004).

National Greenhouse and Energy Reporting Act

The *National Greenhouse and Energy Reporting Act, 2007* (NGER Act) came into effect on 29 September 2007 and introduces a single national reporting framework for the reporting and dissemination of information about greenhouse gas emissions, greenhouse gas projects and energy use, and production of corporations. The first annual reporting period began on 1 July 2008 (DCC, 2008a). The NGER Act makes registration and reporting mandatory for corporations whose energy production, energy use or greenhouse gas emissions meet specified thresholds.

Section 1 of the NGER Act defines the object of the Act:

> *The object of this Act is to introduce a single national reporting framework for the reporting and dissemination of information related to greenhouse gas emissions, greenhouse gas projects, energy consumption and energy production of corporations to:*
>
> - *underpin the introduction of an emissions trading scheme in the future; and*
> - *inform government policy formulation and the Australian public; and*
> - *meet Australia's international reporting obligations; and*
> - *assist Commonwealth, State and Territory government programs and activities; and*
> - *avoid the duplication of similar reporting requirements in the States and Territories.*

GCL, as the parent company of DCPL, reports emissions from its enterprises, including the DCM.

NSW Greenhouse Plan and NSW Climate Action Plan

The *NSW Greenhouse Plan* was released in November 2005 (NSW Greenhouse Office, 2005) and provides a strategic approach to combating climate change in NSW from 2005 to 2008. Key principles and goals of the Plan are to (DECCW, 2009c):

- raise awareness of climate issues within the broader community;
- promote understanding of the likely impacts on NSW, and identify adaptation strategies;
- raise awareness of climate issues within the broader community;
- limit the growth of greenhouse gas emissions and reduce these emissions in NSW;
- promote climate change partnerships by Government, individuals, industry, business and community groups;
- reduce business uncertainties by establishing carbon constraints in order to promote new investment and innovation; and
- identify strategic areas for cooperative work with other Australian jurisdictions including a national emissions trading scheme.

The NSW Government is currently in the process of developing a NSW Climate Action Plan to replace the existing NSW Greenhouse Plan.

4.7.2 Project Greenhouse Gas Emissions

Background

A quantitative assessment of potential Scope 1, 2 and 3 greenhouse gas emissions of the Project has been undertaken by Heggies (2009b) (Appendix D).

As discussed in Section 4.7.1, the GHG Protocol defines three "Scopes" of emissions (Scope 1, Scope 2, and Scope 3) for greenhouse gas accounting and reporting purposes (WBCSD and WRI, 2004). Scopes 1 and 2 have been defined to ensure that two or more entities will not account for emissions in the same Scope.

Quantitative Assessment of Potential Scope 1, 2 and 3 Greenhouse Gas Emissions

A quantitative assessment of Project greenhouse gas emissions is provided in Appendix D. The outcomes of the assessment are summarised below.

The assessment of the Project greenhouse gas emissions (Scope 1, 2 and 3) was conducted using empirical emission factors provided by the NGA factors (DCC, 2009b) and included the following activities:

- fugitive emissions from coal seams;
- combustion of diesel during mining operations;
- use of explosives;
- off-site generation of electricity consumed at the Project;
- vegetation clearance;
- combustion of diesel during the transport of ROM coal to the SCM; and
- combustion of Project product coal.

A summary of the potential Project greenhouse gas emission sources and their respective scopes is provided in Table 4-21.

The major source of direct (i.e. Scope 1) greenhouse gas emissions from the Project would be combustion of diesel used in diesel-powered equipment and fugitive emissions from coal seams (Appendix D).

The total direct (i.e. Scope 1) emissions over the life of the Project are estimated to be approximately 1.29 Mt CO_2-e, which is an average of approximately 0.14 Mt CO_2-e pa over the life of the Project (Appendix D).

The total indirect emissions (i.e. Scope 2 and 3) associated with the on-site use of fuel and electricity over the life of the Project and the combustion of Project product coal are estimated to be 31.28 Mt CO_2-e, which is an average of approximately 3.48 Mt CO_2-e pa (Appendix D).

Table 4-21
Summary of Potential Project Greenhouse Gas Emissions

Component	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
Fugitive Emissions	Emissions from the release of coal bed methane and carbon dioxide as a result of the Project.	NA	NA
Diesel Consumption	Emissions from the combustion of diesel at the Project.	NA	Estimated emissions attributable to the extraction, production and transport of diesel consumed at the Project.
Explosives Consumption	Emissions from explosives used at the Project.	NA	NA
Vegetation Clearance	Emissions from vegetation clearance associated with the Project.	NA	NA
Electricity Consumption	NA	Emissions from the generation of purchased electricity at the Project.	Estimated emissions from the extraction, production and transport of fuel burned for the generation of electricity consumed at the Project and the electricity lost in delivery in the transmission and distribution network.
ROM Coal Transport	NA	NA	Emissions from the combustion of diesel used by the rail contractor transporting ROM coal to the SCM.
Combustion of Coal	NA	NA	Emissions from the combustion of product coal from the Project.

Source: After Appendix D.

The average annual greenhouse gas emission estimate can be compared with the following estimates:

- current estimate of global emissions in 2006 from fuel burning of 29,195.42 Mt CO_2-e pa (International Energy Agency, 2006);
- estimate of Australia's 2007 net emissions, 597 Mt CO_2-e (DCC, 2008b); and
- estimate of NSW's 2007 net emissions, 163 Mt CO_2-e (DCC, 2008b).

Carbon Pollution Production Scheme - Scope 1, 2 and 3 Emission Inclusions

Table 4-22 compares the Project Scope 1, 2 and 3 emissions with the relevant CPRS position policy as described in the White Paper (Commonwealth of Australia, 2008).

Qualitative Assessment of Potential Impacts of Greenhouse Gas Emissions on the Environment

Potential environmental impacts associated with climate change are discussed below.

Climate change involves complex interactions between climatic, biophysical, social, economic, institutional and technological processes.

The weight of scientific opinion supports the proposition that the world is warming due to the release of emissions of carbon dioxide and other greenhouse gases from human activities including industrial processes, fossil fuel combustion, and changes in land use, such as deforestation (Pew Centre on Global Climate Change, undated).

Although understanding of climate change has improved markedly over the past several decades, climate change projections are still subject to uncertainties such as (Commonwealth Scientific and Industrial Research Organisation [CSIRO], 2007):

- *Socio-economic uncertainties associated with the current and future activities of humans, which affect the development of greenhouse gas and aerosol emission scenarios.*
- *Uncertainties associated with our understanding of how the Earth's major biophysical systems behave and how they are represented in climate models.*
- *Uncertainties regarding the assignment of probability distributions to regional climate change projections.*
- *Uncertainties associated with projecting climate change at small spatial scales, particularly for coastal and mountainous areas.*

Table 4-22
Comparison of Scope 1, 2 and 3 Emissions with the Carbon Pollution Production Scheme

Component	Relevant Scope	Relevant CPRS Policy Position	Project Emission Covered by CPRS
Fugitive Emissions	Scope 1	***Policy position 6.16*** *Fugitive emissions will be covered from Scheme commencement. Scheme obligations will apply to entities with a facility that has direct (Scope 1) emissions of 25 000 tonnes of carbon dioxide equivalent a year or more.*	Yes
Diesel Consumption	Scope 1	***Policy position 6.2*** *In general, direct Scheme obligations will apply to entities with a facility that has direct (Scope 1) emissions of 25,000 tonnes of CO_2-e a year or more.*	Yes
Explosives Consumption	Scope 1	NA.	No
Vegetation Clearance	Scope 1	***Policy position 6.27*** *The Government will not include deforestation in the Scheme.*	No
Electricity Consumption	Scopes 2 and 3	***Policy position 6.3*** *Emissions from stationary energy will be covered from Scheme commencement.*	Yes
ROM Coal Transport	Scope 3	***Policy position 6.4*** *Transport emissions will be covered from Scheme commencement. Scheme obligations will be applied to upstream suppliers of transport fuels.*	Yes
Combustion of Coal (Export)[1]	Scope 3	NA.	No
Combustion of Coal (Domestic)	Scope 3	***Policy position 6.12*** *The Government will apply Scheme obligations to entities that first supply coal and coal by-products for use in the domestic market.*	Yes

Source: After Commonwealth of Australia (2008).

[1] Since the majority of coal produced by DCPL is blended with coal from the SCM and sold to overseas (export) customers, the CPRS would generally not apply. However, should coal be sold to domestic customers, the CPRS would apply.

Climate Change Projections for Australia

In Australia, the climate is projected to become warmer and drier. By 2030, warming (for mid-range emissions) is projected to be about 1°C over most of Australia, with slightly less warming in some coastal areas, and slightly more warming inland (CSIRO, 2007). By 2070, annual average temperatures are projected to increase by 1.8 to 3.4°C with spatial variations similar to those for 2030 (CSIRO, 2007) depending on the emission scenarios examined. Substantial increases in the frequency of days over 35^{o}C and fewer frosts are likely (CSIRO, 2007).

Sea level is projected to rise by 18 to 59 centimetres (cm) by 2100, or 2 to 7 cm per decade, as a result of global warming (CSIRO, 2007). Sea-level rise will have impacts on soft sediment shorelines and intertidal ecosystems, which will be especially vulnerable to change with additional impacts from extreme events.

The interaction of severe weather events, such as tropical cyclones, with the coastal ocean has the potential to generate severe waves and storm surge, which in turn can have significant impacts on the coast. Warmer ocean waters and sediment transport following heavy rainfall will affect fisheries and coastal ecosystems (CSIRO, 2007).

Climate change may result in changes to rainfall patterns, run-off patterns and river flow. High emission scenario projections for annual average rainfall in Australia for around 2050 and 2070, relative to 1990 include (CSIRO, 2007):

- in southern areas (-20% to +0% by 2050 and -30% to +5% by 2070);
- in central, eastern and northern areas (-20% to +10% by 2050 and -30% to +20% by 2070);
- decreases are most pronounced in winter and spring;

- some inland and eastern coastal areas may become wetter in summer, and some inland areas may become wetter in autumn; and
- where average rainfall increases, there are predicted to be more extremely wet years and where average rainfall decreases there would be more dry spells.

Higher temperatures are likely to increase evaporation (CSIRO, 2007). When this is combined with the projected changes in rainfall, there would be a decrease in available moisture (CSIRO, 2007).

A 2°C rise in temperature in Australia would be likely to have a number of negative environmental impacts such as the regular bleaching of near-shore coral reefs and a reduction in the total area in which some plants and animals naturally occur, particularly in the Southern Alps (NSW Greenhouse Office, 2005).

Climate change has been identified as one of numerous pressures on the world's wildlife. Research shows that it has led to approximately 25% of the world's mammals and 12% of birds being at significant risk of extinction (AGO, 2005). Some species have migrated both pole-wards and to high elevations to escape warmer conditions. A study of the likely impact of climate change on flora and fauna concluded that minimal climate-warming scenarios for 2050 could lead to extinction of approximately 18% of species (AGO, 2005). Mid-range and maximum warming could lead to extinction of 24% and 35% of species, respectively, by 2050 (AGO, 2005). Australian research has predicted that the bio-climates of some species of plants and vertebrates will disappear with a warming of just 0.5 to 1.0°C (AGO, 2005).

Climate Change Projections for NSW

From 1950 to 2003, the NSW annual mean maximum temperature rose 0.15°C per decade and the NSW annual mean minimum temperature rose 0.19°C per decade. There has been an increase in hot days (35°C or more) of 0.10 days per year, an increase in hot nights (20°C or more) of 0.26 nights per year, a decrease in cold days (15°C or less) of 0.22 days per year and a decrease in cold nights (5°C or less) of 0.29 nights per year (Hennessey *et al.*, 2004).

Projections of climate change in NSW were undertaken for the NSW Government by the CSIRO and BoM, and are reported in the NSW Greenhouse Plan.

It was concluded that without action to limit global greenhouse gas emissions, NSW can expect:

- a warming of between 0.2 to 2.1°C over the next three decades (with the greatest rise in spring and summer) and a warming of 0.7 to 6.4°C by 2070; and
- a general tendency for decreasing annual average rainfall, particularly in spring and particularly in south western NSW (Hennessey *et al*., 2004).

In parts of NSW, some agricultural and forestry activities may benefit from small temperature and carbon dioxide increases, because of the improvements in plant growth that may result. However, most changes in average and extreme climate are expected to have negative impacts on natural ecosystems, water resources, primary industries, human health and settlements (Hennessey *et al*., 2004).

Hotter, dry conditions are likely to put crops under greater heat and water stress. Rivers are likely to decline, making irrigation less reliable and shrinking natural wetlands. Rising temperatures will reduce the available habitat for alpine species such as the Mountain Pygmy Possum (Hennessey *et al*., 2004).

Major storms may become more common over much of NSW which may lead to an increased risk of damage to buildings, bridges and power lines. In the coastal zone, these storms may combine with the rise in the sea level to worsen coastal erosion, damaging beaches and improvements. Bushfires are likely to become more frequent and intense. Human health also faces risks, with warmer temperatures increasing the risk of infectious diseases, food poisoning and mosquito-borne diseases (Hennessey *et al*., 2004).

Potential Impacts of Project Greenhouse Gas Emissions on the Environment

As described above, increased greenhouse gas levels have the potential to alter the interaction amongst climate variables such as cloud cover, rainfall, wind patterns, ocean currents, sea levels and the distribution of plant and animal species.

The Project greenhouse gas emissions would make some contribution to global emissions as described above. However, the Project's contribution to global emissions would be relatively small (e.g. annual average direct Project emissions would be approximately 0.02% of Australia's 2007 emissions). Measures to minimise greenhouse gas emissions from the Project are described below.

The potential effects of climate change on the nature and extent of the Project potential impacts has also been considered including those relating to surface water (Appendix A) and groundwater (Appendix B). Potential environmental costs associated with Project greenhouse gas emissions have also been considered in Appendix G (Socio-Economics Assessment).

4.7.3 Mitigation Measures, Management and Monitoring

DCPL is currently implementing a number of measures to minimise greenhouse gas emissions from the DCM. Relevant measures are described below:

- Maximising energy efficiency as a key consideration in the development of the mine plan. For example, significant savings of greenhouse gas emissions (through increased energy efficiency) are achieved by mine planning decisions which minimise haul distances for ROM coal and waste rock transport and therefore fuel use.
- GCL has prepared and implemented an Energy Savings Action Plan (ESAP) in accordance with the NSW *Energy Administration Amendment (Water and Energy Savings) Act, 2005*. GCL has conducted a comprehensive analysis of energy usage and management strategies at the DCM, and has identified cost-effective energy saving opportunities, including (DCPL, 2008b):
  - installation of power factor correction equipment to reduce the maximum electricity demand at the DCM by an estimated 10%;
  - replacement of conventional electric hot water systems with energy efficient heat pumps in bathhouse facilities;
  - potential adjustment of conveyor belt weight and roller types; and
  - potential adjustment of the number and location of lights in mining and infrastructure areas.

The outcomes of the implementation of the ESAP and annual greenhouse gas emissions at the DCM are and would continue to be reported in the AEMR. The ESAP would be reviewed and updated as necessary for the Project, subject to the conditions of any Project Approval.

Additional mitigation measures that would be implemented for the Project include:

- regular maintenance of plant and equipment to minimise fuel consumption;
- consideration of energy efficiency in plant and equipment selection/phase;
- appropriate mine planning to reduce the number of blast events to the minimum practicable;
- management of blast events to minimise the quantities of explosives used (generally in accordance with the existing BMP);
- implementation of the Vegetation Clearance Protocol to minimise the clearance of vegetation;
- progressive rehabilitation of disturbed areas; and
- implementation of a vegetation offset programme that would include the enhancement of some 214 ha of existing vegetation and the revegetation of some 230 ha of derived grasslands to woodland (Section 4.8.3).

The major greenhouse gas emissions that are not expected to be covered by the CPRS are emissions associated with the consumption of explosives, vegetation clearance and combustion of coal exported overseas. Mitigation measures with respect to the consumption of explosives and vegetation clearance are outlined above. Emissions associated with the combustion of export and domestic coal are the responsibility of the end-users of the coal.

Considerations of potential ecologically sustainable development (ESD) implications of climate change are included where relevant in Section 6.8.2.

4.8 TERRESTRIAL FLORA

A Terrestrial Flora and Fauna Assessment has been prepared for the Project by Cenwest Environmental Services and Resource Strategies (2009a) and is presented in Appendix E. The Terrestrial Flora and Fauna Assessment (Appendix E) was prepared in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and NSW Department of Primary Industries [DPI], 2005).

A description of the existing environment relating to flora is provided in Section 4.8.1. Section 4.8.2 describes the potential impacts of the Project on flora, while Section 4.8.3 outlines flora mitigation, management, monitoring and offset measures.

4.8.1 Existing Environment

Regional Setting

The Project area is located in the NSW North Coast Interim Biogeographic Regionalisation of Australia (IBRA) bioregion (DEWHA, 2009a). The NSW North Coast IBRA bioregion occurs along the east coast of NSW and supports sub-tropical and warm temperate rainforests/sclerophyll forests on soils derived from basalts, eucalypt forests on soils derived from granites and dune and estuary vegetation in coastal areas (DECCW, 2009a).

A number of reserved areas are located in the region, including the Myall River State Forest (located approximately 5 km to the south-east), Monkerai Nature Reserve (located approximately 7 km to the south-west), The Glen Nature Reserve (located approximately 11 km to the north-east) and Ghin-doo-ee National Park (located approximately 11 km to the east).

Local Setting

The existing DCM is located in a rural area characterised by cattle grazing on native and improved pastures. The DCM is situated in a valley which is bounded by ridgelines to the east (Buckleys Range) and west (Linger and Die Ridge). The Mammy Johnsons River is located to the east of the DCM, and flows in a generally southerly direction in the vicinity of the Project.

The portion of ML 1427 not currently subject to mining development, MLA 1 and surrounding company owned land (Figures 1-3a and 1-3b) is managed for agricultural use.

Baseline Flora Surveys

Numerous flora studies have been undertaken in the Project area and surrounds, largely associated with environmental assessments for various stages of the DCM (ERM Mitchell McCotter, 1996a; Woodward-Clyde, 1996c; FloraSearch, 2005; EcoBiological, 2009a, 2009b). A review of relevant flora studies in the area is provided in Appendix E.

Targeted searches for threatened flora species and ecological communities were conducted as part of the above studies. A habitat assessment was conducted in the Project area and surrounds as part of the Terrestrial Flora and Fauna Assessment in accordance with the *Threatened Biodiversity Survey and Assessment Guidelines* (DEC, 2004b) and in consideration of the DECCW *Field Survey Methods* (DECCW, 2009d).

Potential habitat for threatened flora species was evaluated based on the habitat requirements of threatened species which could possibility occur in the Project area (Appendix E).

Vegetation Communities

Almost all of the pre-European forest and woodland which once occurred in the Project area has been extensively cleared and/or logged at least once (Appendix E).

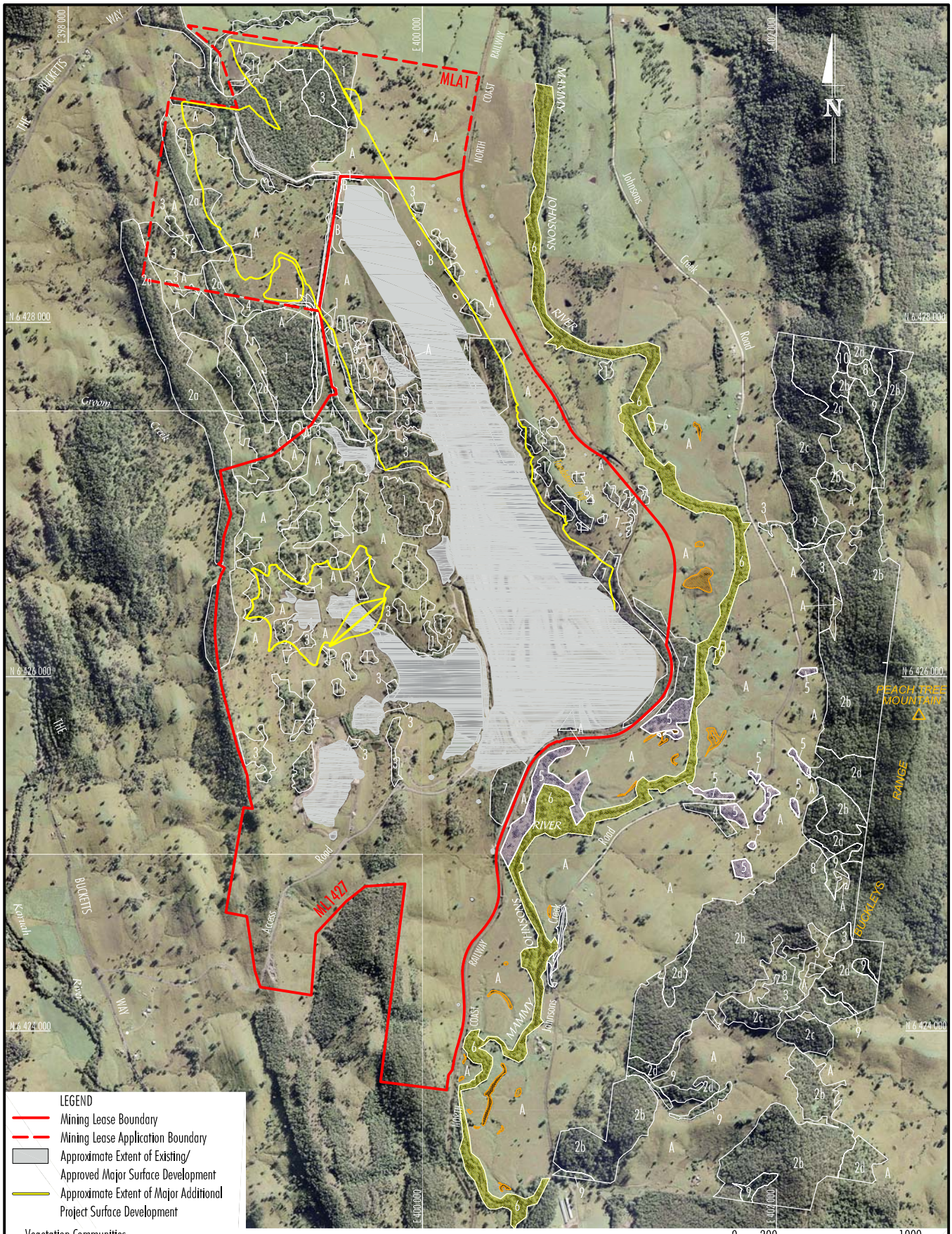
Derived native grasslands occur in the majority of the Project area and are a result of past agricultural land use practices, where trees have been removed for timber, limited cropping or pasture (Figure 4-7). The derived grasslands comprise of a mixture of native and introduced groundcover species with some scattered trees present (EcoBiological, 2009a). Small areas of irrigated cropped land (e.g. Sorghum) also occur in northern areas of ML 1427.

The native vegetation community patches recorded in the Project area are mostly regrowth with scattered old growth trees and include (EcoBiological, 2009a) (Figure 4-7):

- Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest;
- Spotted Gum – Grey Ironbark - Thick-leaved Mahogany Forest;
- Red Gum Grassy Woodland;
- Grey Gum – Red Gum – Apple Riparian Forest; and
- Stringybark - Paperbark Forest.

Flora Species Composition

A complete list of flora species identified in surveys of the DCM area to April 2009 is provided in Appendix E. The two main flora survey reports which cover the DCM area were prepared by ERM Mitchell McCotter (1996a) and EcoBiological (2009a). ERM Mitchell McCotter (1996a) recorded a total of 115 vascular plant species, of which 102 (88.7 %) were native and 13 (11.3 %) introduced (Appendix E). EcoBiological (2009a) recorded notably more native and introduced species than the earlier study by ERM Mitchell McCotter (1996a), with 331 vascular plant species, of which 274 (82.8%) were native and 57 (17.2 %) introduced (Appendix E). This is due in part to the more extensive study area covered by EcoBiological (2009a), across areas containing relatively more remnant native vegetation.



LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- Approximate Extent of Existing/ Approved Major Surface Development
- Approximate Extent of Major Additional Project Surface Development

Vegetation Communities

- 1 Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest
- 2a-2d Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest
- 3 Red Gum Grassy Woodland
- 4 Grey Gum – Red Gum – Apple Riparian Forest
- 5 Cabbage Gum Floodplain Forest - River-Flat Eucalypt Forest on Coastal Floodplains Endangered Ecological Community
- 6 Riparian Closed Forest - Lowland Forest on Floodplain Endangered Ecological Community
- 7 Stringybark – Paperbark Forest
- 8 Dry Gully Rainforest
- 9 Blue Gum Moist Forest
- 10 Perch Sedgeland
- 11 Freshwater Wetlands Endangered Ecological Community

Vegetation Map Units

- A Derived Grasslands
- B Cropping

0 200 1000
Metres
GRID DATUM: MGA 94 ZONE 56

Source: AAHatch- Aerial Photography flown April 2009; DCPL (2009); Vegetation - Ecobiological (2009a and b) and Cenwest Environmental Services & Resource Strategies (2009)

DURALIE EXTENSION PROJECT

FIGURE 4-7

Vegetation Communities and Vegetation Mapping Units

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Introduced Flora Species and Noxious Weeds

A total of 57 introduced flora species have been recorded during the surveys (Appendix E). Five weed species listed as noxious under the NSW *Noxious Weeds Act, 1993* in the Great Lakes LGA (GLC, 2008) have been recorded, *viz.* Noogoora Burr, Bittou Bush, Blackberry, Crofton Weed and Lantana (Appendix E).

Threatened Flora Species

A literature and database review was conducted in addition to targeted surveys to identify threatened flora species listed under the TSC Act or EPBC Act which could potentially occur within the Project area. No threatened flora species have been recorded in the Project area or immediate surrounds (Appendix E).

Threatened Flora Populations

No threatened flora populations listed under the TSC Act are relevant to the Project (Appendix E).

Threatened Ecological Communities

No threatened ecological communities (TECs) listed under the TSC Act or EPBC Act has been recorded within the Project area. However, three TECs listed under the TSC Act have been identified on the floodplain of the Mammy Johnsons River to the east of the Project (Figure 4-7) (EcoBiological, 2009a), *viz.*:

- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community (River-Flat Eucalypt Forest EEC);
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community (Freshwater Wetlands on Coastal Floodplains EEC); and
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion Endangered Ecological Community (Lowland Rainforest on Floodplain EEC).

Critical Habitat

No critical flora habitat as designated by the Register of Critical Habitat held by the Commonwealth Minister of the Environment, Heritage and Arts (DEWHA, 2009b), Register of Critical Habitat held by the Director-General of the DECCW (DECCW, 2009e), the Register of Critical Habitat held by the Director-General of the NSW Department of Industry and Investment-Fisheries (DII-Fisheries) (DII-Fisheries, 2009) or identified within the *Great Lakes Local Environmental Plan, 1996* (Great Lakes LEP) occur within the vicinity of the Project.

4.8.2 Potential Impacts

The following sub-sections evaluate the potential impacts of the Project on flora species, populations and ecological communities, and their habitats in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). This evaluation includes identification of the magnitude, extent and significance of the potential impacts. Proposed measures to avoid, mitigate and offset potential impacts on flora are provided in Section 4.8.3.

Native Vegetation/Habitat Clearance

Project habitat removal and modification would result in impacts including clearing of native vegetation, removal of dead wood and dead trees, bushrock removal, loss of hollow-bearing trees and alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands which are listed as key threatening processes under the TSC Act.

The additional surface disturbance associated with the Project would involve the clearance of approximately 87 ha of native vegetation communities, approximately 109 ha of derived grasslands and approximately 11 ha of cropping land. The native vegetation communities which would be cleared include (Figure 4-7) (Appendix E):

- approximately 61 ha of Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest (Vegetation Community 1);
- approximately 2 ha of Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest (Vegetation Community 2a);
- approximately 20 ha of Red Gum Grassy Woodland (Vegetation Community 3);

- approximately 3 ha of Grey Gum – Red Gum – Apple Riparian Forest (Vegetation Community 4); and
- approximately 1 ha of Stringybark - Paperbark Forest (Vegetation Community 7).

Potential Impacts from Irrigation

The Project would include the irrigation of the following remnant vegetation areas which occur outside of the approximate extent of additional Project major surface development (Appendix E):

- approximately 9 ha of Spotted Gum – Red Ironbark – Thick-leaved Mahogany Forest (Vegetation Community 1);
- approximately 9 ha of Spotted Gum – Grey Ironbark – Thick-leaved Mahogany Forest (Vegetation Community 2a); and
- approximately 10 ha of Red Gum Grassy Woodland (Vegetation Community 3).

Vegetation communities within existing approved irrigation areas would continue to be irrigated prior to vegetation clearance.

Irrigation water would have a medium water salinity rating and is therefore suitable for moderately tolerate crops (Agricultural Water Management, 2009). Additionally, in accordance with the IMP, irrigation would occur to the extent that minimum moisture deficit is maintained, thereby minimising the potential for waterlogging effects on vegetation (DCPL, 2008a). Given this, irrigation of native vegetation would optimise available water to the above three communities at times of soil moisture deficit. The irrigation is expected to lead to increased plant productivity in all components of the particular community. Hence it is expected that supplementary irrigation of the selected regrowth vegetation communities would promote optimal regrowth within the currently fragmented patches. The supplementary irrigation targeting regrowth of native woodland/forest communities would be similar to natural conditions in an ongoing wet period.

Groundwater Dependent Vegetation

Considering the results of the Groundwater Assessment (Appendix B), the potential impacts on groundwater dependant ecosystems have been evaluated, including consideration of the *NSW State Groundwater Dependent Ecosystems Policy* (DLWC, 2004).

Although the groundwater is near the surface along Coal Shaft Creek, the creek is ephemeral and the vegetation which occurs is not characteristic of a groundwater dependant ecosystem. The vegetation along the unnamed drainage lines located to the north of the Project area is also unlikely to be groundwater dependent. It is more likely that the Mammy Johnsons River is a groundwater dependant ecosystem due to the occurrence of species such as Water Gum (*Tristaniopsis laurina*) and the likely connectivity between the River and groundwater systems. The Surface Water Assessment (Appendix A) and Groundwater Assessment (Appendix B) for the Project concluded that the Project is not likely to have a measureable impact on the Mammy Johnsons River, including the groundwater associated with the Mammy Johnsons River alluvium.

Considering the above, the Project is not likely to impact any terrestrial vegetation or wetlands which may be dependant on groundwater.

Introduced Flora

The proposed vegetation disturbance and irrigation associated with the Project have the potential to act as catalysts for weed incursion and, if management measures are not in place, proliferation of weeds could occur. The Project is not considered likely to significantly increase the potential for weed incursion, given the weed control measures outlined in the various DCPL management plans which would continue to be implemented (Appendix E) (Section 4.8.3).

Introduced Fauna

Competition and grazing by the feral European Rabbit is a key threatening process listed under the TSC Act. The European Rabbit and other introduced animals can result in erosion problems as well as reduce recruitment and survival of native plants. However, given the pest control measures outlined in the various DCPL management plans (Section 4.8.3), the Project is unlikely to significantly increase the potential impacts of introduced animals on flora (Appendix E).

Vegetation and Dust

Studies have shown that excessive dust generation can impact on the health and viability of surrounding vegetation. Dust can affect vegetation by inhibiting physiological processes such as photosynthesis, respiration and transpiration, and allow penetration of phytotoxic gaseous pollutants (Eller, 1977; Farmer, 1993). Similar to the existing DCM, dust emissions associated with the Project would originate predominantly from the haulage of materials (i.e. coal and waste rock) and wind blown emissions. With the implementation of Project dust controls, dust is unlikely to significantly impact any flora species (Appendix E). Measures to avoid and mitigate impacts from dust are provided in Section 4.8.3.

Bushfire Risk

The risk of high frequency fire as a result of the Project is considered to be relatively low given the relatively high rainfall in the area and grazing management, supported by the observed lack of evidence of past fires (Appendix E).

Threatened Flora Species

As stated in Section 4.8.1, no threatened flora have been recorded in the Project area. The potential impacts from the Project on threatened flora species were assessed in Appendix E based on the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). The Project is unlikely to affect any threatened flora species listed under the TSC Act or EPBC Act (Appendix E).

Threatened Ecological Communities

As described in Section 4.8.1, no TECs have been recorded in the Project area. The potential impacts from the Project on TECs were assessed in Appendix E. The Project would not adversely impact the three TECs recorded to the east of the Project area (Appendix E).

Cumulative Impacts

The incremental impacts of the Project and the existing/approved DCM in the context of the existing rural land uses and past logging have been considered in Appendix E. Cumulative impacts within the existing DCM are expected to occur as a result of additional vegetation clearing.

4.8.3 Mitigation Measures, Management and Monitoring

The potential impacts of the DCM on flora are currently managed via the implementation of existing management protocols, plans and programs, including the following:

- Vegetation Clearance Protocol (DCPL, 2002b);
- IMP (DCPL, 2008a);
- Site Water Management Plan (DCPL, 2008c);
- Rehabilitation Management Plan (DCPL, 2007a); and
- AQMP (DCPL, 2007e).

Potential impacts of the Project on flora and their habitats would be managed by the continued implementation of the above management protocols, plans and programmes with revision as required for the Project. These measures are described in further detail below.

Rehabilitation and Revegetation of Project Disturbance Areas

The Rehabilitation Management Plan (DCPL, 2007a) describes actions to be undertaken to improve habitat within rehabilitated areas. Measures relevant to flora include:

- exclusion of cattle from areas where existing vegetation is to be protected;
- restriction of the use of light vehicles within revegetated areas;
- environmental and noxious weed management;
- feral animal control; and
- irrigation to promote revegetation.

The disturbance areas associated with the Project would be rehabilitated and revegetated with native grass, shrub and tree species characteristic of the vegetation communities cleared. The Rehabilitation Management Plan (DCPL, 2007a) would be updated to reflect the rehabilitation objectives and rehabilitation works to be undertaken for the Project as well as rehabilitation assessment and completion criteria, subject to the conditions of any Project Approval (Section 5).

Vegetation Clearance Protocol

A Vegetation Clearance Protocol (DCPL, 2002b) has been developed to minimise the impact of DCM vegetation clearance on flora and fauna. The key components of the Vegetation Clearance Protocol include delineation of areas to be cleared of native remnant vegetation, pre-clearance surveys, fauna management measures and vegetation clearance supervision.

Fire Management

The Rehabilitation Management Plan (DCPL, 2007a) outlines the bushfire management measures in place at the DCM, including controlled grazing, hazard reduction burns, provision of fire fighting equipment and annual reporting on bushfire management provided to the Great Lakes RFS (Section 4.2.3).

Dust Controls and Monitoring

Current dust mitigation and management measures implemented at the DCM are presented in the AQMP (DCPL, 2007e) and are summarised in Section 4.6.

Weed Management and Monitoring

The Rehabilitation Management Plan (DCPL, 2007a) and IMP (DCPL, 2008a) provide measures to control weeds, including:

- identification of weeds via regular site inspections and communication with landholders and regulatory authorities;
- irrigation areas would be managed such that a vegetation cover is maintained as much as possible to suppress the establishment of weeds;
- mechanical removal of identified weeds and/or the application of approved herbicides in authorised areas;
- follow-up site inspections to determine the effectiveness of eradication programs; and
- minimisation of seed transport from the site through the use of the site's vehicle wash bay.

Animal Pest Management and Monitoring

The Rehabilitation Management Plan (DCPL, 2007a) provides measures to control animal pests including baiting, removing available feed and maintaining a clean, rubbish-free environment in order to discourage scavenging and reduce the potential for colonisation of these areas by non-endemic fauna (e.g. introduced rodents, predators and birds).

Offset Measures

The EARs for the Project (Section 1.2 and Attachment 1) state that the EA must include a description of the measures that would be implemented to offset the potential impacts of the Project and maintain or improve biodiversity values of the surrounding region in the medium to long-term.

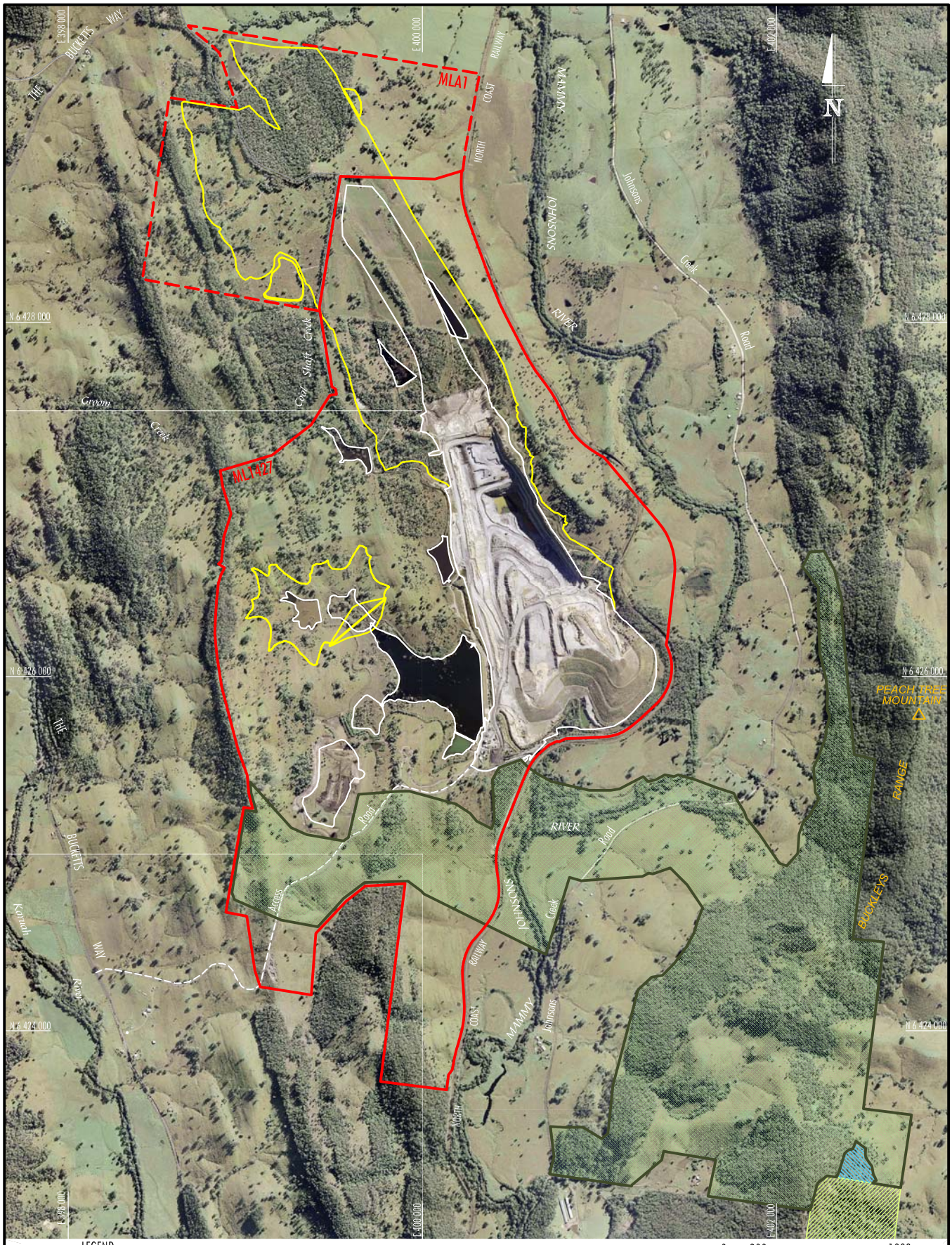
The Project offset measures are proposed in consideration of the EARs, relevant Part 3A development guidelines (e.g. DEC and DPI, 2005), DECCW's principles for the use of biodiversity offsets in NSW (DECCW, 2009f) and ecological principles commonly used in the design of reserves for wildlife conservation.

Offset Area

DCPL proposes an offset area which is located on freehold GCL/DCPL owned land located in the south and to the east of the Project area (Figure 4-8). The land is currently managed for pastoral purposes.

The proposed offset area adjoins DCPL's existing offset area which was approved as part of the DCM June 2009 Modification (Figure 4-8). DCPL's existing offset area also directly adjoins other land which has a conservation agreement included in its conditions of tenure (Figure 4-8).

Table 4-23 provides a summary of the proposed offset. While approximately 87 ha of natural vegetation communities and 109 ha of derived grassland would be cleared for the Project, it is proposed that significant areas of existing native vegetation communities would be enhanced (some 214 ha) and areas of derived grasslands would be revegetated (some 230 ha) (Appendix E).



LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- Approximate Extent of Existing/Approved Major Surface Development
- Approximate Extent of Additional Project Major Surface Development
- Land Under Existing Conservation Agreement
- Existing Duralie Coal Mine Offset Area
- Duralie Extension Project Offset Area

0 200 1000

Metres

GRID DATUM MGA 94 ZONE 56

Source: AAHatch- Aerial Photography flown April 2009 ; DCPL (2009) and Cenwest Environmental Services & Resource Strategies (2009)

DURALIE EXTENSION PROJECT

FIGURE 4-8

Duralie Extension Project Offset Area

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Table 4-23
Summary of the Offset Proposal

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

Source: Appendix E.

* Approximate areas are based on vegetation mapping provided on Figure 4-7.

The proposed offset also accounts for the 109 ha of derived grassland which would be removed by the Project.

Flora and Fauna Values within the Offset Area

Similar to the Project area, the proposed offset area is situated in the Mammy Johnsons River catchment. The proposed offset area covers a portion of Buckleys Range and associated footslopes and incorporates a section of the Mammy Johnsons River and land south of the DCM mining infrastructure within ML 1427 (Figure 4-8). Elevations generally range from approximately RL 50 m along the river flats of the Mammy Johnsons River to approximately RL 150 m on Buckleys Range.

The proposed offset area traverses two roads and the North Coast Railway (Figure 4-8).

There are physical differences between the proposed offset and the areas where vegetation would be cleared within Project area. These include different soil landscapes occurring to the east of the Mammy Johnsons River and the maximum elevation along Buckley Range being higher than the elevation in the Project disturbance areas. These differences are not considered to diminish the suitability of the proposed offset area. Rather the proposed offset area is considerably enriched by this added system variability.

The Vegetation Types Database (DECCW, 2009g) contains a standard list of vegetation types used with the BioMetric tool under the *Native Vegetation Act, 2003*, and the NSW Biobanking Credit Calculator under the TSC Act (DECCW, 2009h). Under these schemes, vegetation types, rather than vegetation communities, are the unit of measure for the calculation of offsets.

Appendix E describes the vegetation types identified by EcoBiological (2009a, 2009b) in the Project area and offset area, together with the approximate area to be cleared in the Project area and conserved in the proposed offset area. All vegetation types impacted by the Project area are represented in the proposed offset area (Appendix E).

EcoBiological (2009b) recorded a range of vertebrate fauna species during surveys of Buckleys Range and surrounds. There were many similarities between the vertebrate species present within the offset area and the Project area. Vertebrate fauna species in the offset area are represented by terrestrial, aquatic and arboreal amphibians, reptiles, woodland and forest birds and arboreal and ground dwelling mammals.

Ecological gains from the proposed offset include (Appendix E):

- Similar vegetation communities/fauna habitats, compared to the Project area, would be conserved/enhanced in the proposed offset area.
- The proposed offset area is suitably located to benefit flora and fauna populations (biodiversity values) potentially impacted by the Project.
- The proposed offset area is suitably located adjacent to existing conserved areas (i.e. the proposed offset area is located directly adjacent to DCPL's existing offset area which directly adjoins land which has a conservation agreement included in its conditions of tenure).
- The proposed offset area would enhance the local connectivity of existing habitat and create linkages to the Mammy Johnsons River and the rehabilitation areas of the final Project landforms.

- Opportunity to enhance the riparian habitat along a length of the Mammy Johnsons River (e.g. increasing the width of riparian vegetation and implementing weed control measures).
- The proposed offset area contains approximately 8 ha of the River-Flat Eucalypt Forest EEC, approximately 14 ha of the Lowland Rainforest on Floodplain EEC, and approximately 0.2 ha of the Freshwater Wetlands on Coastal Floodplains EEC.
- The following threatened fauna were recorded within the offset area or adjoining habitat: Giant Barred Frog, Glossy Black-cockatoo, Speckled Warbler, Brush-tailed Phascogale, Eastern Freetail-bat, Eastern Bentwing-bat and Large Footed Myotis, as well as a significant number of protected species.
- The proposed offset area also contains potential habitat for the threatened Rose-crowned Fruit-Dove, Swift Parrot, Brown Treecreeper (eastern subspecies), Grey-crowned Babbler (eastern subspecies) and Squirrel Glider.

Once established, the proposed corridor across the valley is likely to be utilised by a range of native fauna, including the Squirrel Glider and Brush-tailed Phascogale.

The proposed offset measures constitutes a suitable offset against residual flora and fauna impacts associated with the Project, given the anticipated improvement in the flora and fauna habitat value that are planned to eventuate in the proposed offset area in the medium to long-term.

Security of the Offset Area

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

Management of the Offset Area

A management plan would be prepared by a suitably qualified person(s) to facilitate the revegetation and regeneration of native vegetation and habitats and provide a framework for continued management and monitoring of the offset area. The Offset Management Plan would be prepared to the satisfaction of the Director-General of the DoP.

It is anticipated that the plan would detail measures including:

- encouraging native regeneration by providing appropriate fencing to exclude grazing from existing treed areas;
- selective revegetation in derived grasslands by appropriate plantings or seeding using local seed sources;
- soil erosion management;
- managing weeds and pests;
- managing fire including mosaic burnings likely needed to optimise species diversity;
- signage of the proposed offset area;
- restricting vehicular and people access; and
- monitoring, auditing and reporting the performance of the offset.

Habitat features (e.g. large hollows and some suitable logs) would be salvaged during Project vegetation clearance activities and relocated to areas where habitat enhancement is required (e.g. in the proposed offset area).

Performance of the Offset Area

The Offset Management Plan would contain a monitoring programme developed by a suitably qualified person(s) to assess the performance of the management measures in enhancing habitats for flora and fauna.

The monitoring programme would provide for monitoring of revegetation areas (e.g. using Landscape Function Analysis (LFA)/Ecosystem Function Analysis [or equivalent] and photo points) and the monitoring of existing woodland/ forest areas (e.g. using permanent quadrats and photo points).

Terrestrial fauna surveys would also be conducted every five years (i.e. during approximately Year 5 of the Project and following the cessation of mining) to monitor the use of the offset areas by vertebrate fauna.

The proposed offset area would be independently audited at intervals agreed with relevant authorities. The audits would be conducted by a suitably qualified person(s) to:

- assess compliance with the Offset Management Plan;
- assess the performance of the offset area;
- review the adequacy of the management measures and monitoring programme; and

- recommend actions or measures to improve the performance of the offset, Offset Management Plan, or monitoring programme, if required.

4.9 TERRESTRIAL FAUNA

A Terrestrial Flora and Fauna Assessment has been prepared for the Project by Cenwest Environmental Services and Resource Strategies (2009a) and is presented in Appendix E.

A description of the existing environment relating to fauna is provided in Section 4.9.1. Section 4.9.2 describes the potential impacts of the Project on fauna, while Section 4.9.3 outlines fauna mitigation, management, monitoring and offset measures.

4.9.1 Existing Environment

Regional Setting

As discussed in Section 4.8.1, the Project area is located in the NSW North Coast IBRA bioregion (DEWHA, 2009a). It is also located within the Bassian Zoogeographic Region (Spencer, 1896) which can be used as a coarse predictor of faunal assemblages in an area.

Fauna Surveys

Numerous fauna studies have been undertaken in the Project area and surrounds, largely associated with environmental assessments for various stages of the DCM (Debus, 1995; ERM Mitchell McCotter, 1996b; Fly-by-Night Bat Surveys Pty Ltd, 1996; Paul Webber Consulting Services, 1996; Woodward-Clyde, 1996d; Greg Richards and Associates, 2001; Place Planning and Design, 2003; EcoBiological, 2009a, 2009b). A review of relevant fauna studies in the area is provided in Appendix E.

Targeted searches for threatened fauna species were conducted as part of the above studies.

A habitat assessment was conducted in the Project area and surrounds by as part of the Terrestrial Flora and Fauna Assessment in accordance with the *Threatened Biodiversity Survey and Assessment Guidelines* (DEC, 2004b) and in consideration of the DECCW *Field Survey Methods* (DECCW, 2009d).

Fauna Habitat within the Project Disturbance Area

Four broad fauna habitat types are recognised within the Project area, including (Appendix E):

- *Secondary Grassland* – The predominant habitat type in the Project area characterised by native grasses and herbs, with some exotic species present. These grasslands provide suitable habitat for a range of wholly or partly grassland-dependent native bird species and grazing mammals. The areas adjacent to drainage lines are also suitable for a range of frog and small reptile species. Relatively few reptile species would utilise the grassland habitats.
- *Secondary Grassland with Regrowth Open Woodland/Forest* - This broad fauna habitat type is distinguished from the Secondary Grassland broad fauna habitat type by the presence of either scattered regrowth trees or clumps of scattered trees sometimes presenting as small regrowth woodland/forest remnants. The Secondary Grassland with Regrowth Open Woodland/Forest has the potential to provide habitat for a greater number of native vertebrate species than the Secondary Grasslands.
- *Regrowth Open Forest* – Regrowth Open Forest is more common in the northern half of the Project area. The internal habitat connectivity is relatively high for woodland and forest dependent species due to the moderately dense regrowth, though the external habitat connectivity is relatively low for woodland and forest dependent species given the level of fragmentation producing the surrounding secondary grasslands with scattered tree cover and remnant regrowth woodland/forest clumps.
- *Water Sources (dams/creeks)* - A number of small farm dams are scattered across the Project area together with larger mine infrastructure dams. The drainage lines in the Project area are ephemeral (including the unnamed drainage line in the north of the Project area), without well defined flood plains or tree dominated riparian strips. The northern portion of Coal Shaft Creek occurs within the Project area. Water Source habitats (flowing and non flowing systems) within the Project area provide important additional or complementary habitat and resources for a wide number of species including amphibia, reptiles, birds and mammals.

An aerial photograph of the Project area illustrating the extent of remnant and regrowth vegetation, secondary grasslands and riparian habitats associated with the major streams (e.g. Mammy Johnsons River) is provided in Appendix E.

Native Terrestrial Fauna Species Composition

A total of 197 native vertebrate species have been located within the Project area and surrounds during the fauna surveys from 1996 to 2009, comprising of 18 amphibians, 14 reptiles, 128 birds and 37 mammals (Appendix E). A comprehensive list of fauna species recorded within the Project area and surrounds is provided in Appendix E.

Introduced Terrestrial Fauna Species

A total of nine introduced terrestrial fauna species have been recorded in the Project area and/or surrounds (Appendix E). EcoBiological (2009a) report that the estimated relative abundance of the Black Rat and Red Fox was uncommon, while the Brown Hare and European Rabbit were abundant and common, respectively.

Critical Habitat

No critical fauna habitat as designated by the Register of Critical Habitat held by the Commonwealth Minister of the Environment, Heritage and Arts (DEWHA, 2009b), Register of Critical Habitat held by the Director-General of the DECC (DECCW, 2009e), Register of Critical Habitat held by the Director-General of the DII-Fisheries (DII-Fisheries, 2009); or identified within the Great Lakes LEP occurs within the vicinity of the Project.

Threatened Fauna Species

A total of 18 threatened fauna species listed under the TSC Act and/or EPBC Act have been recorded in the Project area and/or surrounds including one amphibian, one reptile, nine birds, and seven mammals. Most of these species were recorded outside of the Project area within the habitat along the Mammy Johnsons River (e.g. Giant Barred Frog) or on Buckleys Range to the east (e.g. Gang-gang Cockatoo) (Appendix E) (Figure 4-9).

A list of threatened fauna species that are either known to occur or considered to potentially occur in the Project area or immediate surrounds was refined to include only those species likely to be affected by the Project. This list is conservative and includes species which may be subject to only minor removal of known habitat (Table 4-24).

A threatened species assessment was conducted in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005) for the species listed in Table 4-24, while the location of these species is shown on Figure 4-9.

Of the species listed in Table 4-24, four threatened birds and four threatened mammals have been recorded in the Project area, namely the Swift Parrot, Brown Treecreeper (eastern subspecies), Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale, Squirrel Glider, Eastern Bentwing-bat and Eastern Freetail-bat (Appendix E).

Table 4-24
Relevant Threatened Fauna Species

Scientific Name	Common Name	Conservation Status	
		TSC Act[1]	EPBC Act[2]
Birds			
Lathamus discolour	Swift Parrot	E	E
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V	-
Pyrrholaemus sagittata	Speckled Warbler	V	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-
Mammals			
Phascogale tapoatafa	Brush-tailed Phascogale	V	-
Petaurus norfolcensis	Squirrel Glider	V	-
Mormopterus norfolkensis	Eastern Freetail-bat	V	-
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-
Myotis macropus	Large-footed Myotis	V	-

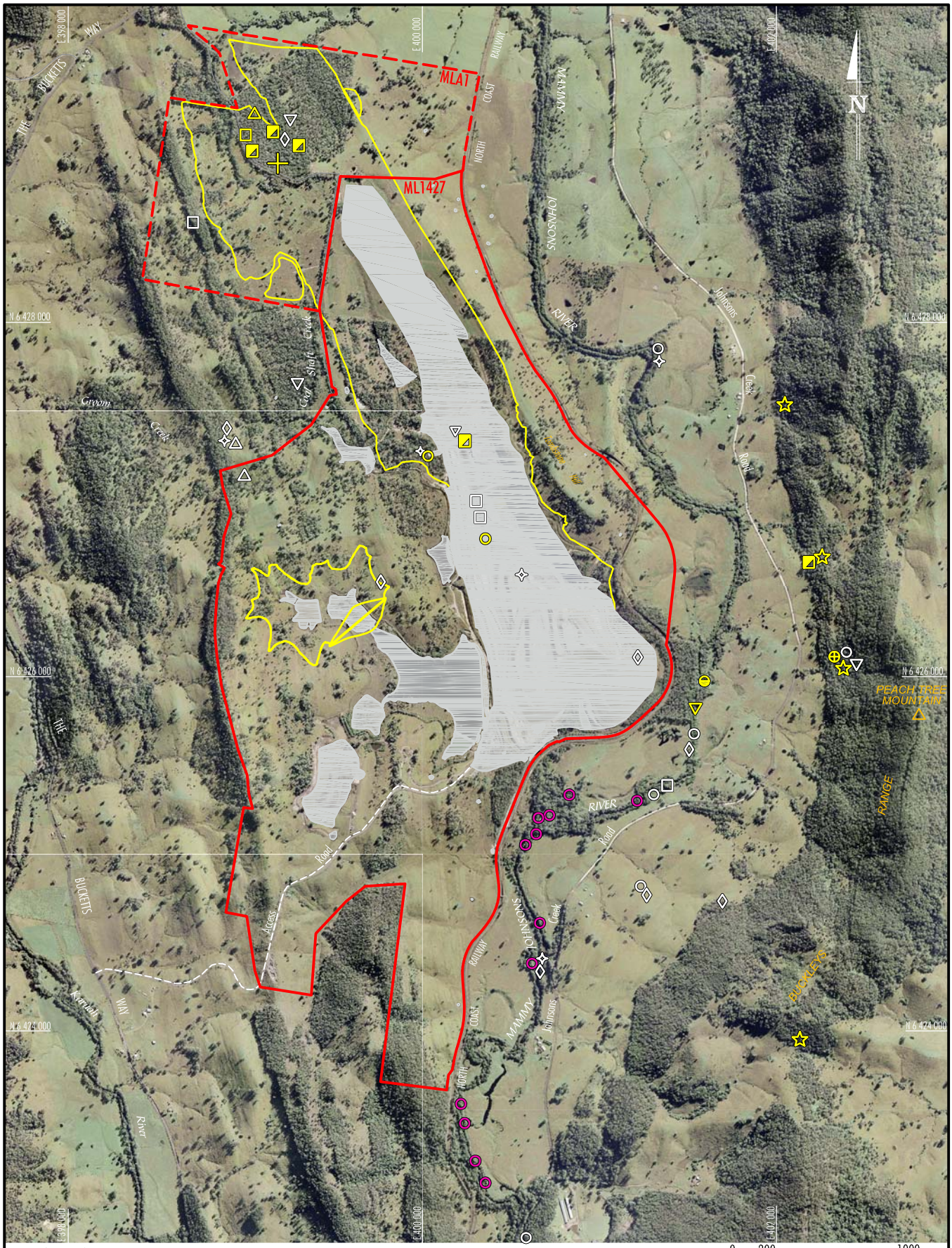
Source: After Appendix E.

[1] Threatened Species status under the TSC Act.

[2] Threatened Species status under the EPBC Act.

V Vulnerable.

E Endangered.



Threatened Fauna

- Giant Barred Frog
- Rose-crowned Fruit-Dove
- Glossy Black-Cockatoo
- Gang-gang Cockatoo
- Swift Parrot
- Sooty Owl
- Powerful Owl
- Brown Treecreeper
- Speckled Warbler
- Grey-crowned Babbler
- Brush-tailed Phascogale
- Koala
- Squirrel Glider
- Eastern Bentwing-bat
- Eastern Freetail-bat
- Large-footed Myotis

LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- Approximate Extent of Existing/Approved Major Surface Development
- Approximate Extent of Additional Project Major Surface Development

0 200 1000

Metres

GRID DATUM MGA 94 ZONE 56

Source: AAHatch- Aerial Photography flown April 2009; DCPL (2009) and Cenwest Environmental Services & Resource Strategies (2009)

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FIGURE 4-9

Threatened Fauna Species Recordings

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DURALIE COAL

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Of the species listed in Table 4-24, only the Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale and Squirrel Glider listed under the TSC Act are considered likely to have viable populations residing within the Project area (Appendix E). The populations of these four species are unlikely to be confined to the relevant habitats within ML 1427 and MLA 1 since there are records of these species outside of the Project area and there is sufficient connectivity between the habitats within and outside of the Project area (Appendix E).

The Swift Parrot and Eastern Bentwing-bat, although they may utilise foraging habitat resources in the Project area, are unlikely to breed within the Project area given the lack of suitable breeding resources (Appendix E). The single record of a pair of Brown Treecreeper (eastern subspecies) in the Project area suggests that this species is unlikely to be resident in the Project area (Appendix E).

The Large-footed Myotis has been recorded in the Project surrounds and potential habitat for this species occurs in the Project area. A threatened species assessment was conducted for this species (Appendix E) and the species is listed in Table 4-24.

Migratory Species under the Commonwealth EPBC Act

The Project area provides limited habitat for migratory species. Four migratory birds have been recorded in the Project area and surrounds (i.e. the White-throated Needletail, Rainbow Bee-eater, Rufous Fantail and Black-faced Monarch) (Appendix E).

4.9.2 Potential Impacts

The following sub-sections evaluate the potential impacts of the Project on fauna species, populations and ecological communities, and their habitats in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). This evaluation includes identification of the magnitude, extent and significance of the potential impacts. Proposed measures to avoid, mitigate and offset potential impacts on fauna are provided in Section 4.9.3.

Habitat Removal and Modification

The area of native vegetation which would be cleared for the Project is described in Section 4.8.2. The vegetation clearance for the Project equates to the clearance of the following broad fauna habitat types (Appendix E):

- approximately 72 ha of Secondary Grassland;
- approximately 28 ha of Secondary Grassland with Regrowth Open Woodland/Forest; and
- approximately 96 ha of Regrowth Open Forest.

Removal of dead wood and dead trees, loss of hollow bearing trees and bushrock removal are recognised as key threatening processes under the TSC Act. An assessment of these key threatening processes is provided in Appendix E.

The Project would result in the reduction of physical habitat connectivity, though the Project is unlikely to lead to the isolation of habitat or result in a substantial additional reduction in habitat connectivity within the surrounding landscape as the disturbance areas are located adjacent to the existing/approved DCM.

A discussion of the potential for Project alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands and impacts on groundwater dependent vegetation is provided in Section 4.8.2.

Introduced Fauna

Many animal pests pose a threat to native fauna through competition for habitat resources and direct predation. Predation by the Feral Cat, competition and grazing by the Feral European Rabbit, and predation by the European Red Fox are key threatening processes listed under the TSC Act.

These key threatening processes may be relevant to the Project as the European Rabbit, European Red Fox and Feral Cat have been recorded during surveys undertaken in the Project area and activities associated with the Project may provide increased refuge and scavenging resources (e.g. discarded food scraps) for these species, unless appropriately managed.

Appropriate management of potential refuge and scavenging resources would likely decrease introduced fauna in response to targeted control measures.

Introduced Flora

A total of 57 introduced flora species have been recorded in the Project area and surrounds, including five noxious weed species (Section 4.8.1). Invasion of native plant communities and establishment of Bitou bush, Boneseed, exotic perennial grasses, exotic vines and scramblers and *Lantana camara* are key threatening processes listed under the TSC Act.

The proposed disturbance and irrigation associated with the Project has the potential to act as a catalyst for weed incursion and, if management measures are not in place, proliferation of weeds can occur. The Project is not considered likely to significantly increase the potential for weed incursion, given the weed control measures outlined in Section 4.8.3, which would continue to be implemented.

Fauna and Noise

A number of recent literature reviews have been conducted on the effects of noise on wildlife (Radle, 2007; Kaseloo, 2005; Institute for Environmental Monitoring and Research, 2001). Noise can potentially adversely impact certain fauna species, although studies on the effect of noise on wildlife have shown very variable responses to potential impacts. Numerous studies/reviews indicate that many fauna species (including poultry) adapt to human activities and readily habituate to noise (e.g. Allaire, 1978; Ames, 1978; Busnel, 1978; Lynch and Speake, 1978; Shaw, 1978; Streeter *et al.*, 1979; Poole, 1982; Radle, 2007; Kaseloo, 2005; Institute for Environmental Monitoring and Research, 2001).

Similar to the existing DCM, noise emissions associated with the Project would originate predominantly from mobile equipment and coal handling. In addition, the mining method requires the drilling and blasting of overburden (Section 4.5).

Noise mitigation and management measures would be implemented as part of the Project as outlined in Section 4.5.3. Noise is considered unlikely to significantly impact any fauna species (Appendix E).

Fauna and Artificial Lighting

Artificial lighting for the Project has the potential to affect the behavioural patterns of some fauna species. For example, some bird and bat species are attracted to insects that swarm around artificial lights. As a consequence of this, these bird and bat species could then become vulnerable to predation by larger predators which may lead to changes in population structure and community composition. Operational lighting is unlikely to significantly impact any fauna species, given the existing operational lighting impacts from the DCM are unlikely to significantly increase as a result of the Project (Appendix E).

Vehicular Traffic Movements

Vehicular traffic movements associated with the Project have the potential to increase the mortality of some fauna species. It is considered unlikely that the additional vehicular traffic movements required for the Project would significantly impact fauna given the location of the proposed traffic movements and the measures to avoid and mitigate potential impacts described in Section 4.9.3.

Bushfire Risk

High frequency fire is listed as a key threatening process under the TSC Act. The risk of high frequency fire as a result of the Project is considered to be relatively low given the relatively high rainfall in the area, grazing management and bushfire management measures, supported by the observed lack of evidence of recent fires in the Project area.

Threatened Fauna Species

The threatened species assessment was conducted in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). The Project disturbance would remove known habitat and potentially displace resident Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale and Squirrel Glider, although the Project is not likely to lead to local populations of these species being placed at risk of extinction (Appendix E).

Migratory Species under the Commonwealth EPBC Act

Given the occurrence of only limited habitat for migratory species under the EPBC Act, the Project is not likely to impact any migratory species (Appendix E).

Cumulative Impacts

Potential cumulative impacts on flora and fauna are considered in Appendix E and Section 4.8.2.

4.9.3 Mitigation Measures, Management and Monitoring

The potential impacts of the DCM on fauna are currently managed via implementation of existing management protocols, plans and programs, including the following:

- Vegetation Clearance Protocol (DCPL, 2002b);
- IMP (DCPL, 2008a);
- Site Water Management Plan (DCPL, 2008c);
- Rehabilitation Management Plan (DCPL, 2007a); and
- AQMP (DCPL, 2007e).

Potential impacts of the Project on fauna and their habitats would be managed by the continued implementation of the above management protocols, plans and programmes which would be revised to incorporate relevant measures for the Project. These measures are described in further detail below.

Habitat Rehabilitation

The disturbance areas associated with the Project would be rehabilitated and revegetated with native grass, shrub and tree species characteristic of the vegetation communities cleared. Section 5 and Appendix N present the rehabilitation objectives and provides a description of the rehabilitation works to be undertaken and the rehabilitation assessment and completion criteria.

The Vegetation Clearance Protocol (DCPL, 2002b) also contains general long-term flora and fauna management measures, including inclusion of hollow-developing tree species in the rehabilitation programmes and inclusion of appropriate species in the rehabilitation programme to provide foraging resources.

Vegetation Clearance Protocol

The Vegetation Clearance Protocol (DCPL, 2002b) has been developed to minimise the impact of vegetation clearance on flora and fauna (Section 4.8.3). Habitat resources, such as hollows, would be opportunistically salvaged for placement within rehabilitation areas or other fauna habitat enhancement areas.

The Vegetation Clearance Protocol (DCPL, 2002b) also contains general long-term fauna management measures, including:

- the placement of nesting boxes in suitable habitat for birds and arboreal mammals;
- the placement of bat boxes in suitable habitat for bats; and
- the relocation of habitat features salvaged from felled trees (e.g. hollow branches) in suitable habitat;

Animal Pest Management and Monitoring

The Rehabilitation Management Plan (DCPL, 2007a) provides measures to control animal pests (Section 4.8.3).

Fire Management

The Rehabilitation Management Plan (DCPL, 2007a) outlines the bushfire management measures in place at the DCM (Section 4.2.3).

Noise Controls and Monitoring

A range of noise control measures are implemented at the DCM to minimise noise emissions. These measures would also be applicable to the Project. The NMP (DCPL, 2007b) contains mitigation measures to limit noise emissions. Project noise mitigation measures are described in Section 4.5.3.

Traffic Controls

The Vegetation Clearance Protocol (DCPL, 2002b) contains general long-term flora and fauna management measures, including the imposition of speed limits on vehicles using the Project roads and tracks, and modification of signage to increase awareness and to assist in reducing potential vehicle strike.

Offset Measures

The offset area is described in Section 4.8.3. The proposed offset measures, would constitute a suitable area to offset residual fauna impacts associated with the Project, given the existing biodiversity values of the proposed offset as well as the anticipated improvement in the fauna habitat values in the medium to long-term. All broad fauna habitat types potentially impacted by the Project are represented in the more diverse offset area.

Broad habitat types present in the offset area include: open forest, closed forest, woodland, rocky escarpments, riparian habitat along a length of the Mammy Johnsons River, unnamed creeks and drainage areas, freshwater wetlands, farm dams and secondary grasslands.

The key benefits of the offset area in relation to fauna include:

- an increase in the area of vegetation/habitat in the medium to long-term;
- conservation and/or enhancement of similar vegetation communities/fauna habitats as those that would be disturbed by the Project;
- an adjacent suitably located area of benefit to fauna populations potentially impacted by the Project;
- enhanced connectivity of existing fauna habitat areas via linkages with the Mammy Johnsons River and rehabilitated final Project landforms;
- the proposed offset area contains approximately 8 ha of the River-Flat Eucalypt Forest EEC, approximately 14 ha of the Lowland Rainforest on Floodplain EEC, and approximately 0.2 ha of the Freshwater Wetlands on Coastal Floodplains EEC;
- known habitat for the Giant Barred Frog, Glossy Black-cockatoo, Speckled Warbler, Brush-tailed Phascogale, Eastern Freetail-bat, Eastern Bentwing-bat and Large Footed Myotis; and
- potential habitat for the Rose-crowned Fruit-Dove, Swift Parrot, Brown Treecreeper (eastern subspecies), Grey-crowned Babbler (eastern subspecies) and Squirrel Glider.

4.10 AQUATIC ECOLOGY

An Aquatic Ecology Assessment for the Project was conducted by Cenwest Environmental Services and Resource Strategies (2009b) and the report is presented in Appendix F. A description of the aquatic ecosystems of the Project area and surrounds is provided in Section 4.10.1. Section 4.10.2 describes the potential impacts of the Project on aquatic ecology, while Section 4.10.3 outlines relevant mitigation measures, management and monitoring.

4.10.1 Existing Environment

A significant number of aquatic ecology investigations have been undertaken in the Project area and surrounds between 1995 and 2009. These investigations have included the sampling of macroinvertebrate assemblages, fish and water quality. Baseline aquatic ecology surveys were conducted on the Karuah River, Mammy Johnsons River and Coal Shaft Creek between 1995 and 1996 (Environmental Management and Planning Services [EMPS], 1996). In accordance with the existing DCM Development Consent (DA 168/99), a biological monitoring programme was developed in 2002 as part of the Site Water Management Plan (DCPL, 2008c) to monitor the chemical and biological attributes of the Mammy Johnsons River. As described in the approved Site Water Management Plan (DCPL, 2008c), the objectives of the monitoring programme are to:

- collect baseline data on the macroinvertebrate community utilising the NSW Australian River System sampling protocols;
- utilise biotic indices (i.e. SIGNAL HU97, Ephemeroptera, Plecoptera and Trichoptera richness, number of families, functional feeding groups and silt tolerant taxa) and community parameters to assess stream "health"; and
- sample stream water quality.

In accordance with the Site Water Management Plan (DCPL, 2008c), Invertebrate Identification Australasia (IIA) has undertaken the biological monitoring programme of the aquatic ecology systems within and around the DCM since the commencement of operations. Stream systems sampled as part of this monitoring include the Mammy Johnsons River, Karuah River, Coal Shaft Creek and the unnamed tributary in MLA 1 as well as the MWD diversion drain dams. The results of the ongoing biological monitoring undertaken at the DCM (15 monitoring rounds undertaken since 2002) indicate that (IIA, 2009):

> *… both the Mammy Johnsons and Karuah Rivers are still in fair to very good condition and possess a healthy, high complex and diverse aquatic system.*
>
> *... the overall biodiversity and river environmental conditions are very good and that there are no apparent adverse effects on the aquatic macroinvertebrate fauna in the Mammy Johnsons River as a result of any activities arising from the operations of the Duralie Mine.*

Results of the aquatic ecology surveys undertaken by EMPS and the 15 rounds of aquatic ecology monitoring undertaken by IIA have been used to inform the Aquatic Ecology Assessment provided in Appendix F and summarised below.

Table 4-25 describes the aquatic ecology sampling locations and sampling periods.

Aquatic Habitats

Aquatic habitats within the Project area and surrounds include: pools; riffle/glide sections; substrate of cobbles, clay or bedrock; deposits of sand/silt and/or layers of detrital material. Submerged macrophytes and overhanging vegetation have been observed at some river locations (i.e. Mammy Johnsons River and Karuah River) (Appendix F).

Streams within the Project disturbance area (i.e. headwater sections of Coal Shaft Creek and an unnamed tributary) are best described as degraded and incised ephemeral drainage lines that provide limited aquatic habitat (Appendix F).

A summary of general water quality in the Project area and surrounds is provided in Section 4.4.1. Specific water quality measurements recorded by IIA (2009) during aquatic ecology sampling between 2002 and 2009 are provided in Appendix F and are summarised below.

The mean pH at all aquatic ecology sampling locations were within the recommended ANZECC/Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) guidelines (i.e. pH 6.5 to 8.5) for the protection of aquatic ecosystems in lowland rivers (i.e. systems at < 150 m altitude).

Table 4-25
Summary of Aquatic Ecology Sampling Locations and Sampling Periods

Sampling Location No.[1]	Stream/Waterbody	Sampling Location Description	Sampling Period
1	Mammy Johnsons River	Upstream of the DCM.	September 2002 to March 2009
2		Downstream of Location 1, upstream of the DCM.	
3		Downstream of Location 2, downstream of the DCM.	
4		Downstream of Location 3, below the DCM, west of Johnsons Creek Road.	
5	Karuah River	At Stroud Road crossing.	
6	Coal Shaft Creek	At last pool before the creek enters the Mammy Johnsons River, above Location 3.	September 2008 to March 2009
7	Unnamed tributary	Upstream (approximately 200 m) of the confluence with the Mammy Johnsons River.	
8	DDD1	Adjacent to Location 9, above the MWD at the DCM.	March 2009
9	DDD2	Adjacent to Location 8, above MWD at the DCM.	March 2004 to September 2008
10	Karuah River	Downstream of the DCM, at Booral.	August 1995
11	Mammy Johnsons River	Adjacent to the DCM.	
12		Adjacent to the DCM.	
13		Upstream of the DCM.	
14	Karuah River	Upstream (approximately 3 km) of the confluence with the Mammy Johnsons River.	
15	Mammy Johnsons River and Karuah River	At the confluence of the Mammy Johnsons River and Karuah River.	
16	Coal Shaft Creek	Upper section of creek at the DCM.	August 1996
17		Middle section of creek at the DCM.	
18		Lower section of creek at the DCM.	

[1] Refer aquatic ecology sampling locations shown on Figures F-2 and F-4 in Appendix F.

Mean dissolved oxygen values recorded at the aquatic ecology sampling locations were below the recommended ANZECC/ARMCANZ (2000) guidelines for the protection of aquatic ecosystems (i.e. 85 to 110% saturation for lowland rivers) at some locations including two locations upstream of the DCM on the Mammy Johnsons River, one location downstream of the DCM on the Mammy Johnsons River and Coal Shaft Creek and the unnamed tributary in MLA 1. IIA (2003, 2007) note that the March 2003 and March 2007 sampling periods (which correlated to the lowest recorded dissolved oxygen values) were proceeded by prolonged dry periods.

All mean EC values (range = 148 to 595 µS/cm) were within the recommended ANZECC/ARMCANZ (2000) guidelines for the protection of aquatic ecosystems in lowland rivers. Coal Shaft Creek, the unnamed tributary in MLA 1 and Diversion Dam Drain 1 all recorded consistently higher conductivity levels than the river sampling locations.

Macroinvertebrates

A total of 153 macroinvertebrate taxa from 74 families were recorded between 2002 and 2009 (Appendix F). The taxa classification and abundance of macroinvertebrates collected from each sampling location is provided in Appendix F. The highest number of taxa recorded at an individual location was on the Mammy Johnsons River (a total of 47 taxa recorded at Location 2) with the lowest number of taxa recorded at the unnamed tributary in MLA 1 (a total of six taxa at Location 7).

The most commonly recorded macroinvertebrate taxa collected at sampling locations between 2002 and 2009 were (Appendix F): *Paratya australiensis* (Freshwater Shrimp); Coleoptera (Beetles); Chironomidae (Midges); Baetidae and Leptophlebiidae (Mayflies); Calamoceratidae, Hydrobiosidae, Hydropsychidae, Leptoceridae and Philopotamidae (Caddisflies); Grypopterygidae (Stoneflies); Sphaeridae (Molluscs); and Hydrobiidae (Mud Snails).

Fish

During the EMPS surveys the Karuah River recorded the highest diversity of fish species. The most abundant fish species recorded included the Australian Bass, Australian Smelt, Freshwater Mullet, Fire-tailed Gudgeon and Western Carp Gudgeon (Appendix F). The least common species were the Nepean Herring, Bullrout and Cox's Gudgeon (Appendix F).

Threatened Aquatic Biota

No threatened aquatic biota listed in the schedules of the TSC Act, NSW *Fisheries Management Act, 1994* (FM Act) or EPBC Act were identified by the aquatic surveys or monitoring or are considered likely to occur in the Project area or surrounds (Appendix F).

Irrigation Management Plan

As described in Section 2.8.1, the DCM water management system includes the beneficial use of contained mine water for irrigation within defined irrigation areas in accordance with the IMP (DCPL, 2008a). The first flush protocol is designed to collect initial (or "first flush") rainfall runoff from irrigation areas which drain to Coal Shaft Creek or Mammy Johnsons River following prolonged dry spells when this runoff would be expected to contain some salt loads as a result of irrigation.

As provided above, the results of the ongoing biological monitoring indicate that both the Mammy Johnsons and Karuah Rivers have remained in fair to very good condition and that there are no apparent adverse effects on aquatic ecology as a result of the existing DCM operations.

4.10.2 Potential Impacts

Potential impacts of the Project on aquatic ecology were considered in terms of habitat alteration; alteration to surface water flows and water quality; potential barriers to fish movement; threatened aquatic biota, and cumulative impacts, as described below.

Disturbance and Alteration of Aquatic Habitat

Some marginal aquatic habitat would be removed or altered as a result of the Project. This would include the diversion of a headwater ephemeral section of Coal Shaft Creek to enable flows from the north to connect with the existing Coal Shaft Creek Diversion. It would also include the removal of a headwater ephemeral section of an unnamed tributary of Mammy Johnsons River, located at the northern extent of the Project area. Part of the current drainage to this headwater section of the unnamed tributary would be captured and diverted south to the Coal Shaft Creek Diversion. Further detail on the above is provided in Section 4.4.2.

The alteration of natural flow regimes of rivers and streams is recognized as a key threatening process under the TSC Act and FM Act. The degradation of native riparian vegetation along NSW watercourses is also listed as a key threatening process under the FM Act.

The sections of stream in the Project disturbance area are the headwater sections of shallow ephemeral drainage lines that provide very limited habitat for aquatic biota. Portions of these sections of streams have been subject to grazing by cattle, erosion and invasion by introduced species.

Surface Water Flows

The Project could potentially result in changes to surface water flows in streams located downstream of the Project (i.e. the Mammy Johnsons River). Alteration to natural flows has the potential to adversely impact aquatic ecosystems through changes in the availability and/or reliability of available surface water or changes in the flow power and/or depth of surface water. Based on the assessment provided in Section 4.4.2 and Appendix A, the Project is considered unlikely to have a significant impact on surface water flows and, therefore, is considered unlikely to have a significant impact on aquatic biota.

Surface Water Quality

Following prolonged dry periods, surface water runoff from mine landforms and disturbed areas has the potential to contain elevated salinity or sediments. The potential surface water quality impacts of the Project are described in detail in Appendix A and summarised in Section 4.4.2.

The key surface water quality issue relating to potential impacts of the Project on aquatic biota is the beneficial use of mine water for irrigation. High salinity concentrations in runoff can have a deleterious impact on assemblages of macroinvertebrates, fish and aquatic plants.

Irrigation within the Project area would be undertaken generally in accordance with the IMP (DCPL, 2008a). The IMP includes a number of management measures, including a first flush protocol. Further detail on the first flush protocol is provided in Section 2.8.1 and Appendix A.

Based on the predicted impacts to surface water flows and water quality described in Section 4.4.2 and Appendix A, as well as the proposed continued implementation of the DCM irrigation management measures, the Project is considered unlikely to have a significant impact on downstream aquatic ecosystems (Appendix F).

Potential impacts to the surface water quality of Mammy Johnsons River as a result of possible changes to groundwater reporting to the Mammy Johnsons River are described in Section 4.3.2 and Appendix B. Based on the predicted impacts on groundwater described in Section 4.3.2 and Appendix B (i.e. inconsequential effects on baseflow and water quality of the Mammy Johnsons River), the Project is considered unlikely to have a significant impact on aquatic biota.

Barriers to Fish Movement

The Project would include the diversion of an additional degraded headwater section of Coal Shaft Creek and the removal of a degraded headwater section of an unnamed tributary of Mammy Johnsons River. These degraded headwater reaches are currently unlikely to be suitable habitat for native fish (Appendix F).

The degraded headwater section of Coal Shaft Creek proposed to be diverted is located upstream from the existing Coal Shaft Creek Diversion, which includes design features that would inhibit the movement of fish upstream. Movement of fish from the Mammy Johnsons River into the lower sections of the non-impacted sections of the unnamed tributary and Coal Shaft Creek would be unchanged by the Project. The Project is therefore considered very unlikely to create a new barrier to fish movement (Appendix F).

Threatened Aquatic Biota

The potential impacts from the Project on threatened aquatic biota have been assessed in Appendix F in consideration of the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). The Project is considered very unlikely to have a significant effect on any threatened aquatic biota (Appendix F).

Cumulative Impacts on Aquatic Ecology

Cumulative impacts on aquatic ecosystems predominantly relate to habitat disturbance and alteration. The assessment of cumulative impacts has taken into consideration the extent and type of habitat disturbance associated with the Project and other major projects in the region, the existing assemblages of aquatic biota, the condition of the streams and the Project ameliorative measures.

As described in the sections above, monitoring has concluded that the current operations are having no adverse effects on aquatic ecology (IIA, 2009) and the Project is expected to have minimal impact on aquatic ecology.

Land use in the region is primarily cattle grazing on native and improved pastures, along with some poultry farming and other kinds of agricultural production. Almost all of the pre-European forest and woodland which once occurred in the Project area (and likely also that which occurred in the region) has been extensively cleared as part of past rural land use practices and logging. Agricultural related actions in the region are considered to have had the greatest impact on regional aquatic ecology (Appendix F).

Management measures relevant to aquatic ecology are summarised in Section 4.10.3. These measures have been incorporated into the Project to minimise the potential impacts of the Project, including cumulative impacts on aquatic ecosystems. With continued implementation of these measures and when compared to the impact from ongoing regional agricultural activities, it is considered highly unlikely that the Project would result in a measurable increase in cumulative impacts on aquatic ecosystems.

4.10.3 Mitigation Measures and Management

The potential impacts of the DCM on aquatic ecology are currently managed via the implementation of existing management plans and programs, including the following:

- IMP (DCPL, 2008a); and
- Site Water Management Plan (DCPL, 2008c).

Potential impacts of the Project on aquatic ecology would be managed by the continued implementation of the above management plans and programmes as part of the Project. In addition, the following measures would be implemented as part of the Project and are expected to improve the quality of aquatic habitats in the vicinity of the Project:

- enhancement of the riparian habitat along a length of the Mammy Johnsons River within the Project offset area (Figure 4-8) (e.g. increasing the width of the riparian vegetation and implementing weed control measures); and
- enhancement and conservation of Freshwater Wetlands on Coastal Floodplains EEC (listed under the TSC Act) located on the eastern side of the Mammy Johnsons River and within the Project offset area (Figure 4-8).

4.11 ABORIGINAL HERITAGE

An ACHA was prepared for the Project by Kayandel Archaeological Services (2009) (Appendix J).

The Project ACHA has been undertaken in accordance with the Draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005a) and the *Interim Requirements* (DEC, 2004a).

A description of Aboriginal heritage in the vicinity of the Project is provided in Section 4.11.1. Section 4.11.2 describes the potential impacts of the Project on Aboriginal heritage and Section 4.11.3 outlines mitigation measures, management and monitoring.

4.11.1 Existing Environment

Aboriginal History

The study area is located on lands which include the border of the Birpai (or Birripai) tribe and the Worimi tribe (Tindale, 1974). The Birpai tribe occupied the area from the mouth of the Manning River at Taree and inland to near Gloucester (South Australian Museum, undated). The Worimi tribe were located from the Hunter River to Forster near Cape Hawke along the coast, at Port Stephens and inland to near Gresford (South Australian Museum, undated).

ERM Mitchell Cotter Pty Ltd (1995) indicates that the historical literature contains evidence of contact between Aboriginal groups living in the region. Regular gatherings or corroborees were described indicating that songs, dances and stories were exchanged and wives sought (ERM Mitchell McCotter Pty Ltd, 1995). There was also inter-tribal participation in specific rituals such as food increase rites and initiation ceremonies (ERM Mitchell McCotter Pty Ltd, 1995).

Leon and Feeney (1998) indicate that the Worimi people had a distinctive way of life and periodically visited the coast, which corresponded with seasonal movements of seafood. The Worimi people also attended various locations for ceremonial purposes. Natural stone material used for manufacturing tools was obtained within the Worimi area and also through trade with neighbouring tribal groups (Leon and Feeney, 1998).

Natural Resources

Semi-permanent water sources were available to Aboriginal groups in the drainage lines located within and surrounding the study area, with permanent water (i.e. Mammy Johnsons River) located immediately to the east of the study area. Variable climatic conditions affected the availability of water and may have subsequently influenced the way Aboriginal people moved through the landscape over time.

A description of the topography and soils in the vicinity of the Project is provided in Section 4.2.

A range of floral and faunal resources are available in the study area and these were potentially seasonally exploited by Aboriginal communities. Sections 4.8.1, 4.9.1, 4.10.1 and Appendices E and F provide comprehensive information on the terrestrial flora and fauna and aquatic ecology attributes of the Project area and surrounds.

Previous Archaeological Investigations

A summary of Aboriginal heritage surveys and assessments of relevance to the Project area is provided below:

- In 1981, Brayshaw (1981) surveyed the Duralie Mine site for Blue Metal Industries.
- ERM Mitchell McCotter Pty Ltd conducted an archaeological survey within ML 1427 and the surrounding area in 1995 with a representative of the Karuah Local Aboriginal Land Council.
- An archaeological survey of Coal Shaft Creek and surrounds was conducted in November 1998 by representatives of the Karuah and Forster Local Aboriginal Land Councils and a NSW National Parks and Wildlife Service (NPWS) officer (Leon and Feeney, 1998).
- A field survey was undertaken in April 2008 by McCardle Cultural Heritage and a representative of the Barkuma Neighbourhood Centre Inc. within MLA 1 and an area south of MLA 1, west of the existing/approved DCM surface disturbance area.

Karuah Local Aboriginal Land Council representatives inspect all construction areas at the DCM prior to disturbance and perform the role of Site Topsoil Monitors during construction works in accordance with the DCM Aboriginal Cultural Heritage Management Plan (ACHMP) (DCPL, 2008d).

To date, Karuah Local Aboriginal Land Council representatives have not identified any Aboriginal heritage items since commencement of the DCM (DCPL, 2006b, 2007f, 2008e; DCPL, pers. comm., 2009).

In addition to the archaeological investigations in the study area and surrounds described above, a number of investigations have been undertaken in the wider region and a summary of these is provided in Appendix J.

Various DECCW Aboriginal Heritage Information Management System (AHIMS) data requests have been completed across the Project area and surrounds, with the most recent data being provided in September 2009.

Cultural Heritage Assessment

Assessment Programme

The ACHA (Appendix J) utilised the results of the fieldwork and information from previous assessments and the results of a Project Aboriginal heritage survey and site inspection conducted by archaeologists and representatives of the Aboriginal community in August 2009. The aim of the Project Aboriginal heritage survey and site inspections was to conduct additional site-specific survey in the Project disturbance area and to provide the contemporary Aboriginal community the opportunity to inspect the area and known Aboriginal heritage sites within the Project area and surrounds in order to provide more informed comment on cultural significance and heritage management and mitigation recommendations.

Table 4-26 summarises the main stages of the Aboriginal heritage consultation/survey programme undertaken as part of the Project.

The fifteen stakeholders who registered an interest in being consulted in relation to the ACHA process were:

- Barrington-Gloucester-Stroud Preservation Alliance Inc.;
- EB Phillips;
- Forster Local Aboriginal Land Council;
- Garigal Aboriginal Community Inc.;
- Garry Smith;

Table 4-26
Summary of the Project Aboriginal Heritage Consultation/Survey Programme

Date	Consultation/Survey Conducted
Previous Consultation	
January 2008	Public advertisement and registration of interested stakeholders.
Project Consultation/Survey	
May/June/July 2009	Identification of local Aboriginal stakeholders with an interest in being consulted in regard to Aboriginal heritage at the Project.
27 July 2009	Provision of a proposed methodology for undertaking the ACHA to registered stakeholders.
August 2009	Feedback from the registered stakeholders in regard to the proposed methodology. Consideration of all comments received on the proposed methodology.
18 August 2009	Invitation to registered stakeholders to attend the Aboriginal cultural heritage survey and site inspection.
25-27 August 2009	Aboriginal cultural heritage survey and site inspection. Cultural significance of the area and Aboriginal heritage sites discussed with the Aboriginal participants.
1 October 2009	Draft ACHA report issued to the registered stakeholders for review, including survey results, archaeological and cultural significance assessment (based on feedback received during previous consultation and fieldwork), potential impacts and proposed management and mitigation measures.
October 2009	Further consultation with the registered stakeholders to discuss the draft ACHA.
October/November 2009	Written feedback and advice received from registered stakeholders (including comments on the consultation, survey, assessment and proposed management and mitigation measures).
November 2009	Comments received from registered stakeholders on the draft ACHA (in relation to cultural heritage) were considered and/or addressed in the ACHA.

Source: After Appendix J.

- Gavin Callaghan;
- Gidawaa Walang Cultural Heritage Consultancy[1];
- Gloucester Environment Group;
- Harry Callaghan;
- JCCC;
- Karuah Local Aboriginal Land Council;
- Maaiangal Group[2];
- Minimbah and District Aboriginal Elders Group Inc.;
- Norma Fisher; and
- NTS Corp;

Archaeological Findings

A total of nine Aboriginal heritage sites were identified within the study area (Table 4-27 and Figure 4-10).

Table 4-27
Known Aboriginal Heritage Sites within the Study Area

Site Type	Site
Isolated Artefact	DM2, DM6, DM11
Open Artefact Scatter	DM9
Scarred Tree	DM3, DM4, DM5, DM10
Scarred Tree – Honey Tree	38-1-0033

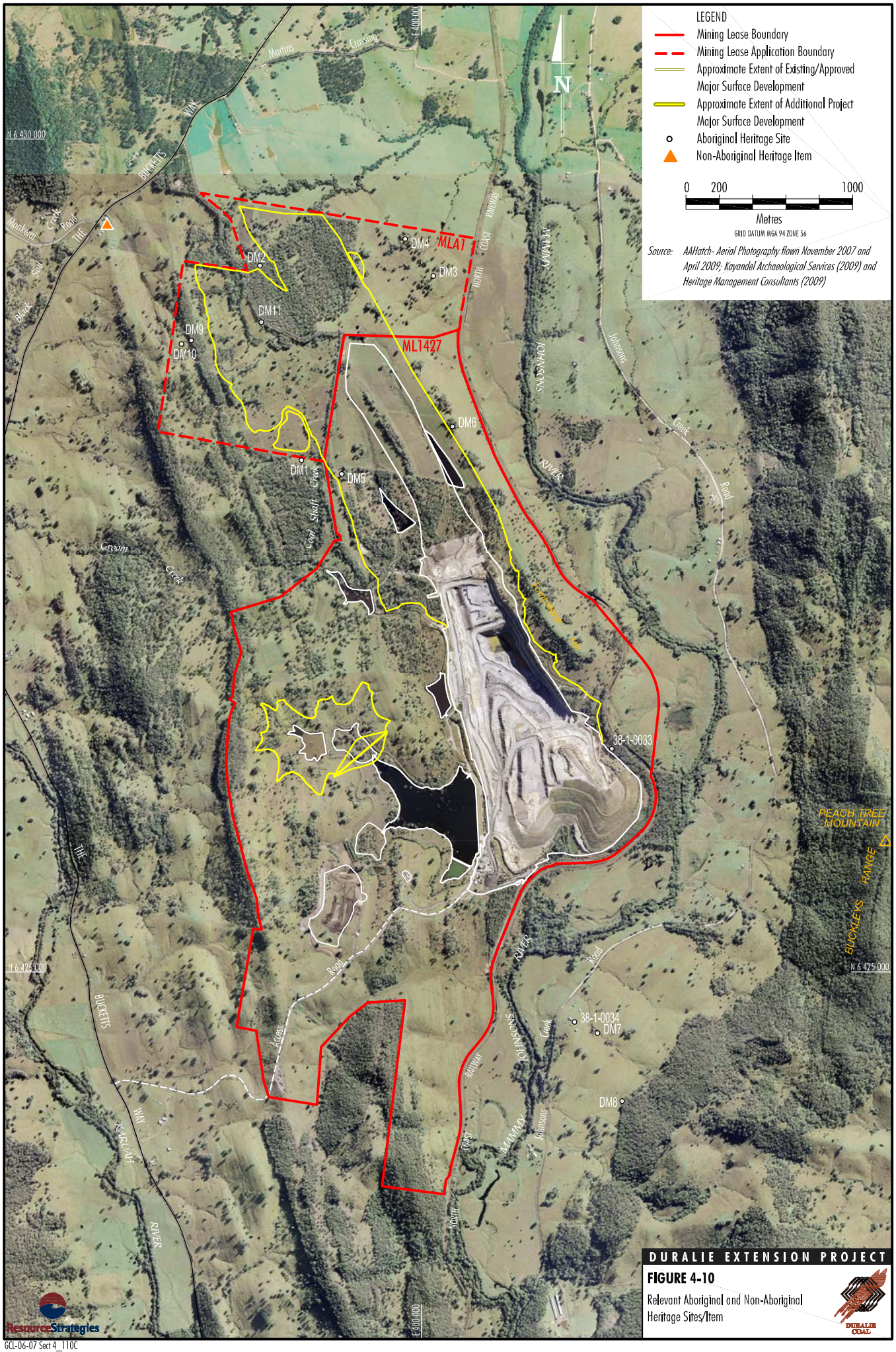
Source: After Appendix J.

In addition to the above, four Aboriginal heritage sites were identified in the immediate surrounds of the study area (within approximately 1 km), and consisted of:

- one isolated artefact;
- two open artefact scatters; and
- one open site – burial site.

1 The Gidawaa Walang Cultural Heritage Consultancy initially registered as Barkuma Neighbourhood Centre Inc. DCPL was informed on 17 August 2009 that Barkuma Neighbourhood Centre Inc. is now trading as Gidawaa Walang Cultural Heritage Consultancy.

2 In correspondence dated 22 October 2009, Nurpula Stephenson indicated that she is affiliated with the Maaiangal Group of the Worimi Nation (herein referred to as the Maaiangal Group) and speaks on behalf of this group.



DURALIE EXTENSION PROJECT

FIGURE 4-10

Relevant Aboriginal and Non-Aboriginal Heritage Sites/Item

ResourceStrategies

DURALIE COAL

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The locations of known Aboriginal heritage sites within the study area and surrounds are shown on Figure 4-10.

Archaeological and Cultural Heritage Values

As part of the ACHA, the existing information (e.g. site cards, photos, site plans, previous archaeological reports) was reviewed for each of the known Aboriginal heritage sites within the study area. Based on this review and the survey and site inspections undertaken in August 2009, each site was assigned an archaeological significance ranking of low, moderate or high.

The archaeological significance rankings for each of the nine known sites within the study area are provided in Table 4-28. One Aboriginal heritage site is of high archaeological significance, six sites are of moderate significance and two sites are of low archaeological significance.

Table 4-28
Archaeological Significance of Aboriginal Heritage Sites within the Study Area

Archaeological Significance Ranking	Aboriginal Heritage Site	Number of Sites
High	38-1-0033	1
Moderate	DM2, DM3, DM4, DM5, DM9, DM10	6
Low	DM11, DM6	2

Source: Appendix J.

No Aboriginal heritage sites within the study area are listed on the Register of the National Estate.

Although the general landscape of the study area and surrounds is of cultural significance, some Aboriginal heritage sites within or surrounding the study area have been identified as being of particular cultural significance to registered stakeholders (e.g. DM10 and Mammy Johnson's Grave). In addition, some Aboriginal representatives indicated that the Mammy Johnsons River is considered to be a natural landscape feature/resource of particular cultural significance. Comments received from the registered stakeholders in relation to cultural significance are detailed in Appendix J.

4.11.2 Potential Impacts

Potential Direct Impacts

Aboriginal heritage sites located within the Project area and surrounds may be potentially subject to direct disturbance.

Two sites (DM5 which is a scarred tree and DM11 which is an isolated artefact) are located within the proposed open pit or the waste rock emplacement areas (Figure 4-10) and would therefore be subject to direct Project disturbance associated with mining activities.

Sites located outside of the proposed open pits and waste emplacement area (e.g. DM2 and DM6) could also be directly disturbed as a result of the development of Project ancillary infrastructure (e.g. water management infrastructure and storages, access roads, etc.) (Section 4.11.3).

The "Honey Tree" (38-1-0033) is located to the east of the existing waste rock emplacement within a fenced and signed enclosure to reduce the risk of accidental damage. The "Honey Tree" would not be disturbed by the Project. The remaining open sites that have been identified outside of, but in close proximity to, the study area (e.g. artefact scatter sites and isolated artefacts) could potentially be subject to accidental disturbance during ongoing exploration and general land management activities.

Potential Indirect Impacts

The types of sites that have been identified in the study area (i.e. isolated artefacts, open artefact scatters and scar trees) are not considered to be particularly sensitive to potential indirect effects (e.g. erosion or blasting vibration) and hence the potential impacts of the Project on these sites would be largely limited to direct effects.

The Mammy Johnsons River has been identified as a natural landscape feature/resource of particular cultural significance. Comprehensive surface water and groundwater assessments are provided in Appendices A and B, respectively, and indicate that there is limited potential for significant hydraulic connection between the Project open pits and the Mammy Johnsons River.

DCPL currently employs a site water management system to intercept and divert runoff from undisturbed and rehabilitated landforms around mining activities and to collect, treat (where necessary) and irrigate excess mine water within ML 1427 (DCPL, 2008c). Measures to manage potential surface water impacts associated with the Project are detailed in Section 4.4 and Appendix A.

Blasting would be used as a component of the Project open pit mining operations. Blasting generates ground-borne vibration. Ground vibration levels would be highest at the source (i.e. within the open pit) and would decrease relative to distance from the source.

Ground vibration levels have been calculated by Heggies for the Mammy Johnson's Grave site. These calculations indicate that the ground vibration level for the largest proposed Project open pit mining MIC (1,500 kg) would meet appropriate criteria at the Mammy Johnson's Grave (Section 4.5).

4.11.3 Mitigation Measures, Management and Monitoring

The mitigation measures, management and monitoring detailed below have been developed in consultation with the registered stakeholders. Input from the consultation process to the below mitigation measures, mitigation and monitoring is described in Appendix J.

The existing ACHMP (DCPL, 2008d) describes measures that are currently employed at the DCM for the management of surface disturbance activities. These measures include:

- Provision of guidance on Aboriginal cultural heritage matters to mining employees and contractors who, as a consequence of their roles at site, have the potential to disturb ground, as part of the induction programme.
- Conduct of pre-clearance inspections prior to major construction works.
- Monitoring of topsoil stripping activities.
- Protocols in the event of identification of new Aboriginal heritage finds.
- Measures to be implemented in the event of discovery of human remains.
- Reporting and communication protocols.

The ACHMP would be updated to reflect the Project and the findings of the ACHA, subject to the conditions of any Project Approval.

The ACHMP would include the following additional measures:

- A protocol for consultation with the Aboriginal community over the life of the Project.
- Updated tables/figures identifying the known Aboriginal heritage sites located within the study area to date and additional detailed information for known sites located within the study area.
- Commitment to fund a study and associated research of Mammy Johnson and her involvement in the region.
- A programme for developing updated AHIMS site cards and plans and for revising the records for registered sites.
- A protocol for managing Aboriginal heritage during the installation/construction of required ancillary surface infrastructure (e.g. irrigation infrastructure, internal roads, etc.).

Surface Disturbance

The following measures would be undertaken to manage the impact of surface disturbance on Aboriginal heritage sites within the study area:

- DCPL would maintain a record of known sites and mark these sites on site plans and relevant Project documentation and implement a protocol for surface works to reduce the risk of accidental damage to known sites.
- Where practicable, known Aboriginal sites would be avoided during Project construction works.
- The "Honey Tree" would continue to be protected within a fenced and signed enclosure to reduce the risk of accidental damage.
- Where avoidance of known Aboriginal heritage sites is not practicable, site(s) would be subject to baseline recording prior to disturbance and artefacts collected by an archaeologist for safekeeping in consultation with the Aboriginal community. If appropriate in the context of the tree condition, culturally modified trees subject to direct surface disturbance (e.g. DM5) would be salvaged and a suitable location for the storage and/or display of the salvaged sections would be identified and managed in consultation with the Aboriginal community.

- Where earthworks are required in close proximity to known Aboriginal heritage sites, the sites would be demarcated with temporary flagging tape or another suitable method to reduce the risk of accidental damage during the earthworks.
- Culturally modified trees located outside of Project disturbance areas would be suitably fenced and signed to reduce the risk of accidental damage.

It is anticipated that the Aboriginal community would provide advice on the storage of collected artefacts, management of artefacts at the completion of Project activities (e.g. artefact replacement onto the post-mining landscape) and the implementation of management measures for salvaged culturally modified trees.

Blasting Vibration

The BMP (DCPL, 2007c) contains measures to mitigate the effects of blasting (Section 4.5.3).

General Management Measures

The following general approach would be taken to manage Aboriginal cultural heritage during the life of the Project:

- Ongoing consultation with the Aboriginal community would be undertaken over the life of the Project. Appropriate Aboriginal representation would occur during archaeological fieldwork (e.g. collection of artefacts prior to construction).
- DCPL would consider reasonable requests from Aboriginal community members to access identified Aboriginal sites located on DCPL-owned land. Such access would be subject to Occupational Health and Safety requirements.
- Erosion and sediment control works would be undertaken in accordance with the requirements of the Project Approval.
- The management measures described in the IMP would be updated to address the Project in accordance with the requirements of the Project Approval.
- Any new sites which may be identified during the development of the Project would be registered with the DECCW in consultation with registered Aboriginal stakeholders.
- A record of known Aboriginal heritage sites, their status and location would be maintained by DCPL.

4.12 NON-ABORIGINAL HERITAGE

A Non-Aboriginal Heritage Assessment for the Project was prepared by Heritage Management Consultants (2009) and is presented as Appendix K. The assessment was prepared in general accordance with the *NSW Heritage Manual* (DUAP, 1996).

A description of the non-Aboriginal heritage within the Project area and surrounds is provided in Section 4.12.1. Section 4.12.2 describes the potential impacts of the Project on non-Aboriginal heritage, while Section 4.12.3 outlines mitigation measures, management and monitoring.

4.12.1 Existing Environment

Historical Overview

The DCM area was part of a large land grant held from the early nineteenth century by the Australian Agricultural Company (the AA Company) that extended from Port Stephens to the Manning River.

Stroud was first developed as a sheep run outpost in 1827, and a small town was developed at this location by Sir Edward Parry, who was the AA Company Superintendent from 1830 to 1834. The Wards River and Johnsons Creek area to the north of the DCM area seems to have been grazed by AA Company sheep from around 1828 (Appendix K).

From the 1850s AA Company holdings in the vicinity of the Project were gradually sold off. As settlers moved into the Gloucester and Mammy Johnsons River valleys, small hamlets sprang up (e.g. Wards River, Clareval and Stroud).

Mining was undertaken on Coal Shaft Creek between approximately 1930 and 1934, and some fragmentary material from this period was recovered during DCM operations and was donated to the local Stroud and District Historical Society.

Further discussion on the early European settlement and the development of the AA Company operations of relevance to non-Aboriginal heritage items in the vicinity of the Project is provided in Appendix K.

Heritage Items of Relevance to the Project

The only non-Aboriginal heritage item identified within the vicinity of the Project area on any heritage register or inventory is the Former Weismantels Inn, which is listed as being of regional significance in Schedule 2 of the Great Lakes LEP. The Former Weismantels Inn is located outside of the Project area and approximately 600 m west of the Clareval North West Open Pit (Figure 4-10).

The Inn is a single storey building comprising three sections and is roughly L-shaped. The building comprises nine main rooms with verandahs across the front/north-western side (bullnose verandah), along the northern eastern side (skillion) and part way along the south-eastern side (skillion) (Appendix K). The Inn serviced regional travellers along the main road to Gloucester as well as local residents from 1883 until the 1920s.

The Former Weismantels Inn is of regional importance in the pattern of European settlement of the Stroud area following breaking up the extensive holdings of the AA Company and land sales for mixed farming along Johnsons Creek (Appendix K). The building complex is in very good condition (Appendix K). Further description of the Former Weismantels Inn is provided in Appendix K.

The Project is located within the Vale of Gloucester Landscape Conservation Area which was registered by the National Trust of Australia (NSW) in 1976. The Vale of Gloucester Landscape Conservation Area has not been listed in either the Gloucester or Great Lakes LEPs or any other regional plan (Appendix K).

A section of post/rail/wire fence was also identified along the northern boundary of the proposed MLA 1 to the west of and perpendicular to Durallie Road. No historical associations with the fence were identified, and the fence was not assessed to be rare or typologically valuable (Appendix K).

4.12.2 Potential Impacts

The Former Weismantels Inn would not be directly impacted by the Project open pit mining operations (Figure 4-10).

Potential indirect impacts to the Former Weismantels Inn from mine blast vibration and airblast emissions were considered in the Noise and Blasting Impact Assessment (Appendix C).

This assessment found that if maximum sized blasts were used in the Clareval North West open pit, applicable blasting vibration building damage criteria were likely to be exceeded (Section 4.5.2). However, with the implementation of the proposed Project blasting mitigation measures (Section 4.5.3), compliance with the applicable blasting vibration criteria at the Former Weismantels Inn would be achieved. With the implementation of applicable blast management measures, the building is expected to remain in good condition (Appendix K).

The Project would not have an adverse affect on the stated historical features of the Vale of Gloucester Landscape Conservation Area as described in the National Trust listing (Appendix K). Potential visual impacts of the Project on the Vale of Gloucester are considered in Section 4.16 and Appendix O.

The section of post/rail/wire fence on the northern boundary of the proposed MLA 1 may be disturbed by ancillary works associated with the Clareval North West open pit.

4.12.3 Mitigation Measures, Management and Monitoring

Specific mitigation measures to minimise the potential impacts of the Project on the Former Weismantels Inn would include:

- implementation of suitable blast management measures (such as a reduction in the MIC) when mining in close proximity to the Former Weismantels Inn (Section 4.5.3); and
- prior to blasting commencing in the Clareval North West open pit, an archival photographic recording of the Former Weismantels Inn would be prepared in accordance with applicable DoP – Heritage Branch standards for a regionally significant heritage sites.

In addition, should operational requirements make the retention of all or part of the post/wire/rail fence in the north of the Project area unfeasible, the fence would be photographically recorded and described, and a copy of the recording and description would be lodged with the local Stroud and District Historical Society.

As described in Section 4.5.3, the BMP would be amended to include blast monitoring at the Former Weismantels Inn, subject to the conditions of any Project Approval.

4.13 ROAD TRANSPORT

A Road Transport Assessment for the Project was prepared by Halcrow MWT (2009) and is presented as Appendix H.

The assessment was prepared in accordance with the *Guide to Traffic Generating Developments* (RTA, 2002) and where relevant, makes reference to the *Road Design Guide* (RTA, 2006)

Section 4.13.1 provides an overview of the existing road network and traffic flows at the DCM.
Section 4.13.2 provides an assessment of the potential impacts of the Project's additional traffic on road network capacity and safety.
Section 4.13.3 describes relevant mitigation measures, management and monitoring.

4.13.1 Existing Environment

Road Hierarchy and Conditions

Regional Roads

The Bucketts Way (Main Road 90) provides access to the Project area. It extends from the Pacific Highway (State Highway 10) at Karuah in the south, to Gloucester in the north and then to the Pacific Highway at Nabiac in the east (Figure 1-1). The Pacific Highway provides access to Newcastle and Sydney from the Project.

The Bucketts Way is a sealed two lane road and in the vicinity of the Project has a posted speed limit of 90 kilometres per hour (km/h). Significant sections of The Bucketts Way have recently been upgraded and the road is typically 7 m wide and has sealed shoulders of varying widths (Appendix H).

The Bucketts Way is widened at the intersection with the DCM access road to provide a separate 130 m right turn deceleration lane and a separate 130 m left turn deceleration lane. This is consistent with a type "CHR" channelised right turn treatment and type "AUL" auxiliary left turn lane treatment as set out in the *Road Design Guide* (RTA, 1996) (Appendix H). Sight distances at the intersection are good (Appendix H).

Local Roads

Durallie Road is a local road that extends in a south-easterly direction from The Bucketts Way to Cheerup Road (Figure 2-1) and provides access to a limited number of private properties.

Durallie Road is sealed for approximately 30 m from its intersection with The Bucketts Way and is then unsealed for the remainder of its length (Appendix H). It typically has a single lane width with opportunities for vehicles to pass at low speed (Appendix H).

Durallie Road forms a tee intersection with The Bucketts Way. Durallie Road is sealed and flared at its approach to the intersection with The Bucketts Way (Appendix H). The basic rural intersection layout is appropriate as the amount of turning traffic is small (Appendix H).

Cheerup Road is an unsealed local road that extends southwards from the eastern end of Durallie Road to ML 1427 (Figure 2-1). It follows a reasonably straight alignment and is typically single lane width with opportunities for vehicles to pass at low speed (Appendix H).

The DCM access road is a sealed two lane road that provides access from The Bucketts Way to the DCM (Figure 4-11). The carriageway is approximately 7 to 7.5 m wide and has double centre lines (Appendix H). The DCM access road has a posted speed limit of 50 km/h.

Background Traffic Volumes

Available traffic flow data was reviewed and additional traffic counts were conducted in July and August 2009. Relevant traffic counter locations are shown on Figure 4-11 and the existing daily traffic volumes are summarised in Table 4-29.

Table 4-29
Existing Traffic Volumes

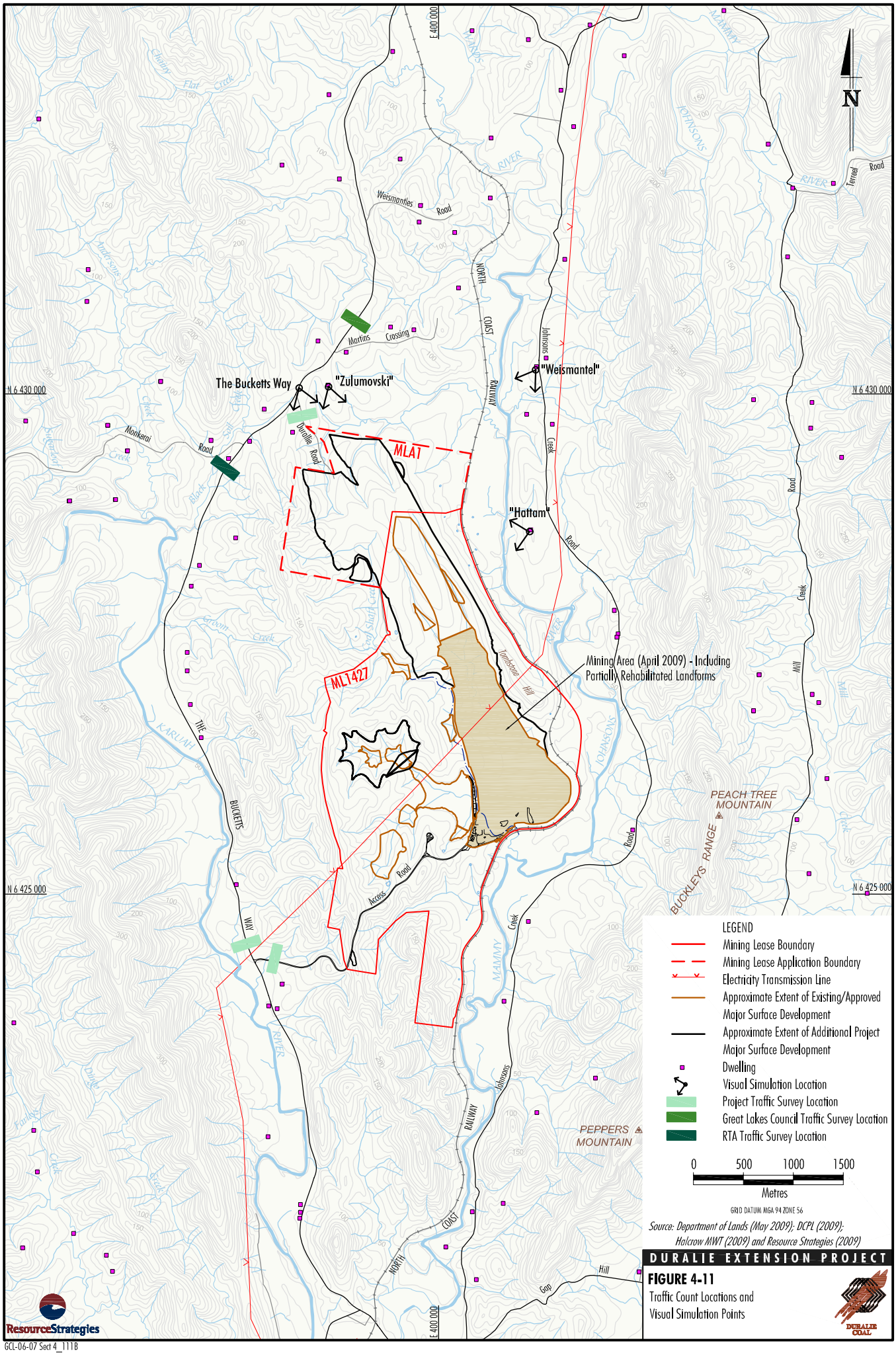
Road[1]	Daily Traffic Volume
The Bucketts Way (north of the DCM Access Road)	1,518
The Bucketts Way (south of the DCM Access Road)[2]	1,474
DCM Access Road	240
Durallie Road[3]	30

Source: After Appendix H.

1 Refer to Figure 4-11.

2 Traffic volumes calculated from the DCM access road and The Bucketts Way (north of the DCM access road) surveys.

3 Surveyed traffic volumes adjusted to reflect expected typical use of Durallie Road without the traffic from atypical exploration activities that occurred during the survey period.



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AUSTROADS (1988) defines a Level of Service as a qualitative measure describing operational conditions within a traffic stream (in terms of speed, travel time, room to manoeuvre, safety and convenience) and their perception by motorists and/or passengers. The roads listed in Table 4-29 all operate with a good level of service (Appendix H).

Road Safety

A review of RTA road accident data on The Bucketts Way between Johnsons Creek Road and Martins Crossing (Figure 4-11) for the period July 2005 to March 2009 has been undertaken as a component of the Road Transport Assessment (Appendix H). The review of the RTA accident data identified no particular accident pattern or causation factors in the local area (Appendix H).

DCPL Contributions to Great Lakes Council

DCPL currently makes annual financial contributions to the GLC to assist in the maintenance of The Bucketts Way and for the conduct of structural inspections of bridges along The Bucketts Way in accordance with Conditions 15 and 16 of the DCM Development Consent (DA 168/99).

4.13.2 Potential Impacts

Potential traffic impacts of the Project on traffic generation, roadway capacity and safety are assessed in Appendix H and summarised below.

Project Traffic Generation

Table 4-30 summarises the estimated existing and predicted cumulative DCM and Project daily vehicle movements (traffic in both directions).

Table 4-30
Existing and Predicted Project Traffic Volumes (Trips/Day)

Vehicle Type	Existing DCM	DCM Incorporating the Project
Light Vehicles	212	238
Heavy Vehicles	28	36
Total Vehicles	**240**	**274**

Source: After Appendix H.

Cumulative Traffic Increases

Long-term Baseline Traffic Growth

The Project would extend the life of the DCM by approximately nine years. During this period the volume of background traffic (i.e. non-DCM traffic) is expected to vary (i.e. increase/decrease). In order to conservatively consider the potential impacts of the Project in the context of potential background traffic growth, an annual baseline growth rate was used.

Based on an analysis of RTA traffic volume data on The Bucketts Way a 3% pa baseline traffic growth rate was applied to the existing traffic volumes provided in Table 4-30 (Appendix H).

Table 4-31 presents the predicted traffic flows in 2010 and 2019 on key roads including additional Project traffic flows and estimated background traffic growth. The existing Level of Service of all assessed roads is not expected to change as a result of the Project (Appendix H).

Table 4-31
Predicted 2010 and 2019 Traffic Volumes Incorporating the Project

Road[1]	Predicted Traffic Conditions[2]	
	2010	2019
The Bucketts Way (north of the DCM Access Road)	1,585	1,957
The Bucketts Way (south of the DCM Access Road)[3]	1,523	1,895
DCM Access Road	274	274
Durallie Road[4]	42	42

Source: After Appendix H.

1 Refer to Figure 4-11.

2 Incorporates a 3% pa baseline traffic growth rate to the existing traffic volumes (Table 4-30).

3 Traffic volumes calculated from the DCM access road and The Bucketts Way (north of the DCM access road) surveys.

4 Surveyed traffic volumes adjusted to reflect expected typical use of Durallie Road without the atypical exploration activities that occurred during the survey period.

Cumulative Traffic Impacts

There is no known existing or approved significant traffic generating developments that have the potential to significantly impact traffic volumes or safety in the vicinity of the DCM (Appendix H). Notwithstanding, other developments in the vicinity of the Project site have the potential to add additional traffic flows that may result in cumulative impacts on the local road network. General baseline traffic growth expected to be generated over the life of the Project was included in the Road Transport Assessment (Appendix H).

Intersection Performance

The Bucketts Way and DCM Access Road Intersection

The existing intersection of The Bucketts Way and the DCM access road (Section 4.13.1) would be appropriate for the Project and no works are required at this intersection to address the minor increase in traffic associated with the Project (Appendix H).

The Bucketts Way and Durallie Road Intersection

As described in Section 2.10.2, Durallie Road would be used intermittently by DCPL employees to access the north-west of the Project area. The predicted traffic volumes on Durallie Road as a result of the Project (Table 4-31) are very low and no additional intersection treatments would be warranted (Appendix H).

Closure of Durallie and Cheerup Roads

As described in Section 2.10.2, the entire length of Cheerup Road and approximately 1 km of Durallie Road (within MLA 1) would be closed in accordance with the requirements of the GLC. These closures would require modification to one existing property access location. DCPL would provide an alternative access route in consultation with the relevant landholder.

Temporary Road Closures Associated with Blasting

When blasting is undertaken within 500 m of Durallie Road, temporary closure of the road for short periods (i.e. less than 15 minutes) would be required. These temporary closures would be conducted in accordance with the Blast Management Plan (Section 4.5.3).

Road Safety

The Road Transport Assessment (Appendix H) did not identify any particular accident patterns or causation factors in the vicinity of the Project (Section 4.13.1). As the increases in traffic resulting from the Project would be minimal, Halcrow MWT (2009) anticipates that no significant road safety issues would occur as a result of the Project.

Night-Lighting

As a result of the open pit mining areas being extended further to the north (Section 2.4), the Project northern mining areas would be visible from sections of The Bucketts Way to the north of the DCM. A visual screen would be established to screen views of the Project open pits and waste rock emplacements from along the eastern side of relevant sections of The Bucketts Way subject to landholders' consent. The screen would be established at the boundary of the relevant property and The Bucketts Way road reserve. Notwithstanding, DCPL would locate lighting plants in the open pit mining areas so that they would be directed away from vehicles travelling south on The Bucketts Way.

Oversize Traffic

A small number (approximately six trips/year) of overwidth, overheight, or overweight loads would be generated during the life of the Project. All such loads would be transported with the relevant permits, licences and escorts as required by the regulatory authorities. The proposed route would be negotiated with the relevant local councils on a case-by-case basis.

4.13.3 Mitigation Measures, Management and Monitoring

DCPL would implement the following road transport management measures:

- DCPL would negotiate an agreement or alternatively provide an alternative access for the one property affected by the closure of Cheerup Road and 1 km of Durallie Road (Section 4.13.2).
- Subject to landholder consent, DCPL would establish a visual screen on the eastern side of the relevant sections of The Bucketts Way to minimise potential night lighting impacts for vehicles on The Bucketts Way (Section 4.13.2).

- DCPL would locate lighting plants in the open pit mining areas so that they would be directed away from vehicles travelling south on The Bucketts Way (Section 4.13.2).
- DCPL would temporarily close Durallie Road when blasting is undertaken within 500 m of the road (Section 4.13.2).
- Employees and contractors would be encouraged to car pool and reduce light vehicle movements.
- All oversized vehicles would have the relevant permits, licences and escorts, as required by the regulatory authorities and the proposed route would be negotiated with the relevant local councils.
- All oversize vehicles loads would be appropriately secured and covered.

The Project would not result in any significant impact on the performance and safety of the road network and no specific intersection works or road upgrades are warranted (Appendix H).

As described in Section 4.13.1, DCPL currently makes annual contributions to the GLC to assist in the maintenance of The Bucketts Way and it is anticipated that similar contributions to the GLC would continue in accordance with the Project Approval.

4.14 REGIONAL ECONOMY

A Socio-Economic Assessment (including a regional economic impact assessment) was prepared for the Project by Gillespie Economics (2009) and is presented in Appendix G.

The regional economic assessment was conducted at two different scales to assess the potential impact of the Project at a regional scale and at the NSW level. The local region for the Project was considered as the combined region encompassing the Great Lakes Statistical Local Area (SLA) and the Gloucester SLA.

Regional economic assessment is primarily concerned with the effect of an impacting agent on an economy in terms of specific indicators, such as gross regional output (business turnover), value-added, income and employment. The regional economic assessment is based on analysis of a 2005 to 2006 input-output table prepared by Gillespie Economics for the regional (i.e. Great Lakes and Gloucester SLAs) and NSW economies.

A summary of the existing regional and NSW economy (including the influence of the existing DCM) is provided in Section 4.14.1. The potential impacts of the Project on the regional and NSW economies are described in Section 4.14.2, while mitigation measures are provided in Section 4.14.3.

4.14.1 Existing Environment

The gross regional product (GRP) for the regional economy (i.e. Great Lakes and Gloucester SLAs) is estimated at $1,009 million (M), comprising $517M to households as wages and salaries (including payments to self employed persons and employers) and $492M in other value-added contributions.

The comparative distribution of various industry sectors to employment, GRP and output earnings for the regional economy (i.e. Great Lakes and Gloucester SLAs) and for the NSW economy are presented in Table 4-32.

Table 4-32
Contributions to Employment, Gross Regional Product and Output by Industry Sector – Regional and NSW Economies (2005 to 2006)

Sector	Total Employment (%)		Contribution to GRP (%)		Contribution to Output (%)	
	Regional	NSW	Regional	NSW	Regional	NSW
Agriculture, Forestry and Fishing	8	3	6	2	6	2
Mining	1	1	3	2	2	2
Manufacturing	6	11	8	11	11	19
Utilities	1	1	2	2	3	3
Building	9	7	9	6	13	9
Services	75	77	67	71	64	65

Source: After Appendix G.

The agriculture, forestry and fishing sectors, mining sector (GRP only) and building sector are of greater relative importance in the regional economy than they are in the NSW economy (Appendix G). The manufacturing sector and services sector are of less relative importance in the regional economy than they are to the NSW economy (Appendix G).

In terms of gross regional output, gross value-added and income, the business services sectors, retail trade sectors and building/construction sectors are the most significant sectors of the regional economy (Appendix G). The retail trade sectors, business services sectors and building/ construction sectors are the most significant sectors of the regional economy for imports while the retail trade sectors, business services sectors and ownership of dwellings sectors are the most significant sectors for exports (Appendix G).

The retail trade sector is the greatest employer in the region followed by the hospitality (accommodation and restaurants) and health (Appendix G). However, in terms of income paid to employment, the business services sectors is the most significant, reflecting the high wages in this sector.

4.14.2 Potential Impacts

The regional economic impact assessment in Appendix G includes consideration of the impacts of the Project operations on both the regional and NSW economies, and following cessation of the Project.

Project Operations

The Project is predicted to make the following contribution to the regional (i.e. Great Lakes and Gloucester SLAs) economy (Appendix G):

- $208M in annual direct and indirect regional output or business turnover;
- $84M in annual direct and indirect regional value added;
- $10M in annual household income; and
- 166 direct and indirect jobs.

The Project is predicted to have the following impacts on the NSW economy (Appendix G):

- $413M in annual direct and indirect regional output or business turnover;
- $196M in annual direct and indirect regional value added;
- $75M in annual household income; and
- 1,004 direct and indirect jobs.

Businesses that can provide the inputs to the production process required by DCPL and/or the products and services required by employees would directly benefit from the Project by way of an increase in economic activity. However, because of the inter-linkages between sectors, many indirect businesses would also benefit (Appendix G).

Flow-on impacts from the Project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added and income flow-on effects are likely to be the services to mining sector, scientific research, technical and computer services sector, electricity supply sector, retail trade sector, accommodation, cafes and restaurants sector and education sector (Appendix G).

The Project would provide direct employment for 135 people (DCPL staff and on-site contractors) who are expected to all reside in the region. The majority of these staff and contractors (62%) are expected to reside in the local region.

The potential impacts of the Project on the NSW economy are expected to be substantially greater than for the regional economy alone, as more Project expenditure would be captured and there is a greater level of inter-sectoral linkages in the larger NSW economy (Appendix G).

End of Project Life

The establishment and operation of the Project would stimulate demand in the regional and NSW economy leading to increased business turnover in a range of sectors and increased employment opportunities. Cessation of the mining operations would, however, result in a contraction in regional economic activity.

The magnitude of the regional economic impacts of cessation of the Project would depend on a number of interrelated factors at the time, including the movements of workers and their families, alternative development opportunities and economic structure and trends in the regional economy at the time (Appendix G).

If it is assumed that some or all of the workers remain in the region, then the impacts of Project cessation would be less severe than if a greater number of workers left the region. This is because the loss of consumption-induced flow-on effects following cessation of the Project would be reduced through the continued consumption expenditure of those who stay (Appendix G).

The decision by workers to move or stay within the region would be affected by a number of factors including the prospects of gaining employment in the local region compared to other regions, the likely loss or gain from homeowners selling, and the extent of "attachment" to the local region (Appendix G).

If new mining resource developments occur in the future this would help broaden the region's economic base and buffer against impacts of the cessation of individual activities (Appendix G). The Gloucester Basin is a prospective location with a range of coal and coal-bed methane resources (e.g. AGL's proposed Gloucester Coal Seam Gas Project).

4.14.3 Mitigation Measures

DCPL would develop a Mine Closure Plan (MCP) before Project closure. The plan would be developed in consultation with GLC, GSC, DoP and the local community and would include consideration of amelioration of potential adverse socio-economic effects due to the reduction in employment at Project closure.

4.15 EMPLOYMENT, POPULATION AND COMMUNITY INFRASTRUCTURE

For the purposes of the employment, population and community infrastructure assessment component of Appendix G, the Great Lakes and Gloucester SLAs were considered as the local region. While the Project would also be expected to have population and workforce effects at a NSW state level and in other nearby regions such as Taree, Clarence, Hastings, Maitland, Gosford and Sydney, the likelihood of potential adverse effects on these regions is considered minor (Appendix G).

4.15.1 Existing Environment

A description of the existing population profile, employment, housing and education resources in the Great Lakes and Gloucester SLAs is provided in Appendix G.

4.15.2 Potential Impacts

The primary potential impact of the Project on community infrastructure relates to population growth and related potential effects on housing and community infrastructure demand (Appendix G).

Workforce

The DCM currently has a workforce of approximately 120 people (Section 2.13). The operational workforce associated with the Project would be approximately 135 personnel (an additional 15 personnel).

The Project is also expected to generate approximately 82 indirect jobs through flow-on employment in the region, consisting of 46 production-induced flow-on jobs (additional to on-site contractors) and 36 consumption induced flow-on jobs (as a result of increased income expenditure) (Appendix G).

It is estimated that the Project would contribute some 1,004 direct and indirect jobs in the wider NSW economy (Section 4.14.2).

Population Effects

Appendix G assumed that approximately all of the incremental direct jobs generated by the Project were likely to be filled by in-migration to the broader region with the same residential distribution as current employees (46% residing in the Gloucester SLA and 16% residing in the Great Lakes SLA). It was also estimated that the household occupancy would be consistent with the average household size for NSW.

The increase in regional population as a result of the Project is predicted to be 47 people, with 35 residing in the Gloucester SLA and 12 in the Great Lakes SLA (Appendix G).

Community Infrastructure Effects

A population influx to the Gloucester SLA of up to 35 and to the Great Lakes SLA of up to 12 is small in the context of annual population growth of the region, representing in the order of 15 months average population growth between 2001 and 2006 for the Gloucester SLA and less than one months average population growth between 2001 and 2006 for Great Lakes SLA (Appendix G).

In Gloucester, the housing demand from this population influx represents 1% of total occupied housing stock in 2006 or 4% of unoccupied residential properties in 2006 (Appendix G). In Great Lakes, it represents 0.03% of total occupied housing stock in 2006 or 0.09% of unoccupied residential properties in 2006 (Appendix G).

During operation of the Project, any incoming workers would be expected to exhibit average family structures and hence would be associated with some children creating some increased demand for education facilities. In the context of recent changes in school enrolments within the Gloucester and Great Lakes SLAs, the increased demand for schooling as a result of the Project is considered to be insignificant (Appendix G).

There is potential for the Project to increase the demand for public health facilities in the region such as for hospitals, general practitioner medical services, dental, physiotherapy, chiropractors and optometrists via the potential increase in population as a result of the Project. However, the potential population increase as a result the Project is very small compared to the total population and both SLAs seem to be reasonably well served by health care services (Appendix G).

Demand for additional investment in community services such as child care, aged care and community care services, by Local, State and Commonwealth Governments can arise from increases in the population. However, the expected increases in population are very small, and no additional investment in community services and facilities infrastructure would be anticipated (Appendix G).

Social Considerations

The Project would create additional direct jobs during the operation of the Project and indirect employment across a range of sectors. Even the temporary generation of employment for the unskilled (e.g. during Project construction/upgrade phases or in other sectors of the economy) may provide experience to help people secure future permanent employment.

The development and operation of the Project has the potential to adversely affect amenity (e.g. via noise, dust, traffic and visual impacts). However, the DCM is an existing mining operation and the Project would include the implementation of mitigation and management measures to minimise potential impacts on amenity (Sections 4.5, 4.6, 4.13 and 4.16).

End of Mine Life

Potential socio-economic impacts associated with the end of Project life are described in Section 4.14.2.

4.15.3 Mitigation Measures, Management and Monitoring

As described in Section 4.15.2, some population growth would occur as a result of the Project employment and associated flow on effects. Appendix G indicates only limited impacts on community infrastructure demand would arise as a result of the Project.

DCPL would continue to consult with the local community through its community consultation measures described in Section 3 and would continue to keep the community informed of the DCM and SCM operations and environmental performance via these methods.

During the Project life if particular social or community infrastructure issues arise, these would be managed in consultation with the relevant local government authority and/or the relevant state government department.

Before Project closure, consultation would be undertaken with relevant regulatory agencies and the local community and consideration would be given to amelioration of potential adverse socio-economic effects due to the reduction in employment at Project closure.

Further discussion on mine closure planning is provided in Section 5.

4.16 VISUAL CHARACTER

A Visual Assessment for the Project was prepared by Resource Strategies (2009) and is presented in Appendix O. A description of the existing visual setting of the Project is provided in Section 4.16.1. Section 4.16.2 describes the potential visual impacts of the Project and Section 4.16.3 outlines visual impact mitigation measures, management and monitoring.

4.16.1 Existing Environment

The Project area and surrounds comprise a number of distinct land use types and landscape units. These include agricultural areas, the existing DCM, rural residential dwellings, mountains, ridgelines and streams, including Coal Shaft Creek and the Mammy Johnsons River. The topographical features (which contribute to the level of scenic quality) of the regional, sub-regional and local settings of the Project area are described in Section 4.2.1 and Appendix O.

In general, views of the existing DCM from surrounding public and private viewpoints are effectively screened by topography and vegetation, except for some areas to the east and south-east. In these areas, the number of privately owned dwellings with potential views of the DCM mine landforms and infrastructure is restricted by DCPL ownership of the majority of land (Figures 1-3a and 1-3b). The glow produced by night-lighting at the DCM is currently visible at nearby residences and along transport routes (Appendix O). Roadside vegetation and topography restrict views of the existing DCM from viewpoints along Johnsons Creek Road.

As described in Section 4.8.1, almost all of the pre-European forest and woodland which once occurred in the Project area has been extensively cleared and/or logged at least once, with the remaining native vegetation community patches being mostly regrowth with scattered old growth trees.

The Project is located within the Vale of Gloucester Landscape Conservation Area which was registered by the National Trust of Australia (NSW) in 1976. The registered area encompasses the valley of the Avon River, Johnsons Creek, and Gloucester Rivers and includes Gloucester, Weismantels, Stroud Road and the Project area. The registration emphasises the scenic value of the encompassing forested ranges, and the predominantly agricultural or rural land use in the valley floor, including the AA Company's historical operations (Section 4.12.1).

The Rehabilitation Management Plan (DCPL, 2007a) describes measures that are currently implemented at the existing DCM to reduce visual impact. These measures include the following:

- the waste rock emplacement has been designed to produce a landform which integrates with the adjoining natural landform (i.e. Tombstone Hill);
- boundary vegetation has been retained along the eastern toe of the waste rock emplacement to provide a visual screen between users of the North Coast Railway and the DCM;
- tubestock trees have been planted on the "Doherty" property to help screen views towards the waste rock emplacement;
- substantial fabricated infrastructure has been painted and maintained with a colour ("Rivergum") that assists it to blend in with the adjoining landscape; and
- the placement, configuration and direction of lighting has been designed to reduce off-site nuisance effects of stray light.

4.16.2 Potential Impacts

The major aspects of the Project considered to have the potential to impact on the visual landscape include (Appendix O):

- additional clearance or disturbance of vegetation within the Project area;
- modification of topographic features including an extension of the waste rock emplacement (the approved maximum elevation would remain unchanged at RL 110 m);
- an extension of the existing Weismantel open pit and development of the new Clareval North West open pit;
- progressive rehabilitation of completed landforms; and
- extension of lighting associated with night-time mining operations.

The extension and development of the open pits (including associated vegetation clearance) for the Project would potentially increase the views available from nearby public roads (e.g. The Bucketts Way) and residential dwellings to the north of the Project. The northern extension of the existing waste rock emplacement may be visible from rural dwellings with westerly views towards the Project. The level of visual modification created by the Project landforms would change following progressive rehabilitation, reducing as vegetation becomes established and matures (Section 5).

The scale and intensity of night-lighting for the Project would be similar in intensity to the existing night-lighting at the DCM.

Visual Assessment Methodology

The potential visual impacts of the Project were assessed by evaluating the level of visual modification of the development in the context of the visual sensitivity of relevant surrounding land use areas. The degree of visual modification of a proposed development can be measured as a function of the contrast between the development and the existing visual landscape, and is generally considered to decrease with distance (Appendix O). Visual (viewer) sensitivity is a measure of how critically a change to the existing landscape would be viewed from various use areas, where different activities are considered to have different sensitivity levels (Appendix O). Visual impacts were then determined generally in accordance with the matrix presented in Table 4-33.

Table 4-33
Visual Impact Matrix

Visual Modification \ Viewer Sensitivity	H	M	L
H	H	H	M
M	H	M	L
L	M	L	L
VL	L	VL	VL

VL = Very Low
L = Low
M = Moderate
H = High

Source: Appendix O.

Visual Impact Assessment

The regional visual setting would remain unchanged as a result of the Project.

At the sub-regional and local level, simulations were prepared for the locations identified in Table 4-34 and shown on Figure 4-11. These simulations are shown on Figures 4-12 to 4-15. Simulations presented for Project landforms during Year 8 of the Project represent when the landforms would be at their maximum heights with the greatest area of disturbance, representing the greatest potential for visual impact. The post-mining simulation illustrates the conceptual landform following completion of mining and rehabilitation activities.

Predicted visual impacts at the four locations included in Table 4-34 and Johnsons Creek Road, based on expected maximum visual modification, are summarised in Table 4-35 and discussed below.

Dwellings

Given the moderate to low level of visual modification coupled with the high visual sensitivity at the "Weismantel" dwelling, a moderate level of potential visual impact would be expected (Table 4-35). With progressive and final rehabilitation the level of visual impact would reduce to low (Figure 4-12).

Given the moderate level of visual modification coupled with the high visual sensitivity at the "Hattam" dwelling, a moderate to high level of potential visual impact would be expected (Table 4-35). With progressive and final rehabilitation the level of visual impact would reduce to moderate/low (Figure 4-13).

Given the high level of visual modification coupled with the high visual sensitivity at the "Zulumovski" dwelling, a high level of potential visual impact would be expected (Table 4-35).

Subject to landholder consent, a vegetation screen and perimeter bund (Section 2.5.5) would be established to help minimise potential visual impacts at the "Zulumovski" dwelling. These mitigation measures are described in further detail in Section 4.16.3. Until consent for the vegetation screen is received, however, it was assumed that views of the Project would be available from the "Zulumovski" dwelling and visual simulations were prepared accordingly (Figure 4-14). Following progressive and final rehabilitation, the level of visual impact would be moderate. With the implementation of a vegetation screen at the receiver, the level of visual impact would be reduced to low.

Roads

Given the high level of visual modification coupled with the moderate level of visual sensitivity of users of The Bucketts Way, a high level of potential visual impact would be expected (Table 4-35).

Subject to landholder consent, a vegetation screen and perimeter bund (Section 2.5.5) would be established to help minimise potential visual impacts on users of The Bucketts Way. These mitigation measures are described in further detail in Section 4.15.3. Until consent for the vegetation screen is received, however, it was assumed that views of the Project would be available from The Bucketts Way and visual simulations were prepared accordingly (Figure 4-15). Following progressive and final rehabilitation, the level of visual impact would be moderate. With the vegetation screen, the level of visual impact would be reduced to low.

Table 4-34
Locations of Visual Simulations

Visual Simulation Location*	Potential View of Project Landforms	Figure
Dwelling – Weismantel	South-west over partially cleared agricultural land and riparian vegetation towards the waste rock emplacement.	Figure 4-12
Dwelling – Hattam	West over partially cleared agricultural land and riparian vegetation to the waste rock emplacement.	Figure 4-13
Dwelling – Zulumovski	South over cleared agricultural land towards the Clareval North West open pit and waste rock emplacement.	Figure 4-14
Road - The Bucketts Way	South-east over cleared agricultural land towards the Clareval North West open pit and waste rock emplacement.	Figure 4-15

Table 4-35
Summary of Visual Assessment

Location	Visual Sensitivity	Visual Modification Level	Potential Impact	Potential Impact After Final Amelioration
Sub-Regional Setting (1 to 5 km)				
"Weismantel" Dwelling	H	M - L	M	L
Local Setting (Up to 1 km)				
"Hattam" Dwelling	H	M	M - H	M - L
"Zulumovski" Dwelling	H	H	H	M
The Bucketts Way	M	H	H	M – L
Johnsons Creek Road	L	L	L	VL

H – High; M – Moderate; L – Low; VL – Very Low.

For Johnsons Creek Road users, the low level of visual modification coupled with the low level of visual sensitivity indicates a low level of visual impact would be expected (Table 4-35). With progressive and final rehabilitation, the level of visual impact associated with the Project at Johnsons Creek Road would reduce to very low.

Night-Lighting

The scale and intensity of night-lighting for the Project would be of a similar intensity when compared to the existing night-lighting at the approved DCM (Appendix O). However, there is potential for new direct views of mobile machinery lights and operational lighting to be available from some exposed viewpoints to the north of the Project and along The Bucketts Way, due to the extension of the open pit and waste rock emplacement areas and associated vegetation clearance.

Vale of Gloucester Landscape Conservation Area

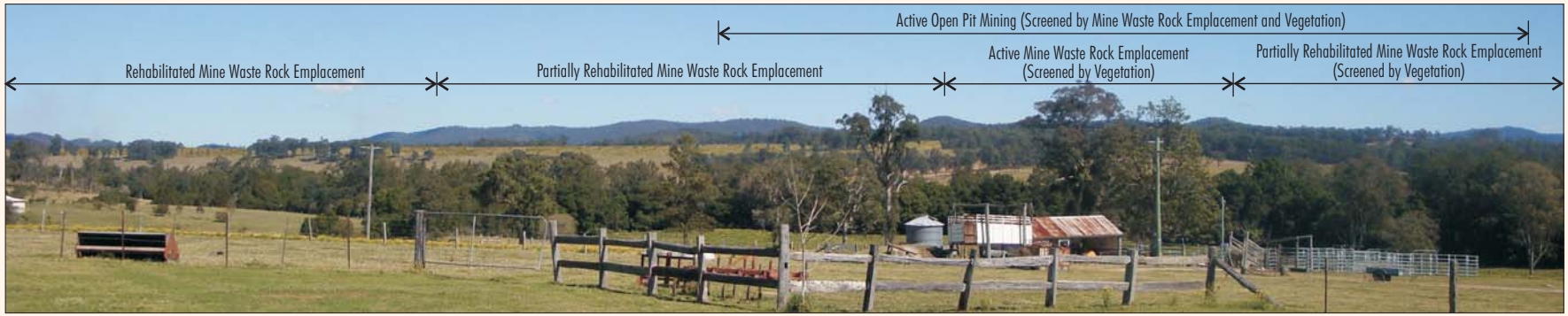
The Project is not considered to have any significant impact on the scenic values described in the National Heritage Trust of Australia (NSW) registration and would not detract from the essentially rural nature of the Vale of Gloucester Landscape Conservation Area (Appendix O).

4.16.3 Mitigation Measures, Management and Monitoring

The general DCM landscape/rehabilitation measures outlined in the Rehabilitation Management Plan (DCPL, 2007a) would continue to be implemented for the Project, specifically:

- progressive rehabilitation of the waste rock emplacement to reduce the contrast between the Project landforms and the surrounding environment (Section 5); and
- maintenance of the vegetation screen between the North Coast Railway line and the Project, with additional maintenance plantings as required.

Existing View



Full Development Simulation (Year 8)

Post-Mining Simulation

Source: Adapted from Urbis (2009)

DURALIE EXTENSION PROJECT

FIGURE 4-12
Existing View and Visual Simulations - "Weismantel" Dwelling

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Existing View

Full Development Simulation (Year 8)

Post-Mining Simulation

Source: Adapted from Urbis (2009)

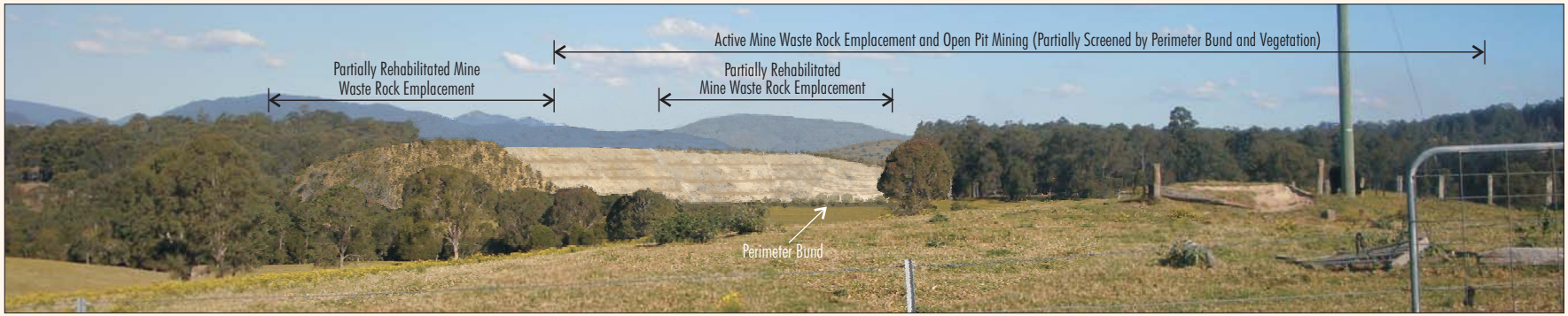
DURALIE EXTENSION PROJECT

FIGURE 4-13
Existing View and Visual Simulations - "Hattam" Dwelling

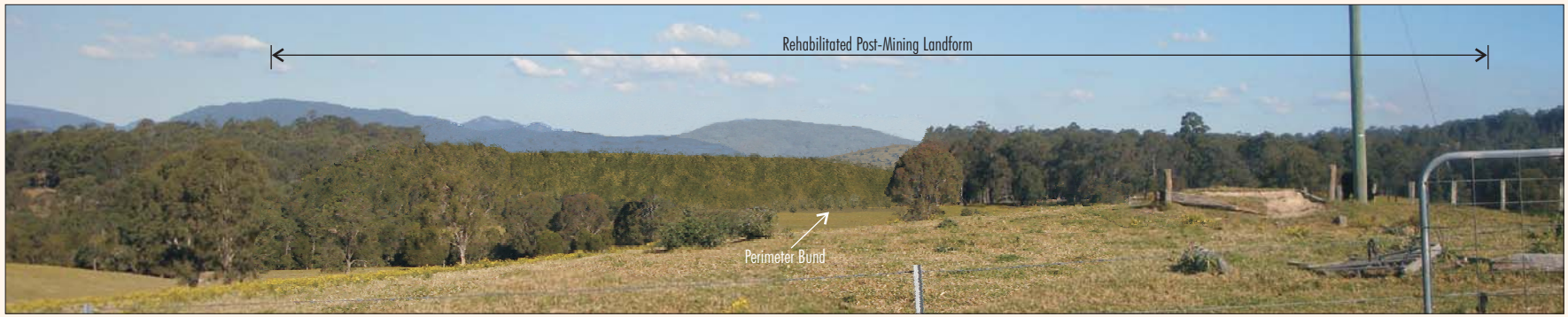
ResourceStrategies

DURALIE COAL

Existing View



Full Development Simulation (Year 8)



Post-Mining Simulation

Source: Adapted from Urbis (2009)

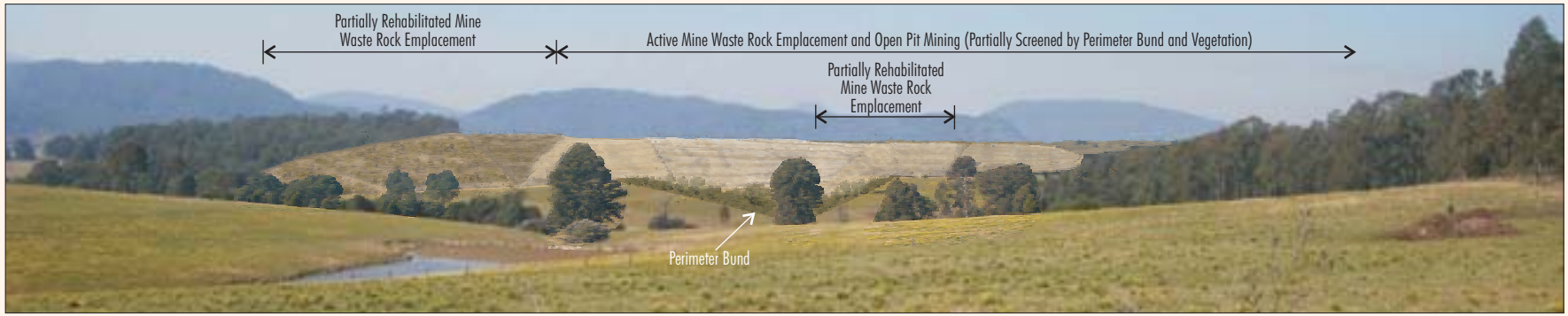
DURALIE EXTENSION PROJECT

FIGURE 4-14
Existing View and Visual Simulations - "Zulomovski" Dwelling

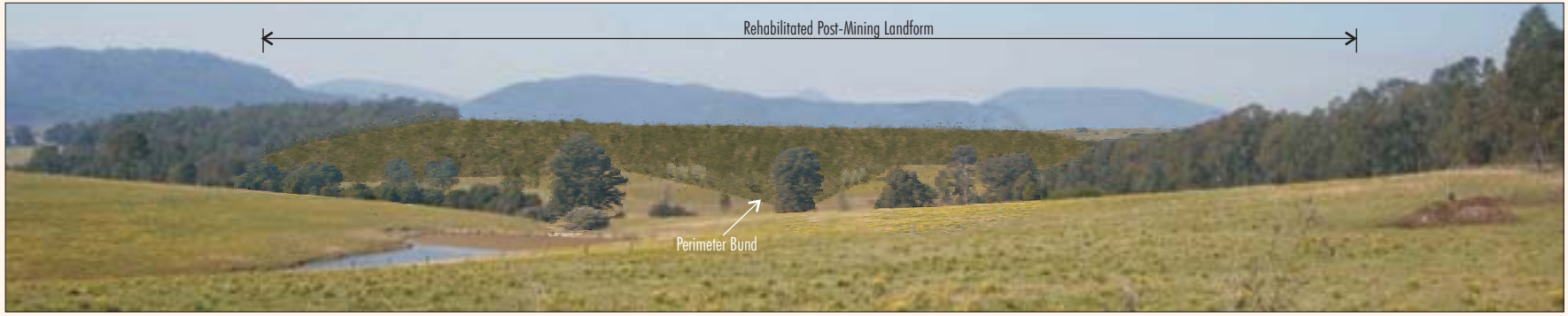
ResourceStrategies

DURALIE COAL

Existing View



Full Development Simulation (Year 8)



Post-Mining Simulation

Source: Adapted from Urbis (2009)

DURALIE EXTENSION PROJECT

FIGURE 4-15
Existing View and Visual Simulations - The Bucketts Way

ResourceStrategies

DURALIE COAL

Additional measures have been developed for the Project that would assist in minimising potential visual impacts from sensitive viewpoints to the north of the Project, including:

- construction of a perimeter bund at the north-west extent of the open pits to partially screen views of the active open pit development areas from The Bucketts Way and the "Zulumovski" dwelling (Section 2.5.5);
- planting of a vegetation screen (to be established with advanced native tree species) on the "Zulumosvki" property to screen views (subject to landholder consent);
- planting of a vegetation screen (to be established with advanced native tree species) to screen views from the portion of The Bucketts Way where the Project would be visible to traffic travelling along the road (subject to landholder consent); and
- placement, configuration and direction of Project fixed and mobile lighting such as to reduce off-site nuisance effects of stray light.

4.17 HAZARD AND RISK

A PHA was conducted by DCPL (2009b) to evaluate potential hazards associated with the Project (Appendix L). The PHA was conducted in accordance with the general principles of risk evaluation and assessment in the DUAP *Multi-Level Risk Assessment Guidelines* (1999) and has been documented in general accordance with *Guidelines for Hazard Analysis: Hazardous Industry Planning Advisory Paper No. 6* (DUAP, 1992a).

Potential incidents and hazards identified for the Project are described in Section 4.17.1. Proposed preventative and control measures to address potential hazards are discussed in Section 4.17.2.

4.17.1 Hazard Identification and Risk Assessment

Potentially hazardous materials required for the Project include hydrocarbons (petrol, diesel, oils, greases, degreaser and kerosene), explosives, chemicals and gas cylinders. The risks posed by the usage of these materials for the Project would include increases in their transport, handling and consumption associated with the increased ROM coal production rate.

For the purposes of risk identification, the Project was subdivided into a number of operational areas (Appendix L) and potential incidents were identified and divided into generic classes for each operational area including:

- leaks/spills;
- fire;
- explosion;
- theft;
- pit slope failure;
- unplanned movement off-site; and
- excessive vibration.

The potential risks identified in the PHA related to the following Project elements/activities:

- transport to site;
- on-site storage;
- transport on-site;
- transport off-site;
- mining operations;
- general operations; and
- water management.

Following identification of the potential hazards associated with the Project, a qualitative assessment of the risks to the public, property and the environment associated with the Project was undertaken (Appendix L).

An assessment of the combination of the consequence and probability rankings concluded that the overall risk rankings for the identified hazards would be low, and therefore tolerable.

4.17.2 Hazard Prevention and Mitigation Measures

A number of hazard prevention and mitigation measures are currently in-place for the existing DCM. These measures are documented in existing DCM management plans (e.g. Health and Safety Management Plan, Training and Competency Scheme and Fitness for Work Management Plan).

The above occupational health and safety plans would be revised or replaced to address the Project requirements.

The following hazard mitigation and/or preventative measures would be adopted by DCPL to reduce the likelihood and/or consequences of potentially hazardous incidents associated with the Project:

- **Maintenance** – Ongoing and timely maintenance of all mobile and fixed plant and equipment in accordance with the manufacturer's recommended maintenance schedule, and consistent with the maintenance schemes required by relevant standards. Only vehicles permitted to carry dangerous goods would be used for transport of hazardous materials.
- **Staff Training** – Operators and drivers would be trained and (where appropriate) licensed for their job descriptions. Only those personnel licensed to undertake skilled and potentially hazardous work would be permitted to do so.
- **Engineering Structures** – Civil engineering structures would be constructed in accordance with applicable codes, guidelines and Australian Standards.
- **Contractor Management** – All contractors employed by DCPL would be required to operate in accordance with the relevant Australian Standards, NSW Legislation and DCPL's Contractor Management Plan.
- **Storage Facilities** – Storage and usage procedures for potentially hazardous materials (i.e. fuels and lubricants) would be developed in accordance with Australian Standards and relevant legislation.