CARRINGTON WEST WING

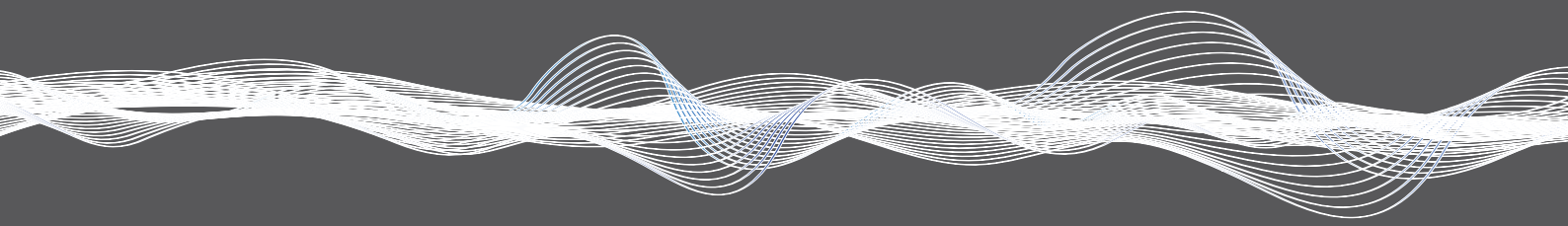
Environmental Assessment

Prepared for Coal & Allied Operations Pty Limited | October 2010

Volume 1 - Main Report

COAL & ALLIED

Managed by Rio Tinto Coal Australia



Carrington West Wing

Environmental Assessment

Final

Coal & Allied Operations Pty Limited | October 2010

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Carrington West Wing

Environmental Assessment

Coal & Allied Operations Pty Limited | October 2010

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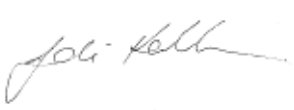
Signature			Signature	
Date	1 October 2010	1 October 2010	Date	6 May 2010

This Report has been prepared in accordance with the brief provided by the Client and has relied upon the information collected at or under the times and conditions specified in the Report. All findings, conclusions or recommendations contained within the Report are based only on the aforementioned circumstances. Furthermore, the Report is for the use of the Client only and no responsibility will be taken for its use by other parties.

Document Control

Version	Date	Prepared by	Reviewed by
v1	16 April 2010	Luke Stewart Jodi Kelehear	Peter Stewart
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v4	21 June 2010	Jodi Kelehear	Luke Stewart
v5	1 September 2010	Jodi Kelehear	Luke Stewart
v6	1 October 2010	Jodi Kelehear	Luke Stewart

Certification

We certify that we have prepared the contents of this EA in accordance with the Director-General's Environmental Assessment Requirements and to the best of our knowledge the information contained in this EA is neither false nor misleading.

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Executive Summary

Background

Coal & Allied Operations Pty Limited (Coal & Allied) proposes to extend its existing approved mining operations at Carrington Pit. Carrington Pit forms part of the Hunter Valley Operations (HVO) mining complex, located approximately 24 kilometres north-west of Singleton, New South Wales (NSW). Coal & Allied owns and operates HVO with management services provided by Rio Tinto Coal Australia. The mining and processing activities at HVO are geographically divided by the Hunter River into HVO North and HVO South. Carrington Pit is located within HVO North. While HVO is managed as one operation, HVO North and HVO South each have separate planning approvals.

Additional coal resources have been identified to the south-west of the existing Carrington Pit. Approval to extract these resources is being sought from the Minister for Planning, by way of a modification to the existing development consent for HVO North, DA 450-10-2003, under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This requisite Environmental Assessment (EA) has been prepared in accordance with the Director-General's Environmental Assessment Requirements.

The proposal

Coal & Allied proposes to extend the existing approved Carrington Pit by approximately 137 hectares (ha) to the south-west, and extract approximately 17 million tonnes (Mt) of in-situ coal from this area. The proposed extension of mining will have a life of approximately six years and is expected to be completed within the existing development consent period, which is currently approved to 2025.

Overburden is proposed to be emplaced in-pit, and at two out-of-pit overburden emplacement areas to be established on previously disturbed and rehabilitated land located immediately north of the proposed extension area. The proposal also comprises the following supplementary activities.

- The approved footprint of the Carrington evaporative sink will be extended, for long term groundwater management purposes.
- The impermeable groundwater barrier wall previously assessed for the western paleochannel will be realigned further south, to prevent groundwater migration from the Hunter River into the mine, and migration of water from the mine into the Hunter River alluvium.
- A two stage, temporary levee and diversion system will be established to ensure that the proposed extension area is protected from flooding, and to enable the temporary diversion of an unnamed tributary of the Hunter River that presently runs in a southerly direction across the proposed extension area.
- A service corridor will be constructed along the southern boundary of the proposed extension area, which may incorporate water pipelines, an all weather access road and other services.

Consultation

Consultation with government agencies and the local community has been undertaken during planning of the proposal and during the preparation of this EA. This has included consultation with the Department of Planning (DoP), Department of Environment, Climate Change and Water (DECCW), NSW Industry &

Investment, the HVO Community Consultative Committee and the Upper Hunter Valley Cultural Heritage Working Group (CHWG). Input from the consultation has been considered in this EA.

Environmental assessment and management

The potential social, economic and environmental impacts of the proposal have been identified and assessed. Measures have been provided to mitigate, manage, and/or monitor potential impacts. Key assessment outcomes are summarised following.

Groundwater

The proposed extension area includes areas of unconsolidated alluvium with highly variable permeability that are contained within a paleochannel. The groundwater within the paleochannel alluvium is naturally of poor quality with moderate salinity and a pre-mining grade towards the Hunter River.

Subsequent to the installation of the proposed barrier wall, some northward leakage of water will continue to occur via the coal measures, where deep regional depressurisation induces downwards flow from the alluvium. This is predicted to result in an impact on the Hunter River baseflow (leakage) of approximately 0.05 mega litres per day (ML/day). This depressurisation would occur under the existing approved Carrington Pit and therefore the predicted loss would apply with or without the proposal.

Total groundwater seepage into the pit is predicted to be relatively low, ranging from less than 0.01ML/day in Year 1, to 0.116ML/day in Year 3, to 0.073ML/day in Year 6. In-pit seepage will be managed within the mine water management system, and will be offset in accordance with regulatory requirements.

The predicted future Hunter River base flow loss of 0.05ML/day is calculated to represent 0.3 per cent of the very low river flow condition, defined as occurring less than 1 per cent of the time. This loss will reduce as water table recovery occurs in the final void. Substantial wet periods, such as the June 2007 event (high rainfall and localised flooding), can be expected to mitigate leakage losses for extended periods of time. Seepage will be offset in accordance with regulatory requirements.

The predicted seepage from the Hunter River associated with the modified mine plan is consistent with the predictions made for the approved mine plan.

The proposed extension of the approved evaporative sink will avert the potential for 'fill and spill' from the backfilled pit shell. No measureable effects on groundwater quality, water supply bores or groundwater dependent ecosystems are predicted as a result of the proposal.

Groundwater management and monitoring commitments will be implemented, including establishment of benchmarks against which impacts can be measured, trigger action protocols developed and mitigative actions initiated.

Surface water

The proposed extension area has potential to be affected by regional flooding from the Hunter River to the south, and local flooding from an Unnamed Tributary. Temporary levees are proposed to protect the extension area from flooding. Also, the Unnamed Tributary will be temporarily diverted to allow mining in its vicinity. At the conclusion of mining, the levees will be removed and the Unnamed Tributary channel will be reinstated to its original position, subject to detailed design considerations.

The Unnamed Tributary is ephemeral, lacks significant riparian vegetation and is of low significance as flora or fauna habitat. Detailed design plans for the temporary diversion and reinstatement of the Unnamed Tributary will be provided in a Management Plan to be developed in consultation with the NSW Office of Water and NSW Industry and Investment.

The flood levees will effectively prevent flooding of the proposed extension area for events up to the 100 year average recurrence interval (ARI) flood event. The impacts of the levees on flooding inside and outside of the project area were assessed. Modelling predicted that there will be no significant change to flood depths as a result of the proposal. The greatest change to flood depths is predicted to be a 0.05 to 0.14 metre (m) increase for the 100 year ARI event, at some locations on Coal & Allied owned land. Changes to flood depths at all properties upstream and downstream of the project area as a result of the proposal are predicted to be zero to less than 0.05m. The proposed post-mining removal of the levees and reinstatement of ground levels will ensure that there will be no flood impacts resulting from the proposal at the end of mine life.

The assessment of surface water impacts also concluded that there will be no increase in erosion potential of the Hunter River channel as a result of the proposal, all water accumulated in the pit in the proposed extension area will be re-used and recycled in the HVO North mine water management system, and the relative reduction in Hunter River flows due to the proposal will be small compared to the total flows in the Hunter River. Water releases into the Hunter River can continue to be managed in compliance with the Hunter River Salinity Trading Scheme. Management measures will be implemented to ensure there are no measurable adverse impacts on riparian and ecological values of watercourses within or downstream of the project area.

Soils and land classes

The land capability assessment found that the proposed extension area is predominately Class II, III and IV rural land prior to mining, as defined in the DECCW's classification system. Class II and III lands are productive lands that are suitable for a range of agricultural uses. The proposed post-mining rehabilitation will restore land capability of the proposed extension area to be generally similar to or better than the existing land capability classification. Similarly, the proposed post-mining agricultural suitability classification is similar to the existing classification. This includes rehabilitation of the 65ha of Class 2 agricultural land (comprising 48 per cent of the proposed extension area) back to Class 2 suitability post mining. Coal & Allied's experience at the adjacent Alluvial Lands, where 63ha of land was successfully rehabilitated to Class 1 and 2 lands, with crop yields at least equivalent to those on nearby farms, evidences that this is achievable. Extensive land and soil management and investment by Coal & Allied are proposed to achieve this rehabilitation outcome.

The proposed out-of-pit emplacement areas which currently comprise Class III, IV and VI rural lands will be transformed into Class IV and VI rural land post-mining. Land management practices including stock control and fertiliser application will be required to ensure maintenance of ground cover. With respect to agricultural suitability, the proposed out-of-pit emplacement areas currently comprise Class 3 and 4 lands and will be rehabilitated back to Class 3 and 4 suitability, though with 26 per cent more Class 4 lands. Accordingly, they will be suitable for improved pasture, cropping within a pasture rotation and/ or low productivity grazing. The proposed rehabilitation strategy includes restoration of both agricultural and biodiversity values of the land, and accordingly, in addition to the proposed agricultural land uses, considerable portions of the out-of-pit emplacement areas are proposed to be rehabilitated with woodland.

Noise and vibration

Modelling of noise from the proposal utilised worst-case operating scenarios in terms of potential noise impacts. This included an assumption that all modelled plant and equipment will operate simultaneously, which in practice, is unlikely to occur. This allowed for a conservative assessment of the potential impacts from the proposal on the area surrounding the mine.

The noise and vibration assessment found that during calm weather, the proposal is not predicted to result in any exceedences of consented noise limits at private residences that are not already within a zone of affectation.

During adverse INP weather conditions (which are a feature, i.e occur more than 30 per cent of the time, during the night period only), predicted mine noise levels without mitigation are above the consented operational noise limits for eight of the assessed locations, and marginally above the consent acquisition limits at five of the assessed locations. After applying restrictions to operation of some plant, noise levels are predicted to satisfy or be within 2 decibels (dB) of the consented operational noise limits at all assessed locations, and consent acquisition limits are predicted to be satisfied at all private residences not already within a zone of affectation. Noise differences of less than around 2dB are generally imperceptible to the human ear. The predicted minor exceedences are unlikely to occur in practice, as the noise modeling used a number of conservative assumptions and typically over-predicts noise levels under adverse weather conditions by approximately 3dB. It is noted that the predicted mitigated noise levels at all of the assessment locations during adverse INP weather conditions are unchanged or lower than those assessed as part of the original Environmental Resources Management (2003) environmental impact assessment for HVO North. The proposed noise management and monitoring measures will minimise the potential for adverse noise impacts.

Blast design and monitoring will ensure noise overpressure and ground vibration from blasting are within acceptable limits. There is one private residence located in close proximity to proposed blasting locations which will require precautionary consultation and arrangements prior to any blasts within 900m of that residence.

Air quality

Similar to noise, worst-case operating scenarios were modelled to facilitate a conservative assessment of the potential air quality impacts of the proposal on the area surrounding the mine.

The proposal is not predicted to result in any exceedences of the DECCW or DoP criteria for annual average particulate matter concentrations (PM_{10} and TSP) or dust deposition at nearby residences or other 'sensitive' areas. This is the case when taking into account dust emissions from HVO North, as well as from surrounding mines and other dust sources.

A minor, 0.5 micrograms per cubic metre ($\mu g/m^3$), exceedence of the DECCW maximum 24-hour average PM_{10} criterion of $50\mu g/m^3$ is predicted to occur at one privately-owned residence during Year 1 of mining. This is only predicted to occur on one day over a one year period. The second highest predicted 24-hour average PM_{10} concentration at this residence is $14\mu g/m^3$ below the $50\mu g/m^3$ criterion. No other exceedances of the DECCW criteria are predicted, and no exceedences of the DoP 24-hour average PM_{10} acquisition criteria are predicted. Dust management and monitoring procedures will be implemented to minimise the potential for adverse impacts.

Aboriginal cultural heritage

Nine Aboriginal cultural heritage places could be impacted by the proposal. Management actions have been developed for these places, in consultation with the local Aboriginal community. These actions include Aboriginal community inspections and/ or Section 90 salvage collections of sites to be impacted, and machine scrapes. Coal & Allied will continue to liaise with the CHWG regarding the management of cultural heritage at HVO.

Ecology

The vast majority of the project area comprises a completely modified landscape in poor condition with little or no native vegetation. There is a small area of woodland approximately 0.89ha in size which will be cleared by the proposal. The impacts of clearing will be managed in accordance with Coal & Allied's existing procedures for the management of flora, fauna, disturbance and rehabilitation.

Field surveys identified the Tiger Orchid (*Cymbidium canaliculatum*) and a single River Red Gum (*Eucalyptus camaldulensis*) within the proposed extension area, both of which are listed as endangered populations under the *Threatened Species Conservation Act 1995* (TSC Act). The Tiger Orchid and River Red Gum comprise isolated occurrences, within a highly fragmented landscape, adjacent to the edge of the operational Carrington Pit, and their long term survival at this location is already subject to considerable doubt. It is proposed to translocate the Tiger Orchid. No other threatened species, populations or communities or migratory species listed under the TSC Act and/ or the *Environment Protection and Biodiversity Conservation Act 1999* which have known or potential habitat in the local area are likely to be significantly impacted by the proposal. The proposed rehabilitation strategy includes rehabilitation of areas of woodland which aim to enhance biodiversity values of the area post-mining.

Visual amenity

There will be limited viewing opportunities of the project area due to the undulating nature of the surrounding landscape. However, mining activities, levees, overburden emplacement areas and night-time lighting will be visible to some surrounding areas, including motorists on Lemington Road and an adjacent private landholder. These components will be similar in appearance to the mining areas currently visible from these locations, and progressive rehabilitation will restore the rural character of the area, consistent with the surrounding landscapes. Accordingly, visual impacts of the proposal are not expected to be significant.

Greenhouse gas emissions

On average, greenhouse gas emissions from the proposal, including emissions from the end use of coal, are estimated to be 6.3Mt of carbon dioxide equivalent (CO_2–e) emissions per annum. This represents approximately 0.0002 per cent of the current volume of CO_2–e stored in the atmosphere, and is unlikely to have any measurable environmental effect.

Traffic and transport

The proposal will not result in any increase in traffic volumes on public road or rail networks. A section of Lemington Road will be temporarily closed when blasting occurs in close proximity. This will not have any significant impact, as closures will only be for around 10 minutes at a time and will be managed in accordance with a Road Closure Management Plan and Traffic Control Plan. Lighting will be managed to minimise the potential for adverse impacts on Lemington Road users.

An existing road located within the project area, Old Lemington Road, will be decommissioned. This road is only used by mine-related traffic, occupiers of the project area and to access a nearby EnergyAustralia substation. The road's decommissioning will not have any significant impact on access to the substation as an alternate all weather access road will be provided.

Non-indigenous heritage

The proposal will not have any impacts on non-indigenous heritage, as there are no items or places of non-indigenous heritage significance located within or adjacent to the project area.

Socio-economics

There will be no significant impacts to amenity of the surrounding area as a result of the proposal. The net production benefits of the proposal are estimated at a minimum of $482M. These benefits accrue to Coal & Allied and its shareholders in the form of net profits, the NSW Government in the form of royalties and the Commonwealth Government in the form of company tax. The proposal is also estimated to provide direct and indirect stimulus to the regional and State economy from the additional purchases by Coal & Allied and its employees.

Any residual environmental impacts of the proposal, after mitigation by Coal & Allied, would need to be valued at greater than $482M to make the proposal questionable from an economic efficiency perspective. Interpreted another way, this is the minimum opportunity cost to society of not proceeding with the proposal.

Project justification and conclusion

It is considered that the proposal is justified, for the following reasons.

- It will allow the efficient transition from mining within the Carrington Pit into the adjacent extension area. It will enable the efficient extraction of an economic resource and provide for continued regional and local economic benefits.
- The site is suited for its proposed purpose and all lands are owned by the proponent.
- No significant adverse economic, social or environmental impacts are anticipated, subject to the implementation of the mitigation, management and monitoring measures presented within the EA.
- The proposal is generally consistent with the relevant objects of the EP&A Act, including the principles of ecologically sustainable development.

In conclusion, the benefits of the proposal sufficiently outweigh its costs.

1 Introduction

1.1 Background

Coal & Allied Operations Pty Limited (Coal & Allied) owns and operates the Hunter Valley Operations (HVO) mining complex located 24 kilometres (km) north-west of Singleton in the Singleton Local Government Area (LGA) (see Figure 1.1). The mining and processing activities at HVO are geographically divided by the Hunter River into HVO North and HVO South, with movements of coal, coarse and fine reject, overburden, topsoil, equipment, water, materials and personnel occurring between the two areas. While HVO North and HVO South each have separate planning approvals, HVO is managed as one operation. Rio Tinto Coal Australia provides management services at HVO for Coal & Allied.

The HVO North complex, which operates under Development Consent No. DA 450-10-2003, comprises the active Carrington, West, and North Pits, inclusive of all related mining activities and infrastructure such as overburden emplacement areas. Other features of the locality are shown in Figure 1.2 and include Bayswater Power Station, Cumnock No.1 Colliery, Ravensworth/Narama Mine, HVO South, Warkworth Mine, Wambo Mine, United Colliery, Ashton Coal, the village of Jerrys Plains and grazing and cropping land.

The Carrington Pit is a truck and shovel operation, approved to mine 10 million tonnes (Mt) of run of mine (ROM) coal per annum. At the time of preparing this report, the pit is well developed and significant areas of rehabilitation are established. The mine planning process has identified coal resources to the south-west of the existing Carrington Pit, of relatively low strip ratio, that could be recovered through the extension of the existing pit. Accordingly, the proposal, referred to as Carrington West Wing, is seeking to extend the existing Carrington Pit to access this coal.

The proposal will enable the continuation of mining of Carrington Pit into the proposed extension area. It will enable the efficient extraction of an economic resource, provide for continued local and regional economic benefits, and result in the provision of government royalties.

A modification under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) is required for the proposed extension. The proposed extension will have a life of approximately six years and is expected to be completed within the existing development consent period, which is currently approved to 2025.

1.2 Overview of the proposal

The proposal is to extend the existing approved Carrington Pit by approximately 137 hectares (ha) to the south-west, into land which is predominantly cleared of native vegetation. The proposal would allow for the extraction of approximately 17Mt of in-situ coal from the Broonie, Bayswater and Vaux seams.

Overburden will be emplaced in-pit, as well as at two out-of-pit overburden emplacement areas to be established on previously disturbed and rehabilitated land immediately north of the proposed extension area. The final landform goal for in-pit disposal of overburden is to return the mined out areas of the proposed extension area as close as possible to the pre-mining landform.

The proposal also includes the following supplementary activities.

- The approved footprint of the Carrington evaporative sink will be extended for the long term management of groundwater post-mining.

- The impermeable groundwater barrier wall previously assessed for the western paleochannel will be realigned further south, to prevent groundwater migration from the Hunter River into the mine, and migration of water from the mine into the Hunter River alluvium.

- A two stage, temporary levee and diversion system will be established to ensure that the proposed extension area is protected from flooding and to enable the diversion of an unnamed tributary of the Hunter River (referred to herein as the 'Unnamed Tributary') that presently runs in a southerly direction across the footprint of the proposed extension area.

- A service corridor will be constructed along the southern boundary of the proposed extension area. This may incorporate water pipelines, an all weather access road and other services.

Key proposal components are shown on Figure 1.3. Further details about the proposal are provided in Section 3.2.

1.3 Report purpose

The proposal requires a modification of the existing Development Consent No. DA 450-10-2003 under the EP&A Act. The Department of Planning (DoP) issued the Environmental Assessment Requirements (EARs) on 31 May 2010. A copy of these can be found in Appendix A. The environmental assessment (EA) has been prepared to meet the EARs and assesses the potential social, economic and environmental impacts of the proposal and provides measures to mitigate, manage, and/or monitor potential impacts. Table 1.1 summarises the EARs and references where each of these requirements have been addressed in the EA.

Table 1.1 Summary of the Environmental Assessment Requirements

Aspect	Requirements	Addressed in EA
Environmental assessment	Executive summary.	Executive Summary
	A detailed description of:	
	• historical operations on the site;	Sections 1.1 and 2.1
	• existing and approved mining operations/ facilities, including any applicable statutory approvals; and	Sections 1.1 and 3.1, Chapter 2
	• existing environmental management and monitoring.	Section 3.1
	A detailed description of the modification, including the:	Chapter 3
	• need for the modification;	Section 1.1, Chapter 7
	• alternatives considered, including a justification for the proposed mine plan and coal rejects disposal strategy on economic, social and environmental grounds;	Section 3.3
	• likely interactions between existing and approved mining operations;	Section 3.2, Chapter 5, Appendices C to I
	• likely staging of the modification; and	Section 3.2
	• plans of any proposed building works.	Not applicable
	Risk assessment.	Section 5.1
	Assessment of key issues, including description of the existing environment, assessment of potential impacts, including cumulative impacts, and description of measures to avoid, minimise, mitigate and/ or offset potential impacts.	Chapter 5 and Appendices C to I
	Statement of commitments.	Chapter 6
	A conclusion justifying the modification.	Chapter 7
	A signed statement from the author of the EA.	Following cover page

Table 1.1 Summary of the Environmental Assessment Requirements

Aspect	Requirements	Addressed in EA
Soil and water	• Assessment of potential impacts on:	
	- quantity and quality of surface and ground water resources;	Sections 5.2 and 5.3, Appendices C and D
	- water users;	As above
	- riparian and ecological values of watercourses;	Sections 5.3.2 and 5.8.2, and Appendices D and I
	- environmental flows; and	Sections 5.2 and 5.3, Appendices C and D
	- flooding;	Section 5.3.2 and Appendix D
	• comparison of impact predictions against those associated with the existing mine plan;	Sections 5.2, 5.3 and 5.4, Appendices C, D and E
	• plans for diversion of the Unnamed Tributary; and	Sections 3.2.2 and 5.3.3
	• revised site water balance.	Appendix D
Noise and blasting	Quantitative assessment of potential noise impacts, including cumulative impacts, based on applicable meteorological and stability category temperature inversion conditions. Assessment of blasting impacts.	Section 5.5 and Appendix F
Air quality	Assessment of potential air quality impacts, including cumulative impacts.	Section 5.6 and Appendix G
Biodiversity	Impact assessment, including estimates of vegetation clearing, and assessment of potential impacts on threatened species or populations, their habitats, endangered ecological communities, riparian vegetation or groundwater dependent ecosystems. Description of measures to maintain or improve biodiversity values.	Sections 5.2, 5.8 and Appendices C and I
Heritage	Assessment of potential impacts on Aboriginal and non-Aboriginal heritage.	Sections 5.7, 5.12 and Appendix H
Greenhouse gas	• Quantitative assessment of scope 1, 2 and 3 greenhouse gas emissions, and qualitative assessment of their potential impacts; and	Section 5.10 and Appendix G
	• description of measures to ensure the project is energy efficient.	Section 5.10.3
Visual	Visual assessment including description of measures to minimise potential impacts.	Section 5.9
Transport	Assessment of potential impacts on safety and performance of the road network, including any potential impacts to Lemington Road.	Section 5.11
Waste	• Estimates of the quantity and nature of potential waste streams; and	Section 3.1
	• description of measures to ensure that the project is energy efficient.	Section 5.10.3
Hazards	Public safety.	Section 3.1
Socio & Economic	• Assessment of potential impacts on the local and regional community; and	Section 5.13
	• assessment of the costs and benefits of the project as a whole, and whether it would result in a net benefit for the	Section 5.13 and Chapter 7

Table 1.1 Summary of the Environmental Assessment Requirements

Aspect	Requirements	Addressed in EA
	New South Wales community.	
Rehabilitation	Description of the proposed rehabilitation strategy, taking into consideration relevant plans or policies, including: • costs of rehabilitation, remediation and repair, including the diversion of the drainage line; • post-mining land use options; • rehabilitation objectives; • general rehabilitation methods and procedures; and • a conceptual final landform design.	Section 3.2.3

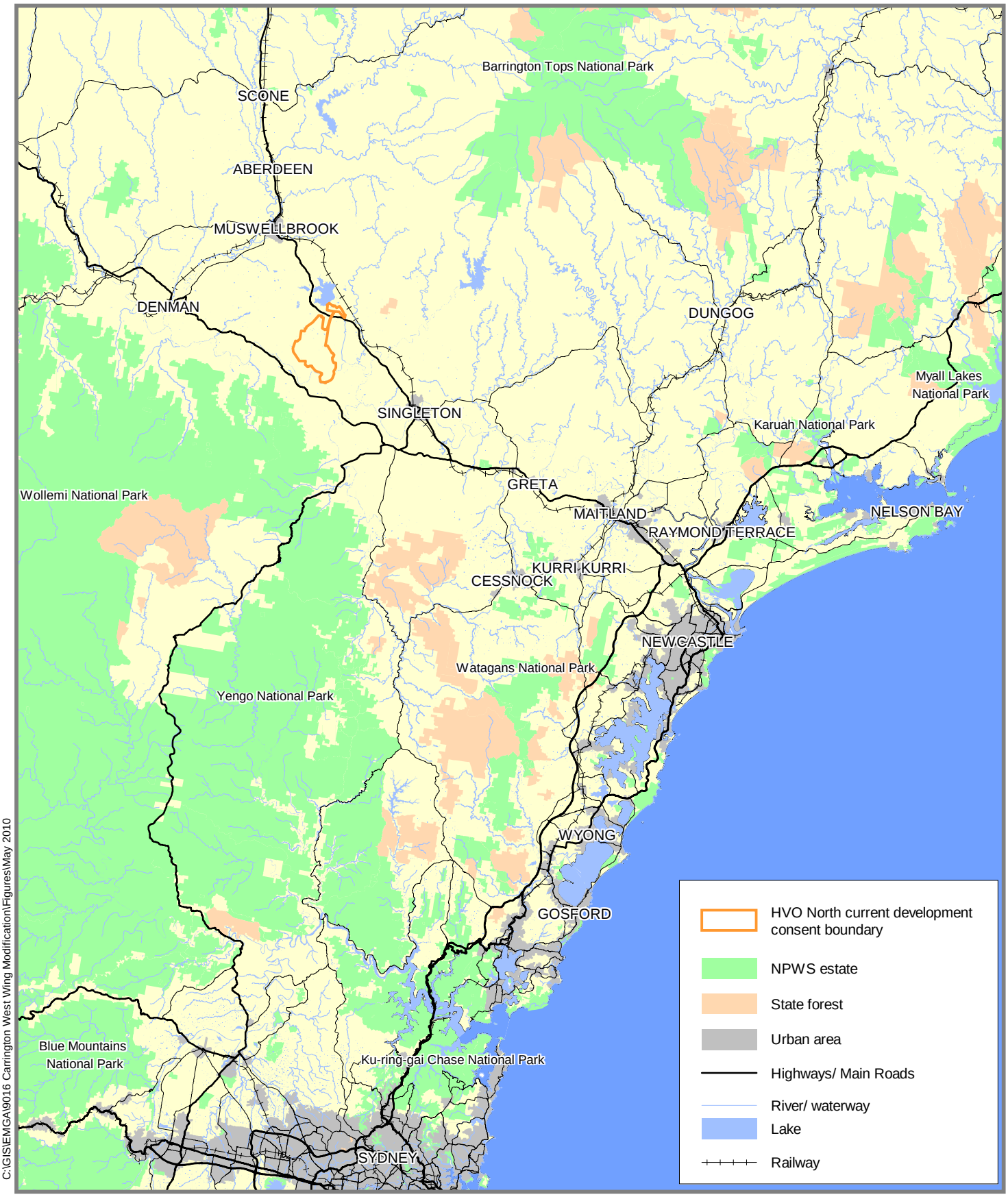
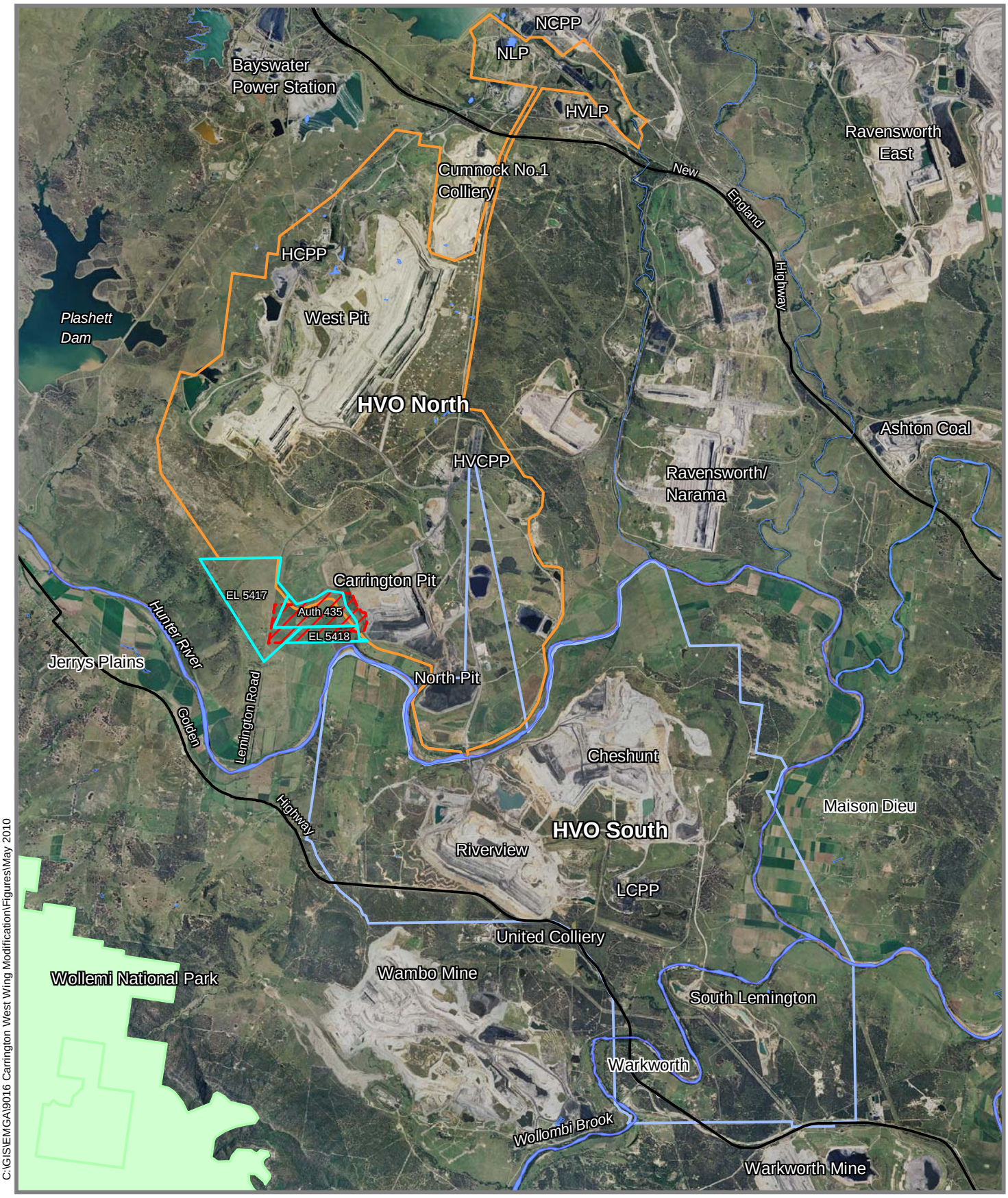


Figure 1.1

Regional setting

Carrington West Wing



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0 2 4

Kilometres

HVO South project approval boundary

HVO North current development consent boundary

Exploration licence and authorisation boundaries

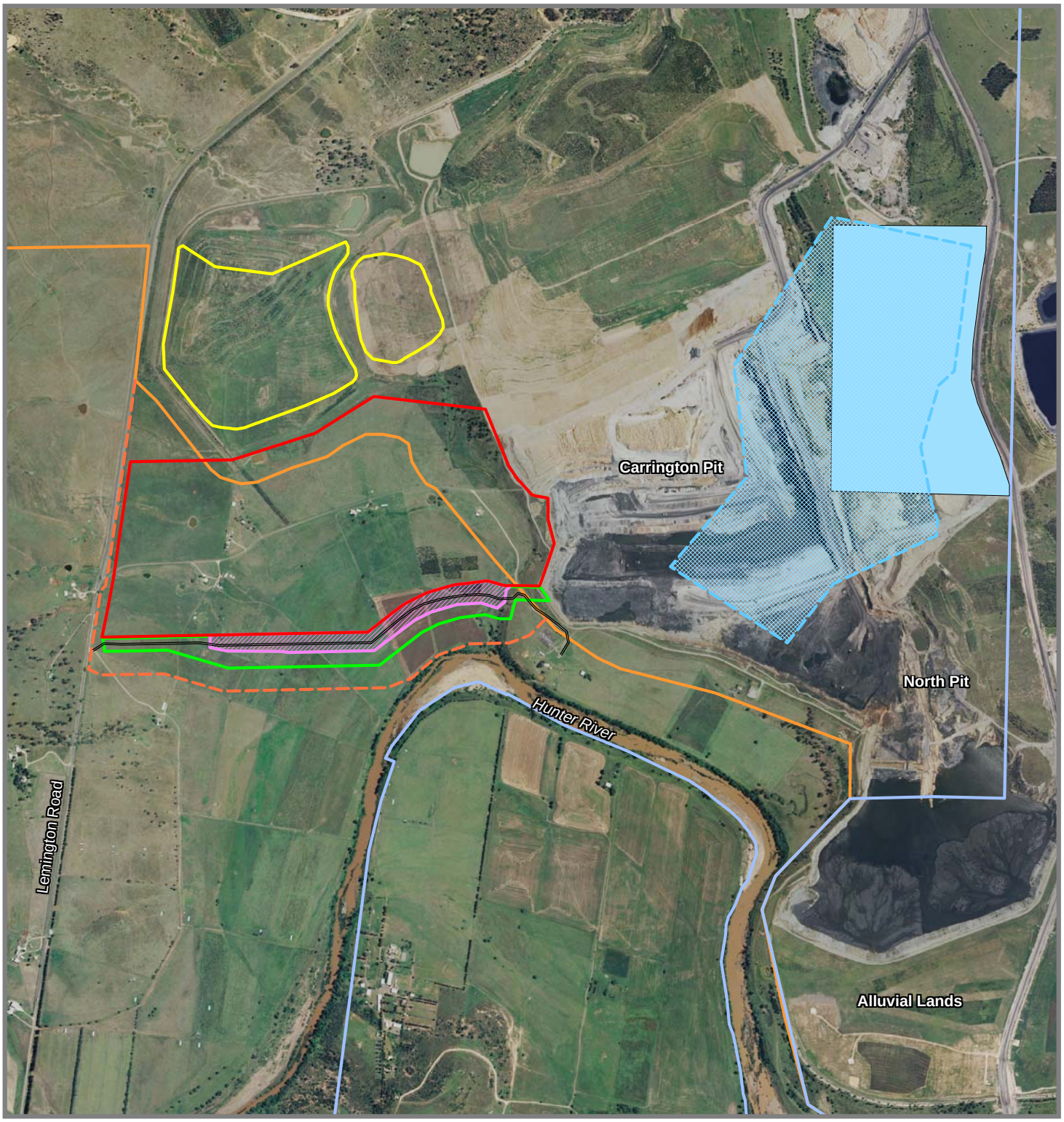
Proposed extension area

National Park

Figure 1.2

Local setting

Carrington West Wing



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Proposed extension area

HVO North current development consent boundary

HVO South project approval boundary

Proposed development consent boundary amendment

Out-of-pit overburden emplacement

Services road

Indicative disturbance area associated with main levee and groundwater barrier wall

Potential temporary disturbance zone associated with construction

Indicative footprint of approved evaporative sink

Proposed footprint of evaporative sink

0 0.5 1

Kilometres

Figure 1.3

Key proposal components

Carrington West Wing

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2 Legislative considerations

This chapter provides details on the application of relevant New South Wales (NSW) and Commonwealth legislation for the proposal.

2.1 HVO North approval history

Over the past 50 years, HVO has expanded through a process of extension and acquisition. There have been numerous separate development consents that applied to the operation. Development Consent No. DA 450-10-2003, for operations at HVO North, was granted by the Minister for Planning and Environment on 12 June 2004 under Part 4 of the EP&A Act, consolidating all approvals for HVO north of the Hunter River into one development consent. There have been two modifications to Development Consent No. DA 450-10-2003 for HVO North, including an extension of the Carrington Pit, approved in 2006. In addition, an access road was consented to in 2005 by Singleton Council. A summary of the consents and modifications is provided in Table 2.1. A copy of Development Consent No. DA 450-10-2003, as modified, constitutes Appendix B.

Table 2.1 Summary of approvals for HVO North

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
450-10-2003	Consent	12/6/2004	DoP	Extension of open cut mining to the east of existing development. Production rate of 12Mt per annum (Mtpa) ROM coal from West Pit, 10Mtpa ROM coal from Carrington Pit and 4Mtpa from North Pit. Coal haulage of 16Mtpa from HVO South to the Hunter Valley Coal Preparation Plant (HVCPP). Total processing capacity of 20Mtpa at HVCPP, 6Mtpa at Howick Coal Preparation Plant (HCPP) and 4.5Mtpa at Newdell Coal Preparation Plant (NCPP). Movement of coal and rejects between areas of HVO, including between HVO South and HVO North. Temporary crossings of the Hunter River for heavy equipment too heavy for existing bridge. Consolidation of 15 existing development approvals applying to HVO North, into a single consent.
884/2004	Consent	02/2/2005	Singleton Council	Construction and use of an access road to the Energy Australia substation.
450-10-2003 M1	Mod 1[(1)] of DA 450-10-2003	16/8/2005	DoP	Upgrade of Hunter Valley Load Point (HVLP) to increase the loading rate from 4,000 tonnes per hour (tph) to an average rate of approximately 5,100tph with a peak load of up to 7,200tph.
450-10-2003 M2	Mod 2[(1)] of DA 450-10-2003	25/6/2006	DoP	Extension of open cut mining to the south and east of Carrington Pit to access 19Mt of ROM coal. Construction of up to three levees and potential construction of groundwater barrier walls. Diversion of an existing drainage channel. Construction of a service corridor and modification of the development consent boundary.

2.2 Environmental Planning and Assessment Act 1979

The EP&A Act provides the legislative basis for the planning system in NSW and is administered by the DoP. Part 3A of the Act relates to major developments which are considered to be significant to the State of NSW. The Minister for Planning is, generally, the determining authority for Part 3A projects.

The *State Environmental Planning Policy (Major Development) 2005* (Major Development SEPP) defines certain developments that fall under Part 3A. Clause 6 of the Major Development SEPP states:

> *'(1) Development that, in the opinion of the Minister, is development of a kind:*
>
> *(a) that is described in Schedule 1 or 2, or*
>
> *…*
>
> *is declared to be a project to which Part 3A of the Act applies.'*

Schedule 1 of the Major Development SEPP specifies certain classes of developments considered to be major development. In relation to coal mining, its states:

> *'(1) Development for the purpose of mining that:*
>
> *(a) is coal or mineral sands mining, or*
>
> *(b) is in an environmentally sensitive area of State significance, or*
>
> *(c) has a capital investment value of more than $30 million or employs 100 or more people.'*

Given that the proposal is for the purposes of coal mining, it is classified as major development and Part 3A applies.

Application to modify a Part 4 development consent using the Part 3A process can be made under the EP&A Act. This approval path is provided for under clause 8(J)(8) of the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) and Section 75W of the EP&A Act. Clause 8(J)(8) of the EP&A Regulation states that:

> *'For the purposes only of modification, the following development consents are taken to be approvals under Part 3A of the Act and section 75W of the Act applies to any modification of such a consent:*
>
> *(a) a development consent granted by the Minister under section 100A or 101 of the Act before 1 July 1998,*
>
> *(b) a development consent granted by the Minister under State Environmental Planning Policy No 34—Major Employment-Generating Industrial Development,*
>
> *(c) a development consent granted by the Minister under Division 4 of Part 4 of the Act (relating to State significant development) before 1 August 2005 or under clause 89 of Schedule 6 to the Act,*
>
> *(d) a development consent granted by the Land and Environment Court, if the original consent authority was the Minister and the consent was of a kind referred to in paragraph (c).*
>
> *The development consent, if so modified, does not become an approval under Part 3A of the Act.'*

Section 75W of the EP&A Act states, in part:

> *'(2) The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.*
>
> *(3) The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.*
>
> *(4) The Minister may modify the approval (with or without conditions) or disapprove of the modification.'*

Section 75W is available to modify DA 450-10-2003 as it was a development consent granted by the Minister under Division 4 of Part 4 of the Act (relating to State significant development) before 1 August 2005. Additionally it was a development to which State Environmental Planning Policy No 34—Major Employment-Generating Industrial Development applied, thus satisfying clause 8(J)(8).

The Minister for Planning was formally requested by Coal & Allied to consider the proposal under Section 75W of the EP&A Act via a letter dated 8th April 2010. The request was accompanied by the Modification Application. Prior to submission of the request, a Government Briefing Report was provided to inform the Minister and the DoP of the details of the proposed modification and to assist with the formulation of the EARs for the associated EA. The EARs were issued on 31 May 2010. A copy of these is contained in Appendix A.

2.3 Other State legislation

Following from government agency consultation, detailed information on the application of *Water Management Act 2000* to the proposal is provided in the section below. An overview of other relevant NSW legislation is provided in Table 2.2.

Water Management Act 2000

The *Water Management Act 2000* (WMA) is primarily concerned with the regulation of the management of surface and groundwater in NSW, in areas where water sharing plans (WSP) operate. Two such plans pertain to this proposal, the WSP for the Hunter Regulated River Water Source, and the WSP for the Hunter Unregulated and Alluvial Sources. The WMA covers legal access to water and the approval of works that affect surface and groundwater. In accordance with the feedback received from government during the environmental assessment process, the sections below focus on groundwater.

As demonstrated in Section 5.2, the proposal complies with the principles which underpin the WMA. Specifically, in accordance with Section 63(2) (b) of the WMA, the EA establishes that no more than minimal harm will result from 'water being taken from the water source' due to the following factors.

- There will be no impact on any licensed water users, basic landholder rights (other than Coal & Allied), or on any identified groundwater dependent ecosystems.
- There will be a very minor to negligible impact on minimum baseflows in the Hunter River. This impact was calculated (and reported) to be approximately 0.05 megalitres (ML)/day, or 0.3 per cent of the 1 per cent minimum flow (ie the flow rate that is exceeded 99 per cent of the time).

Substantial wet periods, such as the June 2007 event (high rainfall and localised flooding), can be expected to mitigate leakage losses for extended periods of time.

- The potential impacts associated with the proposed mine plan, with the barrier wall installed, are the same as those predicted for the approved mine plan, as assessed in 2005 (Mackie Environmental Research, 2005). Seepage from the Hunter River/alluvium without a barrier wall was predicted to be 0.13ML/day by 2010 with the approved mine plan compared with 0.2ML/day for the proposed mine plan. Seepage from the Hunter River/alluvium with a barrier wall was predicted to be 0.05ML/day with the approved mine plan and 0.05ML/day with the proposed mine plan. Impacts predicted in 2005 were considered to have no more than minimal harm.

- There will be no long term drawdown of alluvial groundwater that will degrade the groundwater quality to the south of the barrier wall. Prior to mining at the Carrington Pit, the groundwater within the paleochannel was saline, with an EC typically greater than 8,500 micro Siemens per centimetre (µS/cm) seeping to the Hunter River. This poor water quality is unlikely to be restored in the long term. Instead, an improved water quality is likely to prevail within the Hunter River alluvium to the south of the barrier wall.

- Historically the groundwater resource has been a saline contributor to the Hunter River, albeit at very low flow rates. Isolating and removing this contribution in the long term will lead to a small reduction in salinity and may be regarded as beneficial to the river, rather than constituting 'more than minimal harm'.

It proposed that any 'water take' would be accounted for through current high security water supply licences held by Coal & Allied for pumping from the Hunter River.

Further, as demonstrated in Section 5.2, in accordance with Section 97(6) of the WMA, the EA establishes that 'no more than minimal harm will be done to the aquifer' due to the following factors.

- Due to the elevated salinity levels of the groundwater in the paleochannel, it is considered to have little beneficial use. The proposal will not result in temporary or long term drawdown of alluvial groundwater levels sufficient to degrade groundwater quality, below its current beneficial use class either during mining or into the post-mining period.

  The quality of groundwater entering the mine pit is expected to reflect an average of water quality for the alluvium and coal measures generally. All seeped water would remain within the mine water management system.

- The only identified groundwater dependent ecosystem in proximity to the proposed extension area is the population of River Red Gums (*Eucalyptus camaldulensis*) along the bank of the Hunter River and in the Carrington billabong area immediately south of the existing Carrington Pit. There will be no impact on the groundwater water levels within the alluvium hosting this ecosystem.

- A review of the results indicates a low seepage rate into the mine pit, with a steady increase in mine water seepage as a result of dewatering and stripping of the alluvium north of the barrier wall, from an initial rate of less than 0.01ML/day in Year 1 to about 0.04ML/day in Year 4, then reducing significantly to less than 0.005ML/day. Hardrock seepage into the mine pit is predicted to increase from an initial rate of less than 0.01ML/day to a peak of 0.085ML/day in Year 4 then reducing to 0.073ML/day in Year 6.

- Rainfall recharge in the proposed extension area is very limited due to the widespread presence of a thick and impermeable clay layer which has been encountered over most of the paleochannel area. Rainfall recharge tends to occur in some areas nearer the river where less clayey materials are evident. This area is to the south of the proposed extension area, beyond the proposed location of the barrier wall.

Again, Coal & Allied is committed to offsetting any predicted 'water take' associated with the proposal.

Table 2.2 summarises other NSW legislation that is of relevance to the proposal.

Table 2.2 Summary of other applicable NSW legislation

Legislation	Requirement	Comment
Protection of the Environment Operations Act 1997 (POEO Act)	Section 48 of the POEO Act requires that a premises-based Environment Protection Licence (EPL) be held for the activities listed in Schedule 1.	A premises-based EPL applies across HVO as a whole. This EPL will be reviewed and, if required, updated.
Mining Act 1992	This Act regulates the granting of Mining Leases and mining activities generally and, amongst other legislative instruments, places controls on methods of exploration and mining, the disposal of mining waste, and rehabilitation and environmental management activities.	Three tenements are held by HVO in the area of the proposal, namely Authorisation 435 and Exploration Licences 5418 and 5417. A Mining Lease will be sought by Coal & Allied for the proposed extension area.
Roads Act 1993	The Act sets out the rights of the public in regard to access to public roads, including closure of a public road. Part 4 Division 1 of the Act outlines the process that the application for a proposed road closure would be required to follow, which includes public notification and public submissions to the Minister.	The alignment of the Old Lemington Road runs through the proposed extension area. The road is no longer in public use, however it is still a dedicated road. An application under the Act will be made to close the section of the road affected by the proposal.
National Parks and Wildlife Act 1974	A permit under Section 87 or a consent under Section 90 of the Act is required to disturb or destroy an Aboriginal object.	Section 90 (s90) permits will be sought for affected Aboriginal objects, as required.
Threatened Species Conservation Act 1995 (TSC Act)	If a planned development or activity will have an impact on a threatened species, population or ecological community listed under the Act, this must be taken into account in the development approval process.	The species protected under this Act have been considered in this assessment.

2.4 Environmental planning instruments

The proposal has been assessed in terms of the potential application of State environmental planning policies (SEPPs) and the relevant local environmental plan (LEP).

As of 1 July 2009, regional environmental plans (REPs) no longer form part of the hierarchy of environmental planning instruments in NSW. All REPs as of 1 July 2009, are now deemed SEPPs. One former REP, Hunter REP 1989 – Heritage, potentially applies to the proposal. As it is now deemed to be a SEPP, further discussion is provided below.

2.4.1 State Environmental Planning Policies

i State Environmental Planning Policy (Major Development) 2005

As previously stated, the Major Development SEPP declares certain development as a major project which then requires approval under Part 3A. In addition to the previously cited provisions about the applicability of the SEPP to this Project, clause 2 provides that one of the aims of the SEPP is:

"to facilitate the development, redevelopment or protection of important urban, coastal and regional sites of economic, environmental or social significance to the State so as to facilitate the orderly use, development or conservation of those State significant sites for the benefit of the State".

The proposal involves development of a resource that is of economic significance to the State and, as such, it accords with this provision of the SEPP.

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

The State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of the State. The policy establishes appropriate planning controls to encourage ecologically sustainable development.

The Mining SEPP sets out matters for consideration under a development application scenario, together with permissibility provisions that the consent authority has to take into account, however, these matters and provisions do not affect the requirement for approval under Part 3A of the EP&A Act.

2.4.2 Singleton Local Environmental Plan 1996

The project area is located on land zoned Rural 1(a) under the Singleton Local Environmental Plan 1996. Mining is permissible within this zone with development consent, and the proposed modification is generally consistent with the objectives for this zone.

2.5 Commonwealth legislation

2.5.1 Environment Protection and Biodiversity Conservation Act 1999

An approval from the Minister for the Environment Protection, Heritage and the Arts under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required for actions that may have a significant impact on matters of national environmental significance. These matters comprise:

- world heritage areas;

- national heritage places;
- Ramsar wetlands of international importance;
- threatened species or ecological communities listed in the EPBC Act;
- Commonwealth land;
- marine areas or reserves; and
- nuclear actions.

The *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DEWHA, 2009) provides guidelines that outline a 'self-assessment' process, including detailed criteria, to assist persons in deciding whether or not referral to the Minister for Environment Protection, Heritage and the Arts may be required. These guidelines and associated significance criteria have been used to assess whether the proposal might have a significant impact on matters of national significance (refer to Section 5.8 for details of this assessment). The assessment has found that the proposal is not likely to have the potential to significantly impact on any known matter of national environmental significance and consequently, referral and approval from the Minister for Environment Protection, Heritage and the Arts is not considered to be required for this proposal.

2.5.2 Native Title Act 1993

The *Native Title Act 1993* provides for the recognition and protection of native title. There are no known native title claims over the land within the project area.

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3 Existing operations and proposed modification

Details of the proposal are provided in this chapter, along with an overview of alternatives considered and the existing operations at Carrington Pit, approved by Development Consent No. DA 450-10-2003.

3.1 Existing operations at Carrington Pit

Mining and rehabilitation within Carrington Pit has substantially commenced.

i Mining

Mining at Carrington Pit is undertaken using a truck and shovel operation, supported by loaders, dozers, graders, water carts and a fleet of haul trucks. As part of the integrated HVO, mining equipment is shared throughout all of the active mining areas.

Overburden is either free dug or drilled and blasted. It is removed using a combination of shovels, excavators and front end loaders for haulage to designated emplacements including those areas where mining has been completed within HVO. There are currently two out-of-pit emplacements, located to the north-east and north-west of the operational pit, respectively.

Coal is drilled and blasted, then removed with a front end loader or excavator. The target seams in the existing Carrington Pit are the Broonie Splits and Bayswater seams, which make up part of the Wittingham coal deposits. These seams are interbedded with shale, sandstone and conglomerate, and overburden is predominantly unconsolidated alluvium. The Bayswater seam has 12.8 per cent ash content and 0.48 per cent sulphur content. These properties make the Bayswater seam coal suitable for the domestic market as unwashed steaming coal, and for the export market, as washed coal. The Broonie seam is more suitable as a steaming coal, with potential as a semi-soft coking coal, due to its lower ash content (approximately 9 per cent) and higher sulphur content (0.6 - 0.73 per cent).

ii Coal processing

The ROM coal from Carrington Pit is trucked via internal haul roads to either the HVCPP or the HCPP for processing. Product coal from the HVCPP is then transported by overland conveyor to the HVLP where it is loaded onto trains for transport to Port Waratah at Newcastle. Product coal from the HCPP is either transported by conveyor to local power stations or is trucked to the Newdell Load Point for rail transport to Port Waratah. Tailings from the HVCPP and HCPP are disposed of in the approved tailings storage facilities currently at HVO North.

iii Water management

Water management for Carrington Pit is carried out in accordance with the HVO Water Management Plan. Runoff from areas being cleared in preparation for mining operations is directed to sedimentation dams. After treatment in the sedimentation dams, overflows are diverted to local watercourses. Water from the sedimentation dams may also be used to supplement the mine's water supply, where the structures are licensed for this purpose.

Groundwater inflows and pit runoff that is generated from disturbed areas within mining voids is directed to in-pit sumps and pumped into the mine water management system, for re-use in washing coal or for dust suppression. Excess mine water is held in storage for later re-use or, when required, released into the Hunter River under the Hunter River Salinity Trading Scheme (HRSTS).

Surface drainage controls are utilised to prevent the mine flooding. Notably, an ephemeral creek which flowed north to south through the western part of the Carrington Pit has been permanently diverted to a more westerly route over reconstructed, mined out landform. This permanent diversion is licensed under the *Water Act 1912*.

Depending upon prevailing climatic conditions, the integrated HVO water management system may operate in deficit or surplus. Deficits are made up through water sharing between pits and agreements with other mines. Surpluses are generally contained on site for use in coal preparation, dust suppression, and vehicle wash down. Water surplus to these requirements is discharged via licensed discharge points and in accordance with the HRSTS.

Further details on water management, supply and use are provided in Section 5.3.

iv Waste management

Waste management at HVO is carried out in accordance with the waste management plans which form part of Rio Tinto Coal Australia's Health, Safety, Environment and Quality (HSEQ) Management System and as assessed and approved as part of the Environmental Resources Management (ERM) (2003) Environmental Impact Statement (EIS). Overburden and tailings management are mentioned previously. Examples of waste management procedures which contribute to the energy efficiency of HVO are provided in Section 5.10. Further details of the HVO waste streams and waste management procedures are provided in the ERM (2003) EIS. The only change proposed to these is the re-establishment of the overburden emplacement areas to the north of the proposed extension area. Accordingly, waste management is not discussed further in this document, other than as it relates to the overburden emplacement areas and energy efficiency.

v Safety

Safety at HVO North is actively managed through Rio Tinto Coal Australia's HSEQ Management System. Examples of controls to ensure public safety include restricting public access to the mine site by fencing and controlled access gates, and temporary road closures when blasting occurs in the vicinity. Further details on blasting-related road closures are provided in Section 5.11. Details of fuel and chemical use and management at the site are provided in the ERM (2003) EIS. No changes to the existing safety systems or fuel or chemical storage and handling procedures are proposed, and therefore these aspects are not discussed further in this document.

vi Rehabilitation and final landform

Rehabilitation works generally follow the mining schedule. Rehabilitation activities at Carrington Pit, including the rehabilitation schedule and objectives, are detailed in the Carrington Mining Operation Plan (MOP). It is noted that under the amended *Mining Act 1992*, Rehabilitation Environmental Management Plans (REMPs) will replace MOPs.

The final landform at Carrington Pit is planned to comprise a series of hills, ridges and minor valley systems designed to be consistent with the surrounding pre-mining landscape. It will have a mix of pasture and native habitat areas. The final void at Carrington Pit for the existing approved operation is located in the northern section of the mining area, away from the Hunter River, and is designed to act as an evaporative sink to manage groundwater post-mining.

vii Environmental management

All of Coal & Allied's mining operations in the Hunter Valley currently operate under Rio Tinto Coal Australia's HSEQ Management System which is certified to the international standard ISO:14001(2004).

The HSEQ Management System includes an environmental policy, a series of regulatory required management plans, a monitoring programme and environmental standards and procedures. The HSEQ Management System forms the basis for rigorous and consistent environmental management and is reviewed annually and regularly audited. The effectiveness of the system has been demonstrated through audits, which have shown a consistent trend in environmental improvement throughout the business, including HVO.

The HSEQ Management System enables the operations to apply specific tools that support the implementation, execution and effectiveness of the Rio Tinto health, safety and environmental performance standards.

The HSEQ Management System is designed on the principles of continuous improvement and generally follows the layout of common international standards (including ISO14001) and the Plan, Do, Check and Review cycle:

- Plan - identify what is required;
- Do - implement the activities;
- Check - monitor performance through checking and corrective action; and
- Review - evaluate the suitability, adequacy and effectiveness of the system through the management review.

The HVO has an Environmental Impacts Risk Register in place which systematically identifies all the activities related to the mine that could cause environmental harm, and applies a risk ranking to these aspects. Those aspects which are subsequently identified to have a high level of risk are prioritised in the Environmental Improvement Plans, so that they are appropriately managed.

An Annual Environmental Management Report (AEMR) is produced each calendar year in accordance with the existing consent conditions. The HVO's environmental performance with respect to the relevant monitoring requirements is documented in the AEMR, and made available to the community on the Coal & Allied website.

3.2 The proposal

This section provides details of the proposal. There will be no change to the approved maximum total annual production of coal from HVO North or Carrington Pit as a result of the proposal. The mining methods, equipment, employment levels, coal handling locations, methods and volumes, coal transportation methods and volumes and operating hours will be in accordance with the existing approved operations.

3.2.1 Extension to mining

The proposal is a progression or extension of the existing Carrington Pit to the south-west, into Authorisation (AU) 435, Exploration Licence (EL) 5418 and EL 5417 (see Figure 1.2).

The proposed extension area comprises approximately 137ha. Lemington Road is to the west of the proposed extension area, the Hunter River to the south, the existing Carrington Pit to the east and the previously mined out areas to the north. The extension will allow for the extraction of approximately 17Mt of in-situ coal. The maximum annual production rate from the extension will be within the maximum consent limit for HVO North. The target seams are the Bayswater and Broonie seams, as per the existing approved operations at Carrington Pit. In addition, in the south-western corner of the proposed extension area, the Vaux seam will also be mined.

The proposed extension area is forecast to have a life of approximately six years based on current mine plans. The sequence of mining the proposed extension area based on the current mine plan is described below. Estimates of recoverable coal volumes and the associated volumes of overburden for each year of mining are provided in Table 3.1.

Year 1

Mining begins at the western extremity of the proposed extension area through a box-cut, with the faces oriented in a north-south direction.

To achieve the rehabilitation goal of post-mining landform and land capability class in the proposed extension area being similar to pre-mining, emplacing overburden above the pre-mining landform elevations on the proposed extension area was discounted. Out-of-pit overburden emplacements are proposed on rehabilitated land immediately north of the proposed extension area, outside of the floodplain, as shown on Figure 1.3. Overburden emplacement cannot be accommodated at other locations due to limitations in emplacement capacity and consented height limits.

In year 1, the overburden from the box cut will most likely be dumped in the out-of-pit emplacement areas. Haul roads will be established to access the emplacement areas. These will be located on previously disturbed areas, and will be relocated as required to enable access to the active emplacement areas.

This development first opens up the deepest section of the pit, thereby allowing the maximum in-pit emplacement volume in subsequent years

Years 2-3

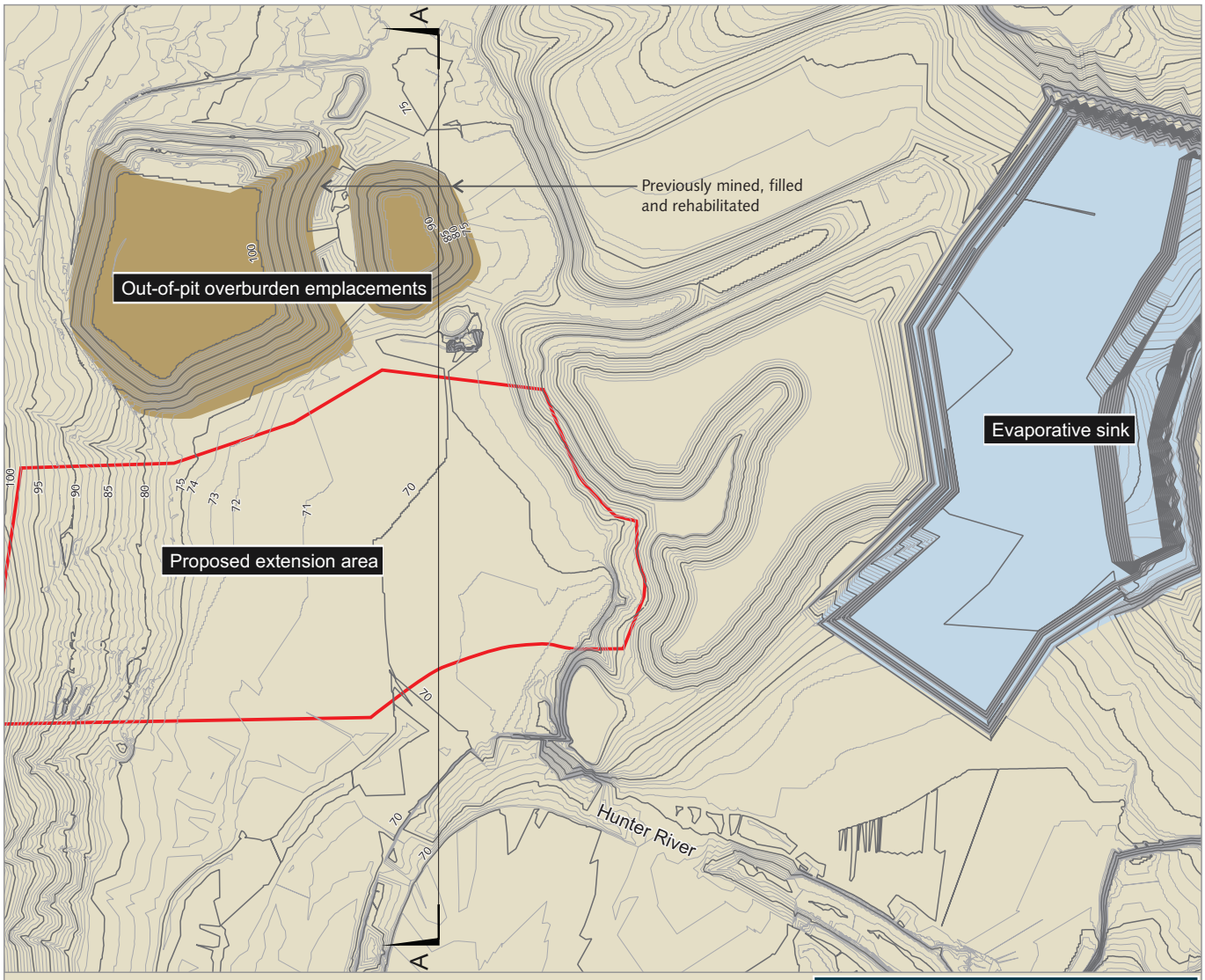
Mining is forecast to continue in an eastward direction, with in-pit emplacement following approximately 50 metres (m) behind the highwall and out-of-pit emplacement occurring at the proposed overburden emplacement areas to the north.

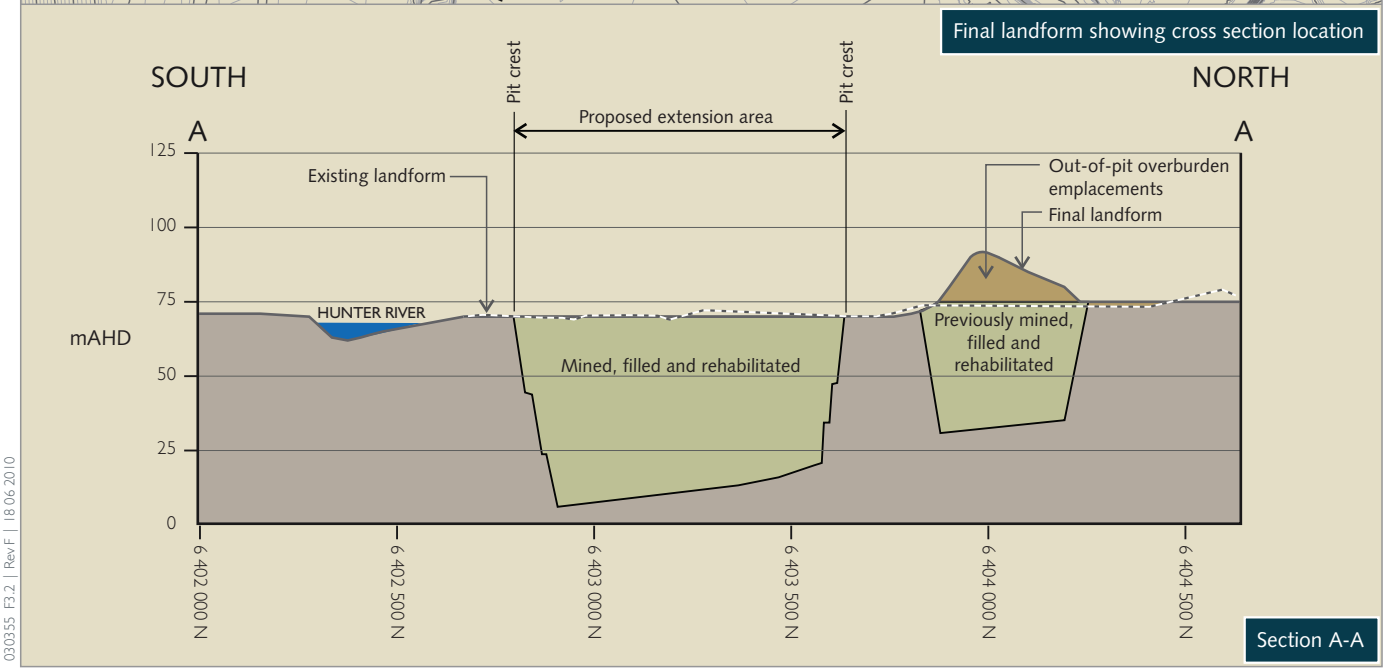
Years 4-5

The face advance is forecast to shift from an eastward direction to a northerly direction, and then to a south easterly direction.

Year 6

Mining is forecast to be completed as the face progresses towards the south-east pit limit. The south-eastern corner will be in-filled at the conclusion of mining. Post-mining, the pit shell within the proposed extension area will be returned as close to its pre-mining landform as possible, as illustrated in Figure 3.1.





0 500 1000
Metres

Figure 3.1
Final Landform - Conceptual Cross Section
Carrington West Wing

Table 3.1 Estimated recoverable coal tonnes and associated overburden volumes

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
ROM coal (t)	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000
Total overburden (bank m^3)	12,707,000	8,429,000	9,231,000	9,171,000	9,363,000	6,967,000
Strip ratio (bank m^3/t)	4.24	2.81	3.08	3.06	3.12	3.44

3.2.2 Supplementary activities

i Carrington Pit configuration

The approved footprint of the evaporative sink will be extended to accommodate the additional post-mining groundwater generated as a result of mining within the proposed extension area. The conceptual footprint of the extended evaporation sink is shown in Figure 3.1.

ii Flood levees

The surface water assessment report prepared by WRM Water & Environment Pty Ltd (2010), and included as Appendix D of this report, states that the proposed extension area may be affected by flooding from the Hunter River to the south and from the ephemeral Unnamed Tributary which crosses the project area. To maintain operational security of the pit during and following flood events up to and including the 100 year Average Recurrence Interval (ARI) flood event, it is proposed to construct flood levees.

The levees will be constructed in two stages. The Stage 1 levees will be in place for approximately the first three years of mining. The 'main' levee, which is designed to provide protection from flooding from the Hunter River, will extend along the southern boundary and then northward, adjacent to the Unnamed Tributary, to join the existing rehabilitated emplacement areas to the north. A smaller levee will also be constructed to the west of the pit, adjacent to Lemington Road, to divert local catchment runoff from a western drainage line around the pit to the north. The main levee height above ground level will be variable, depending on the existing ground surface elevation, with a maximum projected height of 6m. The Stage 1 levees are shown on Figure 3.2.

As mining progresses eastward, the pit will be progressively filled and the Stage 1 levees will be removed. The Stage 2 levees will be built across the fill around the western side of the pit. Stage 2 levees will be in place for approximately Years 4 to 6 of mining within the proposed extension area. The minor levee adjacent to Lemington Road will be removed and the old drainage line collecting local catchment runoff to the west will be reinstated. The Unnamed Tributary will be diverted to the west of the Stage 2 levees, across the filled pit. The diversion will then drain into the paleochannel on the southern side of the levee and back into the Unnamed Tributary, before discharging into the Hunter River. At the end of the life of the extension, the levees will be removed. The Stage 2 levee system and the 'mining completed' scenario are also shown on Figure 3.2.

Further detail on flooding and the proposed levees is provided in Section 5.3.

iii Water course diversions

A drainage line will be established along, and to the north of, the western edge of the proposed extension area to divert water coming from the catchment to the west of the pit. This drainage line will be designed

to complement the function of the Stage 1 levee, proposed for the north-western side of the pit. Water in the drainage line will flow to the north until it meets a branch of the Unnamed Tributary where after it will flow within the tributary. Construction will coincide with the construction of the Stage 1 levees referred to above (see Figure 3.2).

The Unnamed Tributary which currently drains across the proposed extension area in a southerly direction (see Figure 3.2) has a catchment area of approximately 20 square kilometres (km^2). This tributary will require temporary diversion to allow mining in its vicinity. Accordingly, it is proposed to construct a temporary diversion, as shown on Figure 3.2. Construction will coincide with the construction of the Stage 2 levees referred to previously.

The diversion will have a typical base width of approximately 5m, with side slopes generally with a gradient of approximately 1:3 and top of crest width between 15 and 25m. These dimensions are similar to those for existing upstream diversions.

The surface water assessment (refer to Section 5.3) indicates that the erosion potential of the temporary diversion will be approximately half that of the existing Unnamed Tributary, due to increased length and flatter design slope gradients. Accordingly, no hard engineering erosion protection measures are proposed for the diversion. Instead, the soil profile below the new tributary will be reinstated with a suitable growing medium and the channel will be vegetated with suitable grass species.

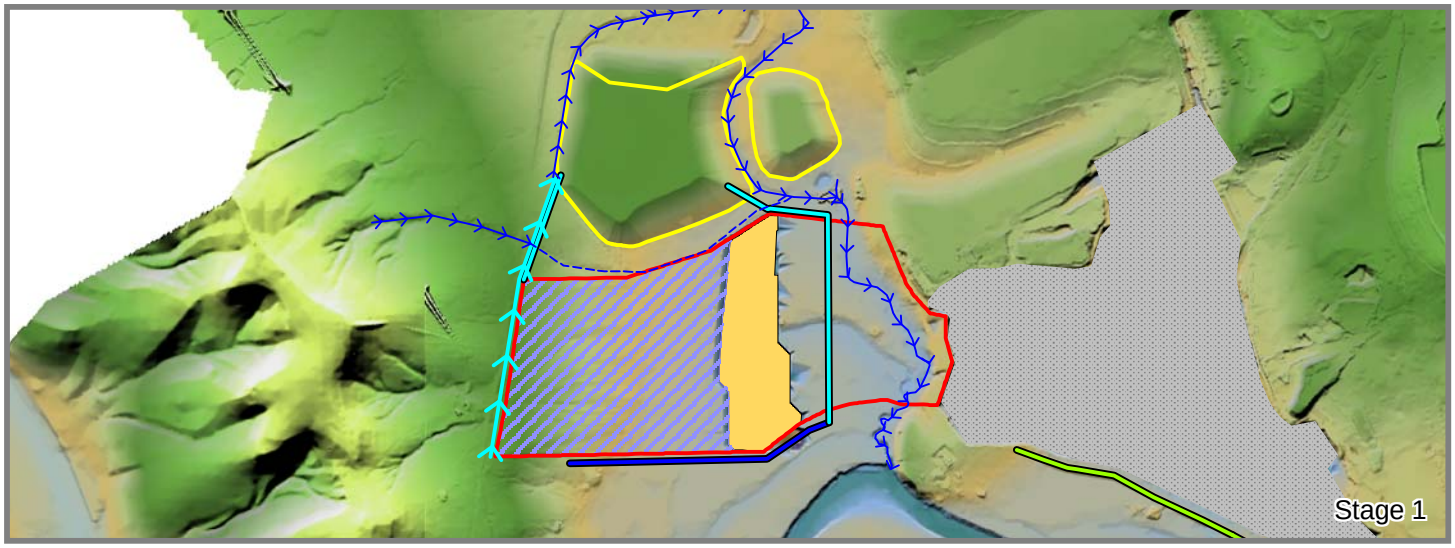
At the end of mining within the proposed extension area, the Unnamed Tributary will be reinstated to its original position. The end-of-mine Unnamed Tributary channel will be constructed to be a similar shape to pre-mining conditions, subject to detailed design considerations (see Figure 3.2). Detailed design plans for the temporary diversion and for reinstatement of the Unnamed Tributary will be included in a management plan to be developed for the Unnamed Tributary in consultation with the NSW Office of Water (NOW) and NSW Industry & Investment (I&I NSW) (refer to Section 5.3.3 for further discussion).

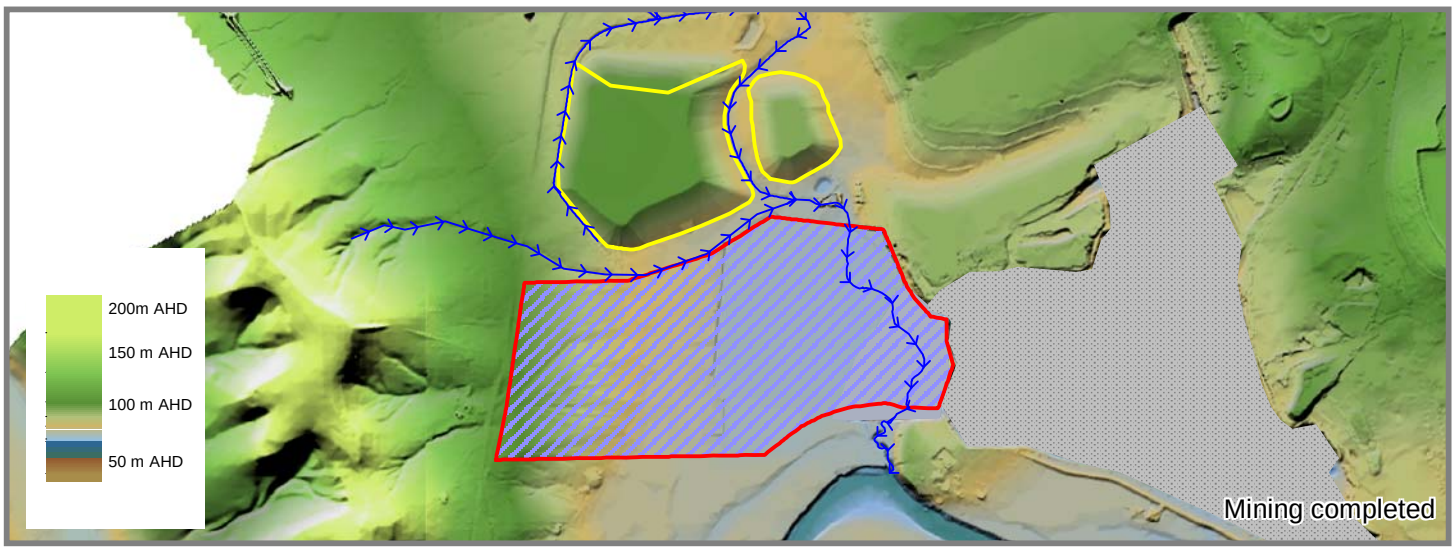
iv Groundwater barrier wall

Areas of the proposed extension area are underlain by a former meander of the Hunter River. This meander, known as a paleochannel, incorporates permeable braids in the alluvium that would connect the river and the alluvium to the mine hydrologically. In 2005, Mackie Environmental Research (MER) reported that leakage from the river to the existing Carrington Pit via the alluvium could be mitigated by installation of impermeable barrier walls across the paleochannel. Such walls would also inhibit long term leakage of leachate from the emplaced waste rocks within the mine void, southward into the undisturbed alluvium and the Hunter River. The barrier wall in the eastern arm of the paleochannel has been constructed. The MER (2005) study also identified and assessed a barrier wall across the western arm of the paelochannel, in the vicinity of the proposed extension area. It is now proposed to realign this wall to the south of its previously assessed location.

Realignment of the barrier wall would effectively:

- isolate the potential impacts of mining from the Hunter River and its associated alluvium;
- inhibit saline groundwater flows from the project area reaching the Hunter River; and
- inhibit long term leakage of leachate from the emplaced waste rocks within the mine void, southward into the undisturbed alluvium and the Hunter River.





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0 0.5 1 1.5

Kilometres

Existing levee

Proposed minor levees

Proposed main levee

Proposed extension area

Indicative active pit extent

Progressive pit rehabilitation

Existing Carrington Pit subject to ongoing rehabilitation

Out-of-pit overburden emplacement area

Section of existing unnamed tributary to be diverted

Existing unnamed tributary

Proposed drainage line diversion

Proposed unnamed tributary diversion

Figure 3.2

Levees and drainage diversions

Carrington West Wing

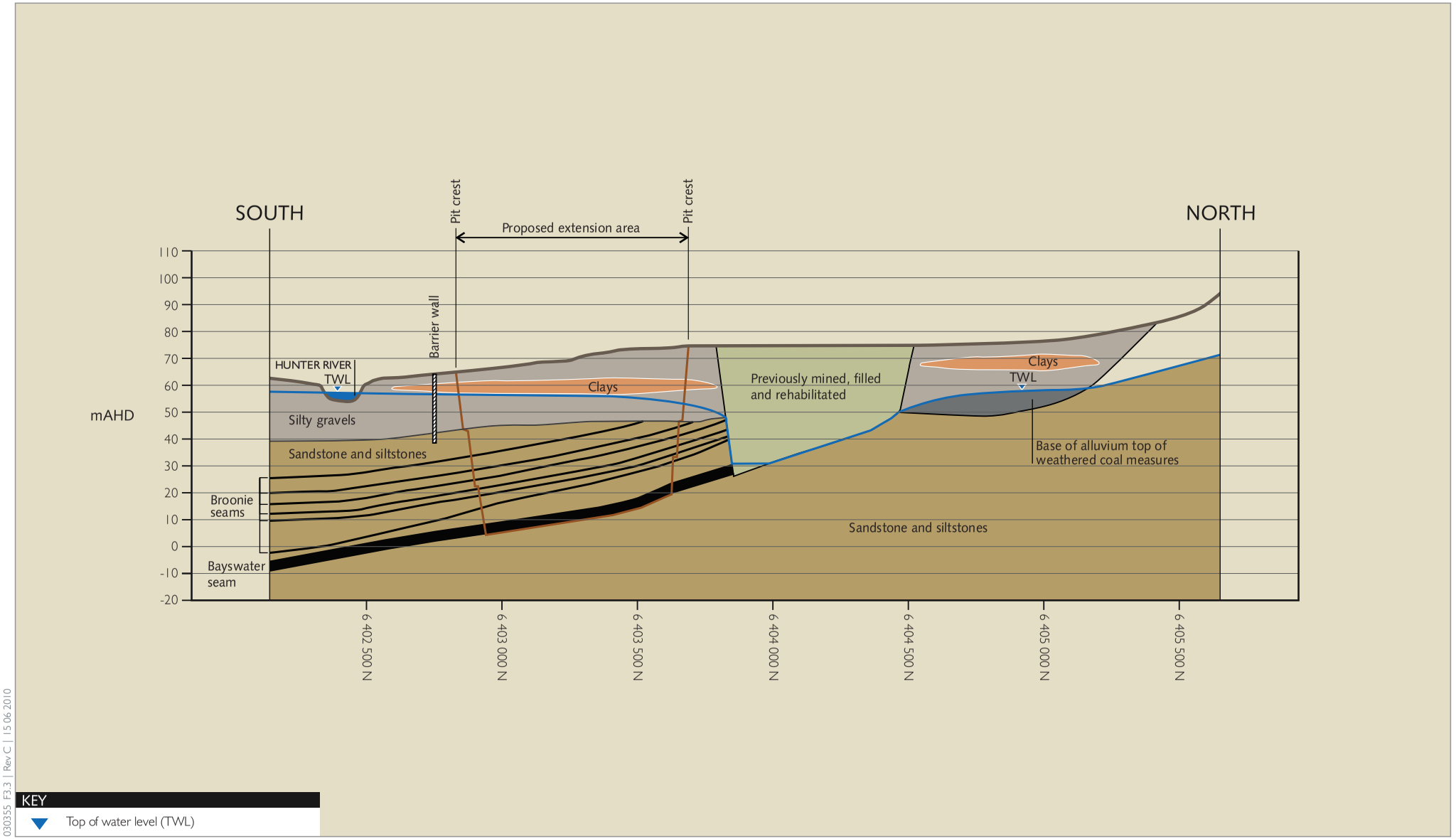

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Figure 3.3

Elevation view of groundwater barrier wall

Carrington West Wing

The proposed location of the groundwater barrier wall is shown on Figure 1.3. The barrier wall will most likely be composed of a soil bentonite mix, making it highly impermeable. The wall is proposed to be sufficiently deep to prevent flows of groundwater within the alluvium in either direction. An elevation view of the groundwater barrier wall is shown on Figure 3.3. The potential groundwater impacts from the proposed barrier wall, in terms of both flow quantities and water quality, are discussed in Section 5.2.

In addition to the barrier wall constructed in the eastern arm of the paleochannel, a barrier wall (significantly larger than that proposed for the current application) was constructed at the Alluvial Lands mining area, located within HVO North to the south-east of the proposed extension area. Monitoring results have shown that this wall is effective. Therefore, Coal & Allied is highly confident of the proposed barrier wall being successfully constructed and operating effectively.

v Service corridor

A service corridor is to be located to the south of EL 5418. This will likely contain water pipelines, an all weather access road and other services. The all weather services road will connect to an existing vehicle track to the east, which leads to an EnergyAustralia substation (see Figure 1.3). This will ensure access is maintained to the EnergyAustralia substation throughout the proposal.

vi Modification of development consent boundary

To accommodate the proposal, the existing development consent boundary will be modified to include the southern limit of EL 5418 (as shown in Figure 1.3).

3.2.3 Rehabilitation and final landform

Rehabilitation and development of the final landform will be undertaken progressively across the mined area, consistent with the existing approved approach, methodologies and final land use options described in 3.1 vi and in the ERM (2003) EIS. Broad rehabilitation objectives are as follows:

- successful design and rehabilitation of landforms to ensure structural stability, revegetation success and containment of wastes;
- development of a final landform with recognition of the pre-mining landform features, which incorporates the existing rehabilitated landforms and is consistent with the surrounding landscape features; and
- post-mining land use compatible with surrounding land uses, capable of supporting viable grazing and ecological values and providing environmental and community benefits.

Rehabilitation and final landform management are consistent with the above and will include the following outcomes.

- The pit void will be backfilled, regraded to similar grade to its pre-mining landform and revegetated to produce grasslands, with scattered native trees, suitable for cattle grazing and some rotational cropping.
- The out-of-pit emplacement areas will be vegetated with woodland species, which provide a habitat resource for native species, and grasslands which are suitable for cattle grazing and some rotational cropping.
- The extended evaporative sink will remain in place following the cessation of mining.

- As described in Sections 3.2.2 ii and iii, surface drainage will be restored to be consistent with the pre-mining drainage patterns. This will include removal of the levees and reinstatement of the Unnamed Tributary channel to its original position, subject to detailed design considerations. Drainage considerations are discussed in greater detail in Section 5.3.

The indicative rehabilitation scheme and evaporative sink footprint are shown on Figure 3.4. The proposed post-mining land capability and agricultural suitability classes are described in further detail in Section 5.4. Generally, the rehabilitation process will comprise the following five conceptual phases.

- Decommissioning; including removal of infrastructure and removal and/or containment of any hazardous or contaminated material.

- Landform establishment; including design and installation of structural soil conservation and drainage works, eg contour furrows, contour banks, sedimentation dams and/ or diversion drains, to ensure the long term stability and productivity of the rehabilitated land. Slope gradients will vary according to erosion hazard, stability and drainage requirements, though will generally be less than 10 degrees. Visual amenity and public, stock and fauna safety will also be addressed during this phase of rehabilitation.

- Growing media development; ensuring physical, chemical and biological characteristics of the growing media to optimise its potential in terms of the preferred vegetative cover.

- Ecosystem establishment; including species selection, revegetation and habitat augmentation, and weed and pest management.

- Ecosystem sustainability; incorporating assessment against performance indicators for components including floristic structure, nutrient cycling, recruitment and recovery, and community structure and function.

The specific requirements for rehabilitation will be determined in consultation with relevant government agencies and stakeholders and will be documented in the REMP/ MOP, as required by the *Mining Act 1992*. The REMP/ MOP will address the landscape and rehabilitation domains, objectives, methodology, criteria, performance measures and indicators, as well as the monitoring, review and reporting processes and requirements, and contingency measures. The monitoring of rehabilitation performance will be reported in an annual report.

3.3 Alternatives considered

Proposal alternatives considered included variations of the proposed extension area and the 'do nothing' option.

3.3.1 Proposed extension area footprint

A number of options were considered for the extent of proposed extension area. These included:

- extending mining further south of the currently proposed extension area footprint;

- extending mining to the south-east of the currently proposed extension area footprint; and

- the currently proposed extension area footprint.

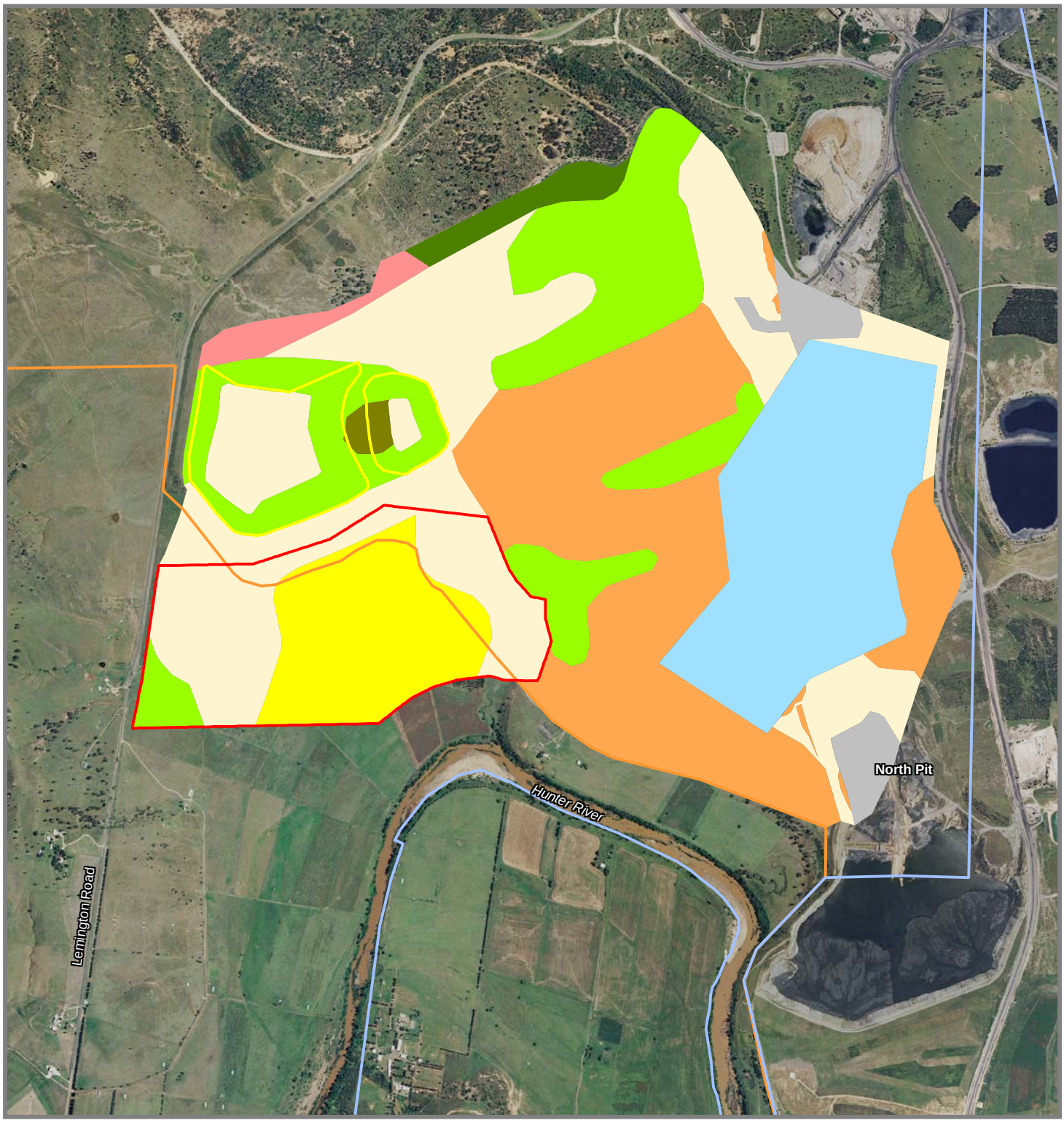
The first option was dismissed as further resource investigation is required before proceeding with developing mine plans.

The second option was dismissed to ensure that the proposed extension area was offset to the north of the existing paleochannel. This negates potential impacts to the active meander bench (refer to Appendix D).

The third option was preferred as it will enable the efficient extraction of a relatively low strip ratio coal resource whilst managing potential environmental impacts, including erosion potential.

3.3.2 Do Nothing Option

The 'do nothing' option would avoid potential environmental impacts associated with the proposal and the costs associated with development of the proposal and environmental management measures. However, it would miss the opportunity of accessing an economic resource through an extension of existing mining operations where considerable social and physical capital is already in place. Under this scenario, the attendant social and economic benefits would not be realised.



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Regenerated Grassland (grazing)
Regenerated Woodland (biodiversity)
Rehabilitated Grassland (grazing/cropping)
Rehabilitated Woodland (biodiversity)
Rehabilitated Woodland (grazing)
Void / dam / mining area
Rehabilitated Woodland (Central Hunter Box - Ironbark Woodland) - indicative location
Rehabilitated Grassland (grazing/ cropping) - Class II land capability

HVO North current development consent boundary
HVO South project approval boundary
Proposed footprint of evaporative sink
Out-of-pit overburden emplacement
Proposed extension area

0 0.5 1 1.5
Kilometres

Figure 3.4

Proposed final landuse

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4 Consultation

4.1 Consultation principles

Coal & Allied aims to build enduring relationships with the communities in which it operates, characterised by mutual respect, active partnership and long term commitment. Consultation specifically for the proposal has been conducted to provide key stakeholders with:

- accurate and timely information in relation to the proposal;
- information to support their understanding of the planning framework in which the modification application will be considered; and
- the opportunity to provide feedback and express any concerns or support relating to the proposal, as well as receive feedback on how these are being addressed in the EA.

4.2 Consultation with government

Consultation was undertaken with the DoP, Department of Environment, Climate Change and Water (DECCW) and I&I NSW throughout the project design phase, and during the preparation of this EA. A summary of consultation undertaken with these government agencies is provided in Table 4.1**.**

Table 4.1 Summary of consultation undertaken with government agencies

Agency	Date consulted	Description
DoP	14 August 2009	Meeting to introduce the proposal and discuss the approval pathway, consultation approach and scheduling.
	13 November 2009	Presentation and update on key proposal components, and provision of a draft government briefing report on the proposal.
	26 August 2010	Meeting to discuss proposed responses to adequacy review comments.
DECCW (including NOW)	19 August 2009	Meeting to introduce the proposal.
	21 August 2009	Meeting to discuss groundwater-related issues.
	24 August 2009	Provision of a briefing paper on proposal-related groundwater issues.
	25 November 2009	Meeting to discuss water licensing requirements, groundwater management and the proposed barrier wall.
	11 August 2010	Meeting to discuss predicted impacts of the proposal and application of the *Water Management Act 2000*.
I&I NSW	12 October 2009	Meeting to discuss the proposal, groundwater issues and land management issues.

The key issues that have arisen during discussions with government agencies are captured in the EARs and are set out in Table 1.1**.**

4.3 Consultation with community

The community has been consulted during the development of the EA. This has been through existing Coal & Allied engagement tools, as well as community information sessions with project information available. The established engagement tools utilised are:

- shopfronts in Singleton and Muswellbrook, freecall community information line (1800 727 745) and Coal & Allied website that includes information on the proposal (www.coalandallied.com.au);
- quarterly newsletters distributed to all residents within the Singleton LGA which provide information on Coal & Allied mining operations in the LGA, including upcoming projects;
- the Hunter Valley Operations Community Consultative Committee (CCC) which meets regularly to discuss mining operations and environmental performance, and comprises representatives of the community, Singleton Council and Coal & Allied; and
- Upper Hunter Valley Cultural Heritage Working Group (CHWG) which meets regularly to discuss heritage aspects of Coal & Allied operations, and is comprised of representatives of Coal & Allied and the Upper Hunter Valley Aboriginal community.

A summary of community consultation undertaken is provided in Table 4.2. A more in depth description of consultation undertaken with the local Aboriginal community is provided in Section 5.7 and Appendix H.

Table 4.2 Summary of meetings with community

Stakeholder	Date consulted	Description
Local community and near neighbours	September 2009, December 2009 and March 2010	Newsletters (Singleton edition) showcasing that options to extend mining in the Carrington Pit were being investigated, inviting community members to attend the Community Information Sessions and outlining the proposed approvals process.
	11 and 12 December 2009	Community Information Session held, where Coal & Allied representatives presented information about the proposal and sought community feedback. Details of the information sessions were publicised in advance by newspaper advertisements (Singleton Argus and Hunter Valley News) and by direct phone calls to CCC representatives and elected Councillors. Community members were also given the opportunity to request an additional face to face meeting.
	2009-2010	Proposal information displayed at the Singleton shopfront since December 2009. The proposal has been discussed with community members when they have visited the Singleton Shopfront and at additional meetings which have taken place on request.
Cultural Heritage Working Group	27 August 2009	Meeting which included an introduction to the proposal and settled the scope for the Aboriginal cultural heritage assessment.
	1 October 2009	Meeting which included a discussion of the proposal, Aboriginal cultural heritage survey results, previous Aboriginal heritage assessments undertaken in the area and management options for Aboriginal sites, particularly the salvage of site CM-CD1.
	9 December 2009	Meeting which included a discussion of the preliminary findings of the Aboriginal cultural heritage assessment and the proposed management

Table 4.2 Summary of meetings with community

Stakeholder	Date consulted	Description
		recommendations, focusing on site CM-CD1. Timing for provision of the draft Aboriginal cultural heritage assessment report was also discussed.
	22 January 2010	Draft Aboriginal cultural heritage assessment report issued for review and feedback.
	12 February 2010	Meeting which included a review of previous discussions and recommendations and survey results from the additional cultural heritage survey undertaken in February 2010. The CHWG provided feedback on the draft Aboriginal heritage report, and offsets were discussed.
CCC	19 November 2009	Meeting which included an overview of the proposal and sought feedback from the CCC.
	22 April 2010	Meeting which included presentation of details on the approval process and timing, project layout and impact assessments.
	2 June 2010	Presentation of the proposal in detail to interested CCC members.

Table 4.3 summarises the issues raised by the community during the consultation process and references where these issues are addressed in the EA.

Table 4.3 Summary of issues raised

Issue raised	Addressed in EA
Potential impacts on agricultural land	Section 5.4, Appendix E
Land classification of alluvial river flats within the proposed extension area	Section 5.4, Appendix E
Mining of alluvial river flats	Section 5.2 to 5.4, Appendices C to E
Potential flooding impacts associated with proposed levee system	Section 5.3, Appendix D
Potential noise and dust impacts, including amenity impacts	Sections 5.5 and 5.6, Appendices F and G
Siting for out-of-pit overburden emplacement areas	Chapter 3
Cumulative impacts	Chapter 5, Appendices C to I
Provision of monitoring results to the community	Section 3.1 vii
Process and timing of proposal consultation and notification	Chapter 4
Water quality testing for private storage tanks (potential dust impacts)	Section 5.6, Appendix G
Potential ecological impacts	Section 5.8, Appendix I
Potential water impacts	Sections 5.2 and 5.3, Appendices C and D
Requirements for additional Aboriginal heritage surveys	Section 5.7, Appendix H
Appropriate recognition and offsetting for site CM-CD1	Section 5.7, Appendix H

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5 Environmental assessment and management

5.1 Introduction

An environmental constraints study was undertaken in June 2009 to identify key environmental attributes for consideration in the mine planning process. The study considered the potential unmitigated environmental risks resulting from the proposal. Identification of these risks, together with consultation with government agencies and the community, enabled key issues to be identified for further assessment.

The unmitigated potential environmental risks were assigned the following qualitative risk ratings in the environmental constraints study.

- *High* – groundwater.
- *Medium* – surface water, soils and land classes, noise and vibration, air quality and Aboriginal cultural heritage.
- *Low* – ecology, visual amenity, greenhouse gas emissions, traffic and transport, non-indigenous heritage, and socio-economics.

An environmental impact assessment for each environmental attribute has been undertaken, commensurate with its risk. Appropriate measures have been nominated for each attribute to mitigate, manage and/or monitor potential impacts.

5.2 Groundwater

Mackie Environmental Research has undertaken a groundwater study of the proposal. The technical report is presented in Appendix C and key findings are summarised below.

5.2.1 Existing environment

Considerable existing groundwater information is available for the regional and local area, derived from previous groundwater investigations, modelling and monitoring.

Geology over the majority of the proposed extension area consists of unconsolidated alluvium that immediately overlies the Permian coal measures. The alluvium is contained within a former meander, or paleochannel, of the Hunter River (see Figure 5.1). The majority of the proposed extension area lies within the western 'arm' of the paleochannel. The western channel alluvium is similar to alluvium encountered in the eastern channel which has now been largely removed by approved mining activities. The alluvium to the north of the proposed extension area has also been largely removed. The paleochannel is characterised by shallow soil, and sandy-silty sediments overlying a clay layer of 2 to 6m thickness, which in turn overlies a mixed clayey, silty, gravel sequence of similar thickness. The clay layer is absent in a number of piezometers drilled in the western part of the proposed extension area.

The paleochannel geometry has been progressively defined from exploration drilling and numerous piezometer drilling programmes during the period of mining at Carrington Pit. Additional tailored groundwater investigations have been undertaken for the current proposal, including the installation of 12 piezometers, facilitating an improved understanding of the depth and extent of the paleochannel in the proposed extension area.

The permeability (hydraulic conductivity) distribution within the paleochannel alluvium has been assessed over a period of 10 years by undertaking hydraulic testing at piezometer locations, and subsequently using computer based numerical modelling to predict candidate areas of higher or lower conductivity. Permeability of the alluvium is highly variable. As with many of the paleoalluvial deposits in the region, the more permeable horizons generally occur within the gravels toward the base of the alluvial sequence.

Existing groundwater monitoring data indicates that groundwater within the paleochannel alluvium is generally poor quality in its natural state. Groundwater is moderately saline, with a measured electrical conductivity (EC) range of 2,000 to more than 8,500µS/cm. The pH levels typically range from about 6.8 to 8.5 pH units.

Rainfall infiltration and recharge to the shallow alluvium have historically been very limited over much of the defined paleochannel area due to the widespread occurrence of a thick and impermeable clay layer. Limited recharge is believed to have contributed to the very shallow hydraulic gradients and the poor groundwater qualities (high salinities) observed prior to mining in the existing Carrington Pit area. However, alluvial deposits nearer the river appear to support higher rates of rainfall recharge, suggesting an increase in permeability of the shallower unconsolidated materials (near the river).

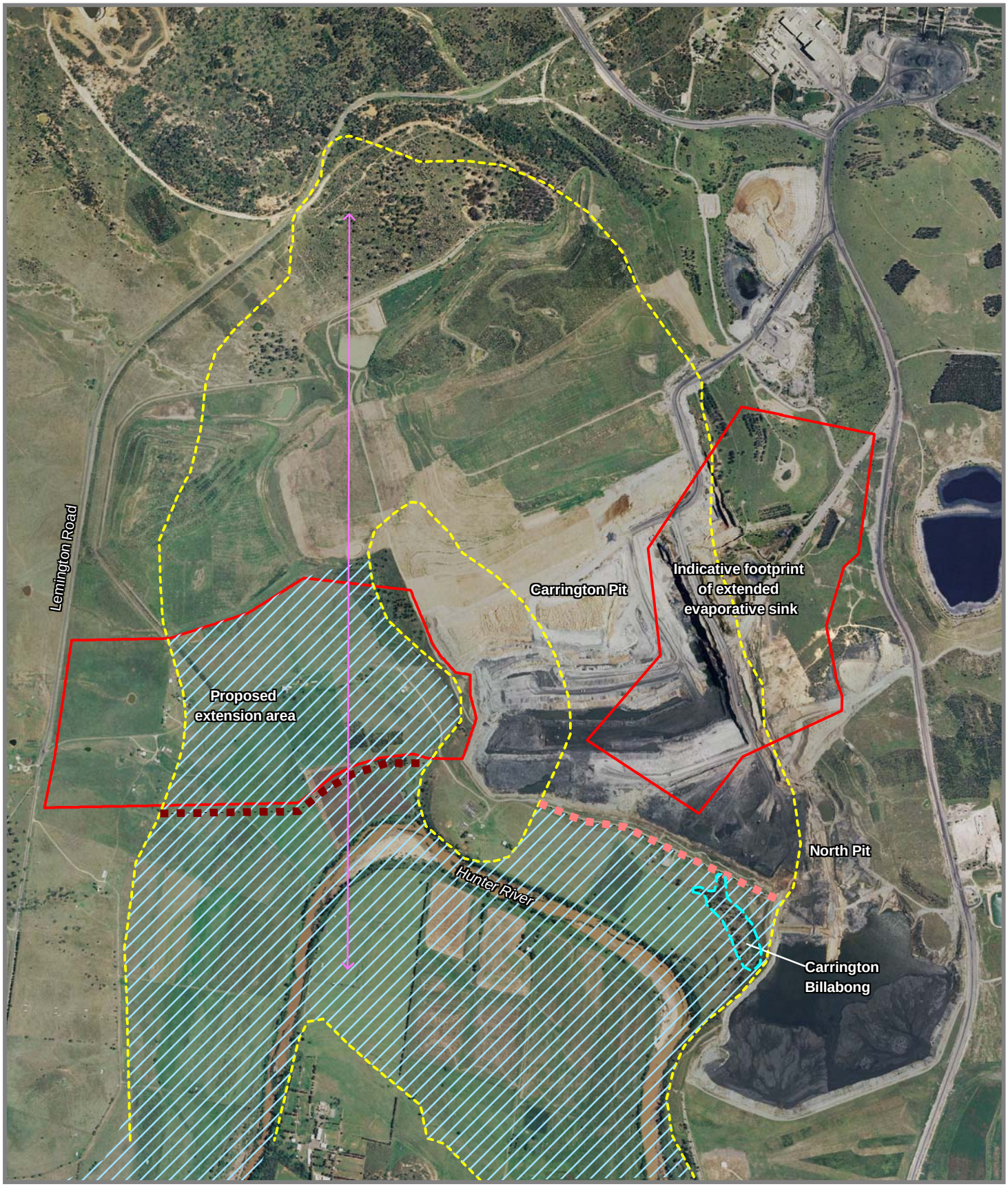
Investigations undertaken by MER in 2005 reported the prevailing hydraulic gradients within the alluvium to be southward (ie, towards the Hunter River) in both the eastern and western arms of the paleochannel. This (saline) groundwater migrated towards and into the Hunter River, where a slight increase in river water salinity (at low flows), could be observed downstream of the paleochannel. A reversal of this gradient as a result of mining was predicted for the eastern channel by about 2007, after which time leakage would be induced from the Hunter River into the alluvium and ultimately into the Carrington Pit. Change to the hydraulic grade in the western and less disturbed channel was expected to be slower. Monitoring has shown these predictions to be accurate with a northward (ie towards the pit) hydraulic gradient now prevailing in both channels.

Beyond the paleochannel, rainfall recharge to the regolith and underlying coal measures is calculated to be very low, based upon the observed water table and the measured permeabilities of the rock strata regionally. Low recharge rates are also evident from inspections of open cut highwalls during dry spells. Minor seepage is generally evident in the shallower strata following rainfall events and commonly associated with fractures, joints and bedding planes.

Overburden emplaced within the pit shell will exhibit different hydraulic properties to the in-situ overburden and coal measures. The emplaced overburden material is generally more permeable and porous due to loosening and fragmentation from excavation. While the overburden materials are reshaped and rehabilitated, they permit rainfall to infiltrate and percolate downwards to the floor of the pit shell. Post-mining this water will steadily rise within the final pit shell and, unless controlled, has the potential to fill and spill from the pit shell. In order to inhibit spillage, a final void evaporative sink was incorporated in the Carrington Pit closure plan. The currently approved evaporative sink is located in the eastern part of existing Carrington Pit.

As with most Hunter Valley coal seams, the coal measures within the project area have a high buffering capacity and relatively low sulphur content, so there is no significant risk from acid rock drainage.

The water source the subject of this assessment is within the Hunter Regulated River Alluvial Water Source, as designated by the *Water Sharing Plan for the Hunter Unregulated and Alluvial Sources 2009*.



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Source: Adapted from Mackie Environmental Research 2010

Paleochannel perimeter

Alluvium

Proposed western barrier wall

Existing barrier wall

Carrington billabong

South - North section - Figure 3.3

0 0.5 1 1.5

Kilometres

Figure 5.1

Key groundwater components

Carrington West Wing

5.2.2 Impact assessment

The potential mining-related impacts on the groundwater systems within the paleochannel and the underlying hardrock regime, have been previously assessed using computer-based aquifer modelling techniques (MER 1999, 2000, 2003, 2004, 2005 and 2007). Two models have previously been employed:

- a single layer model addressing the paleochannel alluvium and the management of seepage and river leakage during mining; and
- a regional four layer model addressing the hard rock coal measures aquifers, cumulative impacts and the magnitude of leakage induced by depressurisation within the coal measures.

These models utilised a finite difference scheme (ModFlow - Surfact). These previous models have been consolidated into a single model utilising the same ModFlow - Surfact code. The updated model has been used to simulate the existing groundwater flow regime and to predict the changes that may occur during mining of the proposed extension area. The model was re-calibrated to historical and recent piezometric monitoring data for both the eastern and western arms of the paleochannel. This process has resulted in a modified permeability distribution for the project area when compared to the prior model(s).

Consideration has been given to the NOW (2005) guideline, *Management of Stream/Aquifer Systems in Coal Mining Developments – Hunter Region*. In accordance with the guideline, no excavation is permitted within 150m of identified connected alluvium to the Hunter River, or within the alluvial materials identified as belonging to the identified Hunter Regulated Alluvial Water Source, without a detailed assessment developed to a standard approved by NOW. This assessment needs to indicate that likely impacts on stream flow, stability and water quality in surface and groundwaters will be negligible. A detailed assessment of the predicted potential impacts on stream flow, stability and water quality has been undertaken and the results are presented in the following sections and in Appendices C and D.

i Seepage

The proposed mining will require the removal of alluvium to access the coal. Saturation within the alluvium currently varies from zero at the northern boundary of the proposed extension area to about 3m deep along the southern boundary where a barrier wall is proposed.

The predicted dry weather seepage rates into the pit from the proposed mining were modelled. The results of the modelling are presented in Table 5.1 for the alluvium and hardrock aquifers respectively. A review of the results indicates a low seepage rate, with a steady increase in mine water seepage as a result of dewatering and stripping of the alluvium north of the barrier wall, from an initial rate of less than 0.01ML/day in Year 1 to about 0.039ML/day in Year 4, then reducing significantly to less than 0.005ML/day. Hardrock seepage into the mine pit is predicted to increase from an initial rate of less than 0.01ML/day to a peak of 0.085ML/day in Year 4 then reducing to 0.073ML/day in Year 6.

Table 5.1 Predicted dry seepage rates

Year	Alluvium (ML/day)	Hardrock (ML/day)	Total seepage (ML/day)
1	<0.010	<0.010	<0.010
2	0.030	0.052	0.082
3	0.039	0.077	0.116
4	0.005	0.085	0.090
5	0.001	0.083	0.084
6	0.001	0.073	0.073

The relatively low seepage rates are attributed to the strata depressurisation already evident around the existing Carrington Pit. It is noted that the hardrock seepage rates represent complete drainage of the mined strata based on porous media flow. In reality, blast fragmentation and handling-emplacement of the waste rock will result in a large component of evaporative loss. Actual seepage contributions to the mine water system are therefore likely to be lower than predicted. However, rainfall recharge through emplaced overburden may contribute an additional 0.25ML/day to pit seepage. In accordance with regulatory requirements, a licence will either be purchased or an existing licence transferred to account for the seepage.

The quality of groundwater entering the mine pit is expected to reflect an average of water quality for the alluvium and coal measures generally. Based on current monitoring, the quality is expected to be in the range of 2,000 to 8,000µS/cm, with a likely average EC of about 4,000µS/cm. All seeped water would remain within the mine water management system.

ii Hunter River base flows and depressurisation

As noted in Section 5.2.1, pre-mining groundwater flows were in a southerly direction towards the Hunter River. The pre-mining dry weather (saline) baseflow contributions from the western arm of the paleochannel to the Hunter River are calculated from numerical modelling to have been approximately 0.22ML/day. Recent monitoring (2010) indicates that flows are now northward towards the existing mining pit (as predicted by MER in 2005). Flow rates in the paleochannel alluvium are estimated to be in the order of 0.2ML/day before barrier wall installation. These flows are sourced predominantly from drainage of porous storage within the alluvium, supplementary rainfall recharge to the alluvium, and a small component from the Hunter River as leakage loss.

The installation of the barrier wall will restrict the northwards leakage through the alluvium. However, subsequent to the installation of the barrier wall, there will still be sustained leakage via the coal measures, where deeper depressurisation induces downwards flow from the alluvium. Induced leakage from overlying alluvium will be at a rate governed by the vertical permeability of the coal measures. Since the vertical permeability is low, the leakage rate is predicted to be low. The water will travel through the hardrock beneath the barrier wall and into the pit shell. The contributions to pit seepage via this pathway are estimated to be about 0.05ML/day from the Hunter River alluvium.

The predicted future loss of Hunter River base flow of 0.05ML/day is calculated to represent 0.3 per cent of the very low river flow condition defined as occurring less than 1 percent of the time. This loss will reduce as water table recovery occurs in the final void. Substantial wet periods, such as the June 2007 event (high rainfall and localised flooding), can be expected to mitigate leakage losses for extended periods of time. Seepage will be offset in accordance with regulatory requirements.

Table 5.2 provides a comparison between predicted impacts from the proposed mine plan against those associated with the approved mine plan, as assessed in 2005 (MER, 2005).

Table 5.2 Comparison of approved and proposed potential impacts on Hunter River/ alluvium seepage

Parameter	Approved mine plan	Proposed mine plan
Seepage from the Hunter River/ alluvium without barrier wall	0.13ML/day by 2010	0.2ML/day
Seepage from the Hunter River/ alluvium with a barrier wall	0.05ML/day	0.05ML/day

As shown in Table 5.2, the potential impacts associated with the proposed mine plan, with the barrier wall installed, are consistent with those predicted for the approved mine plan.

As described in Section 5.2.1, the groundwater salinity within the project area varies between 2,000 and 8,500µS/cm and is considered to have little beneficial use. The proposal will not result in temporary or long term drawdown of alluvial groundwater levels sufficient to degrade groundwater quality, below its current beneficial use class either during mining or into the post-mining period.

iii Final void characteristics

The approved evaporative sink will be extended to comprise a maximum surface area of about 100ha. The proposed long term steady state free standing water elevation for the evaporative sink is 40m above the Australian Height Datum, consistent with previous design criteria. This elevation is approximately 25m below the elevation of the crests of the barrier walls and 20m below the median water level of the Hunter River. Numerical model simulations have confirmed that the nominated free standing water level would ensure that groundwater within the emplaced mine overburden would remain isolated from the Hunter River alluvial lands south of the barrier walls.

Recovery and equilibration to the evaporative sink are expected to take more than 50 years, assuming average rainfall conditions.

An estimate of the final void water quality has been calculated from simple reaction path modelling of the dissolution of typical waste rock sandstones, siltstones and shales. The mineralogy of these rocks has been assessed by X-ray diffraction and found to comprise quartz, feldspar, mixed layer clays (illite-smectite), and carbonate minerals (siderite/ankerite and minor dolomite). Modelled long term water quality is characterised by sodium and calcium concentrations being greater than magnesium (depending on exchange capacity), and sulphate and chloride concentrations being greater than bicarbonate. The pH levels would range from 8.0 to 9.0, while total dissolved solids (TDS) would rise above 1,300 milligrams per litre (mg/L), depending upon mineral availability and type. These results have been compared with previous leachate trials conducted for the Carrington Pit, West Pit and for coarse rejects from the CPPs. Consideration of all available results suggests a long term void water quality exhibiting a pH range from 7.5 to 9.5, and a TDS range from 1,000mg/L, increasing to about 3,000 to 4,000mg/L in the long term. The ion speciated signature is predicted to have sodium concentrations greater than magnesium, which are predicted to be greater than calcium. The bicarbonate concentrations are predicted to be greater than chloride, which in turn would be greater than sulphate concentrations. This is similar to the regional groundwater quality observed in the coal measures. It differs from the pre-mining paleochannel groundwater quality in so far as bicarbonate is more dominant than chloride, ie the void water is less saline.

The void water is predicted to exhibit salinity in the very long term (+50 years) in the order of 3,000 to 4,000mg/L. Since the pit shell and evaporative sink will be isolated from the Hunter River and the adjacent alluvium, and given the natural saline conditions of the paleochannel, it is improbable that water qualities beyond the final pit shell will be measurably affected. If anything, they would be improved due to the reduction in saline groundwater that may occur under natural conditions.

iv Water supply bores and wells

There are no identified private boreholes or wells within the predicted zone of depressurisation and dewatering. The nearest boreholes are located about 2.5km to the south and are constructed in shallow river alluvium.

v Groundwater dependent ecosystems

The only identified groundwater dependent ecosystem in proximity to the proposed extension area, is the population of River Red Gums (*Eucalyptus camaldulensis*) along the bank of the Hunter River and in the Carrington billabong area immediately south of the existing Carrington Pit. There will be no impact on the groundwater water levels within the alluvium hosting this ecosystem.

5.2.3 Management and monitoring

Groundwater management is, and will continue to be, undertaken in accordance with relevant HSEQ Management System procedures and the HVO Water Management Plan. Coal & Allied is committed to continued monitoring, including:

- two-monthly monitoring of water levels in any new standpipe piezometer in proximity to the proposed extension area and quarterly monitoring elsewhere, unless water level changes dictate otherwise;
- daily or more frequent monitoring of pore pressures by installed auto recorders at some existing piezometers, in order to discriminate between oscillatory groundwater movements attributed to rainfall recharge, and longer term pressure losses related to open cut and underground mining; and
- construction of additional piezometers where deemed necessary, as information is generated from within the existing network during the course of mining. Permeability testing will be completed on new piezometers in order to facilitate estimation of leakage and subsurface flows.

Coal & Allied has also committed to continued groundwater quality monitoring including:

- two-monthly or quarterly (depending upon location) monitoring of basic water quality parameters, pH and EC, in existing and any new piezometers; and
- six monthly measurement of TDS and speciation of water samples in piezometers.

Future impact analyses will include the following.

- Where monitoring data shows significant departures from predictions in three consecutive readings, an investigation into the cause will be triggered. This could include a need to conduct more intensive monitoring, eg increased frequency, parameters or additional piezometers, or to these are not investigations.
- Formal review of depressurisation of coal measures and comparison of responses with aquifer model predictions conducted biennially by a suitably qualified hydrogeologist.
- Annual reporting (including all water level and water quality data) in the AEMR.

The proposed management and monitoring measures are consistent with those currently being implemented at HVO, in accordance with Coal & Allied's HSEQ System procedures and the HVO Water Management Plan. Monitoring has demonstrated that management measures implemented for existing operations have been successful and has verified previous groundwater modelling predictions.

Given that the mitigation and management measures proposed are generally consistent with those applied throughout HVO, it is reasonable to assume that these measures can be practically implemented for the proposal.

5.2.4 Conclusions

The groundwater study was based on historical regional and local groundwater data and computer based simulations of aquifer systems in order to assess the potential impacts of the proposal. The data used in the assessment stretches over 10 years and includes recent data collected from a comprehensive drilling programme undertaken specifically for the proposal.

The proposed extension area includes areas of unconsolidated alluvium with highly variable permeability. The groundwater within the paleochannel alluvium is naturally of poor quality with moderate salinity and pre-mining grade towards the Hunter River.

The groundwater barrier wall is a key element of the proposal and accordingly, the assessment was based on the premise that the barrier wall would be constructed prior to mining.

During the six year mining period, modelling predicts a steady increase in mine water seepage from the alluvium as a result of dewatering and stripping of the alluvium north of the barrier wall, from an initial rate of less than 0.01ML/day in Year 1 to about 0.04ML/day in Year 4, and declining after this time. Hardrock seepage into the mine pit is predicted to increase from an initial rate of less than 0.01ML/day to a final rate of 0.073ML/day. The relatively low seepage rates are attributed to the strata depressurisation already evident around Carrington Pit. Seepage to pit will remain within the mine water management system, and will be offset in accordance with regulatory requirements.

Subsequent to the installation of the barrier wall, some northward leakage would continue to occur via the coal measures, where deep regional depressurisation induces downwards flow from the alluvium. This is predicted to result in an impact on the Hunter River baseflow (leakage) of approximately 0.05ML/day. This depressurisation would occur under the existing approved Carrington Pit and therefore the predicted loss would apply with or without the extension.

The predicted future Hunter River base flow loss of 0.05ML/day is calculated to represent 0.3 per cent of the very low river flow condition, defined as occurring less than 1 percent of the time. This loss will reduce as water table recovery occurs in the final void. Substantial wet periods, such as the June 2007 event (high rainfall and localised flooding), can be expected to mitigate leakage losses for extended periods of time. Seepage will be offset in accordance with regulatory requirements.

The predicted seepage from the Hunter River associated with the modified mine plan is consistent with the predictions made for the approved mine plan.

The proposed extension of the approved evaporative sink will avert the potential for ‘fill and spill’ from the backfilled pit shell. No measureable effects on groundwater quality or impacts to known water supply bores, wells or groundwater dependent ecosystems are predicted.

Groundwater management and monitoring commitments will be implemented, including establishment of benchmarks against which impacts can be measured, trigger action protocols developed and mitigative actions initiated.

5.3 Surface water

This section provides a summary of the surface water study which was prepared by WRM Water & Environment and Water Solutions to assess the potential impacts of the proposal on surface water. A copy of the detailed technical report is presented in Appendix D.

5.3.1 Existing environment

The HVO North complex is located partly on the Hunter River floodplain and partly on the adjoining hillslopes. The Hunter River has a catchment area of approximately 13,400km^2 to HVO. The catchment extends some 110km to the north and 140km to the west and includes the major tributaries of the Pages River, Dart Brook and the Goulburn River.

At its nearest point, the Hunter River is approximately 250m south of the proposed extension area. In the vicinity of the Carrington Pit it has a base width of between 80m and 150m and is about 10m deep. The river floodplain varies in width from 700m to about 1.7km in the vicinity of HVO North. The proposed extension area is located on the northern floodplain of the Hunter River. Levees are currently used to prevent Hunter River floodwater from entering areas of the existing mine. The existing licensed levees at HVO North are shown in Figure 3.2.

A local catchment of 13.75km^2 drains the project area via the Unnamed Tributary, as well as some minor tributary channels to the Hunter River, as shown in Figure 3.2.

The mean annual rainfall, as measured at the Jerrys Plains Post Office monitoring station, is 643 millimetres (mm). Mean annual evaporation at the same location is 1613mm, which is more than double mean annual rainfall.

The Liddell stream flow gauge is located approximately 7km upstream of HVO North. Data has been collected at Liddell since 1969. The volumetric runoff coefficient (rainfall to runoff relationship) of the Hunter River flows to Liddell is approximately 4 per cent. Flow is non-zero almost 100 per cent of the time, which is characteristic of regulated river systems. Very little runoff is generated by the catchment when annual rainfall is less than about 400mm. Once annual rainfall exceeds this value, the volume of surface runoff increases substantially.

Surface water quality is monitored for HVO at 22 locations, in on-site dams and surrounding natural watercourses, including the Hunter River. The monitoring is managed under the HSEQ Management System and reported to government agencies annually through the AEMR. Two water quality sampling locations on the Hunter River are located immediately upstream and downstream of the proposed extension area, respectively. A comparison of results from these sampling locations indicates that there is no significant change in water quality between them. The results of water quality monitoring at these locations for 2008 are summarised in Table 5.3.

Table 5.3 Water quality monitoring results, Hunter River

Parameter	Range		Annual average	
	Upstream	Downstream	Upstream	Downstream
pH	8.1-8.7	7.9-8.7	8.2	8.2
Electrical conductivity (µS/cm)	340-1200	330-1,220	804	823
Total suspended solids (mg/L)	12-246	7-240	62	62

The Unnamed Tributary which traverses the proposed extension area is ephemeral and subject to gully erosion. It lacks any significant riparian vegetation, and the majority of the channel is devoid of native vegetation. Natural hydrological regimes of the Unnamed Tributary are likely to have been significantly altered by historic and ongoing disturbances such as clearing and grazing, and its upstream reaches have been subject to previous diversions and realignments. At its downstream end, the Unnamed Tributary is a fourth-order stream, based on the Strahler system of stream order classification. However, the stream is ephemeral, and effectively functions as a lower order stream.

The existing HVO mine water management system, which incorporates Carrington Pit, is operated in accordance with the HVO Water Management Plan, last updated in September 2009. The key objectives of the Plan are as follows:

- divert clean surface water runoff away from areas disturbed by mining activities;
- collect surface water runoff from areas disturbed by mining activities, to control suspended sediment prior to runoff from site or re-use via the mine water management system;
- transfer open cut pit water to storage dams for re-use in the mine water management system;
- maximise the re-use and recycling of stored water on site, especially for use as the process supply to the CPPs and other related activities;
- use stored water for dust suppression on haul roads, trafficable areas and stockpiles;
- minimise extraction of water from the Hunter River during dry and drought periods; and
- minimise offsite discharge under the HRSTS during wet periods.

The HVO Water Management Plan and the ERM (2003) EIS include details of water management structures and dams. The proposal does not involve any changes to the existing water management system beyond the proposed diversion of the Unnamed Tributary, levee construction and evaporative sink extension, which are described and assessed in this EA.

The HRSTS was introduced by the NSW Government to reduce salinity levels in the Hunter River. It operates under the *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002*. The HVO North participates in the HRSTS. Under the Scheme, credit holders are permitted to discharge saline water to the Hunter River on a managed basis, during periods of high river flows. A total of 1,000 credits are available for allocation through the scheme. In the 2009/ 2010 period HVO held an allocation of 139 credits. If the discharge criteria were met, water was permitted to be released from three of HVO's dams, at a rate of up to 130ML/day, 120ML/day and 100ML/day respectively, regardless of where it was generated.

5.3.2 Impact assessment

i Hunter River flooding

The proposal is potentially affected by regional flooding from the Hunter River to the south and local flooding from the Unnamed Tributary. Temporary levees, referred to as the Stage 1 (Years 1 to 3) and Stage 2 (Years 4 to 6) levees, as described in Section 3.2.2 ii and shown on Figure 3.2, are proposed to protect the extension area from flooding.

Design flood discharges for the Hunter River were estimated from an annual series flood frequency analysis of recorded flows. The XP-RAFTS rainfall runoff routing model was used to estimate design flood discharges for the Unnamed Tributary. The TUFLOW two-dimensional hydraulic model (WBM, 2008) was used to simulate the flow patterns of the Hunter River channel and floodplain adjacent to HVO North.

The existing, Stage 1 and Stage 2 models were used to determine design flood levels, depths, extents and velocities on the floodplain adjacent to the proposed extension area for the 2, 5, 10, 20, 50 and 100 year ARI design floods and the impacts of the proposed levees on adjoining properties. Tables and figures detailing the outputs from the models can be found in Appendix D.

The modelling predicted that the greatest change to flood levels as a result of the proposal would be a 0.1 to 0.14m increase in flood levels for the 100 year ARI event, at some locations on Coal & Allied owned land. There are no buildings located within this 'zone of impact', and these changes are not significant, particularly when considering the existing flood depths at these locations, which are generally around 5m to 6m. Changes to flood levels at all properties upstream and downstream of the project area as a result of the proposal are predicted to range from zero to less than 0.05m. The modelling took into account the effects of existing levees on the Hunter River floodplain. As an example, modelling by Llyall and Associates (2005) found that the levees at HVO North, which were assessed and approved as part of the 2005 Statement of Environmental Effects (SEE), would result in a maximum 0.06m increase in flood levels at an area upstream of one of the levees, with smaller changes in flood levels at other locations.

At the conclusion of mining, the levees would be removed and the ground levels across the proposed extension area returned as close as possible to the pre-mining landform. Therefore, the existing conditions model would represent the 'End of Mine' scenario. There would be no flood impacts resulting from the proposal at the end of mine life.

In summary, the main findings from the flood assessment are as follows.

- The Stage 1 and Stage 2 flood levees would effectively prevent flooding of the proposed extension area for events up to the 100 year ARI event.
- Runoff from the Unnamed Tributary catchment would be effectively conveyed around the levees by the proposed diversion. The proposed diversion would effectively convey the 10 year ARI within its banks.
- The 2 year ARI Hunter River design flood would generally be confined to the main channel. The Hunter River flood flows would exceed the capacity of the channel and inundate the floodplain in the vicinity of the proposed extension area for the 5 year ARI design event.
- There is negligible impact on flood levels along the Hunter River main channel for floods up to the 10 year ARI design flood, and a minor impact on the floodplain immediately adjacent to the proposed levee for the 10 year ARI design flood.
- The extent of the flood impact for the 100 year ARI design flood is confined to Coal & Allied owned land on the Hunter River floodplain immediately south of the proposed levee. The 100 year ARI flood levels along the proposed diversion drain would be up to 0.14m higher than existing conditions. It is expected that elevated flood levels would remain in these areas for 12 hours to 48 hours, depending upon the duration and severity of the flood event.
- Flood velocities along the Hunter River channel, with the levees in place, would generally remain unchanged from existing conditions.

ii Change in surface water runoff volume

The volume of surface runoff water entering the mine water management system is dependent on rainfall and the catchment areas of the open pits, active overburden emplacement areas, industrial areas and rehabilitation areas, which can vary considerably over the life of the proposal.

The expected removal of Hunter River catchment due to mining and the associated average annual runoff volume reductions are presented in Table 5.4. The volume of surface water runoff from the various catchment areas encompassed in the mine water management system was estimated using the OPSIM model. This model is used to assess the dynamics of the site water balance under conditions of varying rainfall and groundwater seepage. The model operates on a daily time-step and includes rainfall, runoff, groundwater inflows, evaporation and site water demands, as well as interactions between the various mine storages. For comparison, Table 5.4 also includes the average annual flow in the Hunter River, at the closest gauging station.

Table 5.4 shows that the relative reduction in the Hunter River flows due to the proposal would be small compared to the total flows in the Hunter River. It is proposed that the catchment removed due to mining will be largely rehabilitated at the end of the life of the proposal.

Table 5.4 Catchment diversion and loss of runoff, Hunter River

Scenario	Catchment loss (ha)	Average Annual Catchment Runoff Reduction (ML/annum)	Average Annual Hunter River Volume (ML/annum)
Years 1 – 3	155.4	136	421,000
Years 4 - 6	90.4	79	

iii Change in runoff water quality

Land disturbance associated with mining has the potential to adversely affect the quality of surface runoff through increased sediment loads. In addition, runoff from active mining areas (pits, roads, coal stockpiles, etc.) and overburden emplacements may have increased salinity compared to natural runoff. The measures set out in Section 5.3.3 will be implemented to minimise potential impacts to water quality. The proposed management measures will ensure no measurable adverse impacts on riparian and ecological values of watercourses on the site and downstream of the project.

iv Unnamed tributary diversion

The proposed diversion of the Unnamed Tributary to be undertaken concurrent with the construction of the Stage 2 levees, is described in Section 3.2.2 iii and shown in Figure 3.2. The diversion will be some 50 per cent longer than the existing Unnamed Tributary channel. The channel slope, and therefore erosion potential, will be approximately half that of the existing channel. Further, the bed slope at the downstream confluence will be approximately one sixth of the existing channel bed slope. For this reason, no hard engineering erosion protection measures are proposed for the diversion. The soil profile below the channel will be reinstated with a suitable growing medium and the channel will be vegetated with grasses. As stated previously, the proposed diversion would effectively convey runoff from the Unnamed Tributary catchment around the levees, and would convey the 10 year ARI flood event within its banks.

At the end of the proposed extension area life, the levees will be removed and the Unnamed Tributary channel will be reinstated to its original position. The end-of-mine Unnamed Tributary channel will be constructed to be a similar shape to existing conditions, subject to detailed design considerations.

v Post-mining water management

The final landform is described in Section 3.2.3. Rehabilitation will be undertaken progressively across the mined area and will incorporate surface water management considerations. It will be undertaken in accordance with the REMP/ MOP, as required by the *Mining Act 1992*.

The final void evaporative sink, located in the northern section of the existing Carrington Pit, has been designed to facilitate evaporative losses at a rate which is greater than the accumulation of groundwater within the pit shell, rainfall runoff and infiltration through the rehabilitated final landform. The evaporative sink will need to be extended to accommodate the proposal. As described in Section 5.2.2 iii, it is proposed that this void surface area be extended to a maximum surface area of around 100ha. The environmental implications of the extended evaporative sink are dealt with in Section 5.2 of this document.

vi Additional pit water

Additional pit water would be generated by the collection of surface water runoff from areas draining to the open cut pit area and groundwater inflow to the pit. The management of water in the proposed extension area would essentially be the same as for the existing operations. All water accumulated in the pit will be re-used and recycled in the HVO mine water management system.

An assessment of potential impacts on the HVO North surface water management system has been undertaken, using a computerised water balance simulation model known as the OPSIM model. This included simulation of controlled discharges in accordance with the requirements of the HRSTS. This assessment found that the proposal is expected to have little impact on the existing HVO water management system and discharges should be in compliance with the HRSTS. There are no substantial changes proposed to the HVO water management system to accommodate the proposal.

vii Hunter River erosion

The hydraulic modelling conducted for this proposal shows that flood levels and flood velocities along the Hunter River channel would be virtually unchanged by the proposal for events up to and including the 100 year ARI event. On this basis, there would be no increase in erosion potential of the Hunter River channel as a result of the proposal. However, the Hunter River channel adjacent to the proposed extension area is located on an alluvial floodplain and is poorly aligned and is therefore susceptible to erosion under existing conditions.

The hydraulic model has been used to determine the potential changes in the Hunter River channel over time. Historical aerial photographs have been obtained of the area to determine the historic changes that have occurred to the channel, in an attempt to verify the findings of the hydraulic model.

Assuming the current rate of erosion of 10 to 15m over 46 years, as was estimated from the aerial photographs, it would take between 521 and 782 years for the Hunter River to reach the groundwater barrier wall. However, the geomorphologic assessment indicates that a new channel would almost certainly be created in a similar location to the existing channel before this occurred. The hydraulic model results support this view. In other words, the risk that the Hunter River could continue to erode northward to reach the groundwater barrier wall is considered extremely low to unlikely, and in any event would not be attributable to the proposal.

5.3.3 Management and monitoring

Surface water management and monitoring at HVO North, inclusive of the proposal, will continue to be undertaken in accordance with the HSEQ Management System. There are no substantial changes proposed to the HVO water management system due to the proposal.

Management measures will include the following.

- Water quality monitoring will be continued.
- The HVO water balance model will be regularly updated to ensure currency with the operational configuration of the mine water management system.
- Runoff from undisturbed catchments will be diverted away from disturbed areas using surface drains.
- Surface runoff from disturbed areas will be treated through sedimentation basins prior to discharge from the site. All new sediment dams and water management systems will be designed in accordance with relevant standards.
- Sedimentation basins will be used to treat surface runoff from rehabilitated areas until the quality of runoff is suitable for release. These will be maintained or constructed as required and will be designed in accordance with relevant design standards.
- Saline water from mining related activities will be collected within the mine water management system. Discharges will be managed in compliance with the HRSTS.

As mentioned in Section 3.2.2 iii, detailed design plans for the temporary diversion and reinstatement of the Unnamed Tributary will be provided in a Management Plan to be developed in consultation with NOW and I&I NSW. The Management Plan would include details of:

- existing and proposed channel alignment, longitudinal section and cross-sections;
- proposed locations of cut and fill;
- sediment and erosion control measures to be implemented during construction;
- proposed revegetation of the channel bed, banks and riparian zone;
- a proposed monitoring regime to ensure ongoing stability and ecological health of the stream, which would include periodic inspection for erosion or deposition and a photographic record of key cross-section locations, supplemented by ground survey if instability is detected; and
- contingency measures to be implemented to address any observed issues with establishment of the modified channel.

Conceptual design criteria for the Unnamed Tributary are provided in Section 3.7 of the surface water study presented in Appendix D.

5.3.4 Conclusions

The Stage 1 and Stage 2 flood levees will effectively prevent flooding of the proposed extension area for events up to and including the 100 year ARI event. The 100 year ARI flood levels along the proposed levees would be within 0.14m of existing conditions, and changes to flood depths at properties upstream and downstream of the project area are predicted to be zero to less than 0.05m. The proposed post-mining removal of the levees and reinstatement of ground levels will ensure that there will be no flood impacts resulting from the proposal at the end of mine life.

There would be no increase in erosion potential of the Hunter River channel as a result of the proposal.

All water accumulated in the pit in the proposed extension area will be re-used and recycled in the HVO mine water management system. It is expected that the proposal would have little impact on the existing HVO water management system and water releases into the Hunter River could be managed in compliance with the HRSTS.

During the life of the proposed extension, relative reduction in the Hunter River flows due to the proposal would be small compared to the total flows in the Hunter River.

Management measures will be implemented to ensure there are no measurable adverse impacts on riparian and ecological values of watercourses within or downstream of the project area.

5.4 Soils and land classes

This section provides a summary of the soils and land resource study prepared by GSS Environmental, which is presented in full in Appendix E.

5.4.1 Existing environment

i Soils

Following the collection and collation of existing data and maps on soils, land capability and agricultural suitability for the area, a site inspection was undertaken to classify the soil profile types within the proposed extension area. The following soil units and extents were identified within the proposed extension area.

- Brown Uniform Silty Clay Loam, covering 32 per cent, or 43.9ha.
- Brown Uniform Silty Clay, covering 42 per cent, or 56.8ha.
- Red Brown Duplex Loam, covering 26 per cent, or 36.1ha.

ii Land capability

A land capability assessment was conducted in accordance with DECCW's rural land capability classification system. This classification system identifies eight possible land classes, with land capability decreasing progressively from Class I to Class VIII.

The proposed extension area encompasses Class II, III, IV and V lands. The central portion of the proposed extension area contains 65.0ha of Class II land. The western portion of the proposed extension area is classified as Class III (44.0ha). Both are suitable for a range of agricultural uses, including regular cultivation. The eastern portion of the proposed extension area is classified as Class IV land (23.9ha).

Class IV land comprises the better classes of grazing land and whilst it can sustain cultivation for an occasional crop, it is not suitable for cultivation on a regular basis owing to limitations of erosion potential. In addition, there is a small portion of Class V land (3.9ha) in the south-west corner of the proposed extension area which is unsuitable for cultivation on a regular basis, however, the land can sustain grazing and occasional cultivation, provided structural soil conservation works are in place.

The proposed out-of-pit emplacement areas comprise Class III, IV and VI lands. Class III land (22.2ha) is located on the lower to flat slopes. The eastern and central northern portions of the emplacement areas are classified as Class IV land (16.4ha).

Figure 5.2 shows the areal extents of the various land capability classes pre-mining.

iii Agricultural suitability

An agricultural suitability classification system was also used to assess the land. There are five classes, providing a ranking of lands according to their relative productivity for a range of agricultural activities. Class 1 is the most productive and Class 5 the least productive.

The majority of the proposed extension area is classified as Class 2 or 3 agricultural suitability, covering areas of 65.0ha and 67.9ha respectively. Class 2 land includes highly productive land suited to both row and field crops, however, it is not suited to continuous cultivation. It is associated with Brown Uniform Silty Clays and Loams of the lower flat slopes in the central southern portion of the proposed extension area. Class 3 land includes moderately productive lands suited to improved pasture and cropping within a pasture rotation. Class 3 lands are predominantly located in the eastern and western portions of the proposed extension area on mid to lower slopes. Class 4 land covers 3.9ha and includes marginal lands not suitable for cultivation and with a low to very low productivity for grazing. These lands are located in the south-eastern portion of the proposed extension area on mid to upper slopes.

The proposed out-of-pit emplacement areas comprise Class 3 and 4 agricultural suitability, covering areas of 38.6ha and 19.6ha, respectively. Class 3 lands are predominantly located in the southern and western portions of the emplacement areas on flat to low sloping areas. Class 4 lands are located in the northern portion of the emplacement areas on the mid to upper slopes.

Figure 5.3 shows the distribution of the agricultural suitability classes pre-mining.

5.4.2 Impact assessment

i Land capability

A comparison of the areas of rural land capability classes pre and post-mining is provided in Table 5.5 and Table 5.6 for the proposed extension area and out-of-pit emplacement areas, respectively. These areas are shown on Figure 5.2.

Table 5.5 Pre and post-mining rural land capability classes – proposed extension area

Land Class	Pre-mining		Post-mining	
	ha	%	ha	%
Class II	65.0	48	65.0	48
Class III	44.0	32	64.6	47
Class IV	23.9	17	7.2	5
Class V	3.9	3	0	0
Total	136.8	100	136.8	100

As can be seen from Table 5.5 and Figure 5.2, the proposed extension area is predominately Class II, III and IV rural land prior to mining. The proposed post-mining rehabilitation will restore land capability of the proposed extension area to be generally similar to or better than the existing rural land capability classification. Class II land will be rehabilitated back to Class II capability post mining. Class III land will be rehabilitated back to Class III land, with a small area rehabilitated to Class IV. Class IV land will be rehabilitated to Class III, which constitutes an increase in capability from its pre-mining state, and similarly, Class V land will be transformed to Class IV land.

Table 5.6 Pre and post-mining rural land capability classes – out-of-pit emplacement areas

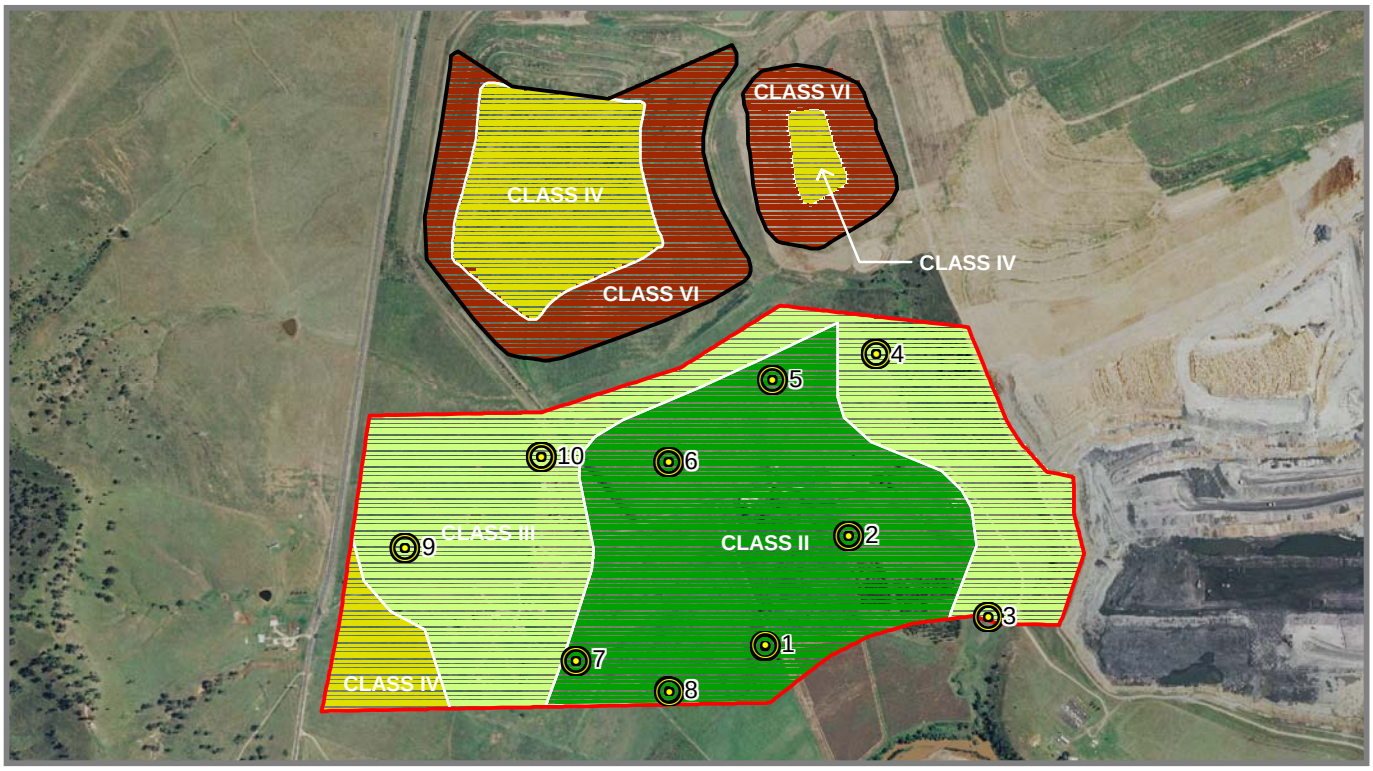
Land Class	Pre-mining		Post-mining	
	ha	%	ha	%
Class III	22.2	38	0	0
Class IV	16.4	28	23.1	40
Class VI	19.6	34	35.1	60
Total	58.2	100	58.2	100

As indicated in Table 5.6, the post-mining land capability classification of the out-of-pit emplacement areas differs to the existing land capability classification, as would be expected. An estimated 38 per cent of the out-of-pit overburden emplacement areas are Class III land prior to mining. An increase in slope will result in this land being transformed into Class IV and VI land post-mining. The rehabilitated land will require appropriate management measures, including the introduction of stock control and fertiliser application, to ensure ground cover is maintained. It is noted that the proposed rehabilitation strategy includes restoration of both agricultural and biodiversity values of the land, and accordingly, in addition to the proposed agricultural land uses, considerable portions of the out-of-pit emplacement areas are proposed to be rehabilitated with woodland.

ii Agricultural suitability

A comparison of the areas of each agricultural land class pre and post-mining is provided in Table 5.7 and Table 5.8 for the proposed extension area and the out-of-pit emplacement areas, respectively. These areas are shown on Figure 5.3.

Pre-mining



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0 500 1000

Metres

Post-mining

Out-of-pit overburden emplacement areas

Proposed extension area

Soil test pit locations

Land Capability

Class II

Class III

Class IV

Class V

Class VI

Figure 5.2

Pre and post-mining land capability classes

Carrington West Wing

Pre-mining

Post-mining

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0 500 1000

Metres

Out-of-pit overburden emplacement areas

Proposed extension area

Soil test pit locations

Agricultural suitability

Class 2

Class 3

Class 4

Figure 5.3

Pre and post-mining agricultural suitability classes

Table 5.7 Pre and post-mining agricultural land suitability – proposed extension area

Land Class	Pre-mining		Post-mining	
	ha	%	ha	%
Class 2	65.0	48	65.0	48
Class 3	67.9	50	64.6	47
Class 4	3.9	3	7.2	5
Total	136.8	100	136.8	100

Note. Some figures are not exact due to rounding.

Table 5.7 shows that the proposed post-mining agricultural suitability classification is similar to the existing agricultural suitability classification, comprising predominately Class 2 and Class 3 lands. The only change to agricultural suitability classification proposed is a transformation of approximately 3ha of the Class 3 land to Class 4 land. Class 4 land has low to very low productivity for grazing and is not suitable for cultivation.

Table 5.8 Pre and post-mining agricultural land suitability – out-of-pit emplacement areas

Land Class	Pre-mining		Post-mining	
	ha	%	ha	%
Class 3	38.6	66	23.1	40
Class 4	19.6	34	35.1	60
Total	58.2	100	58.2	100

The data in Table 5.8 shows that the proposed post-mining agricultural suitability classification of the out-of-pit emplacement areas differs to the existing agricultural suitability classification, in that approximately 26 per cent of the land will be transformed from Class 3 into Class 4 land. Whilst still marginally productive, Class 4 land is unsuitable for cultivation. It is suitable for low productivity grazing.

iii Topsoil

Laboratory soil analytical results were used in conjunction with the field assessment to determine the depth of soil material suitable for recovery and re-use as a topdressing material in rehabilitation. The recommended stripping depth and land area for each soil unit, together with the volume available for respreading are provided in Table 5.9.

Table 5.9 Recommended soil stripping depths, areas and volumes

Soil unit type	Recommended stripping depth (m)	Area (ha)	Volume (m^3)
Brown Uniform Silty Clay Loam	1.00	43.9	439,000
Brown Uniform Silty Clay	0.20	56.8	113,600
Red Brown Duplex Loam	0.10	36.1	36,100
Total			588,700

Allowing for a 10 per cent handling loss, approximately 529,830 cubic metres (m^3) of suitable topdressing will be available for the proposed extension area.

5.4.3 Management and monitoring

In order to reduce the potential for soil degradation within the proposed extension area and adjoining lands, management and mitigation strategies for the stripping, handling and use of topsoil, landform design, erosion and sediment control and seedbed preparation will be implemented to achieve the desired post-mining land capability and agricultural suitability outcomes. The detailed rehabilitation plans, consistent with Figure 3.4, will be documented in the REMP/ MOP, and will be tracked for progress in the AEMR.

In addition, a detailed Topsoil Management Plan will be prepared prior to any disturbance, to document topsoil management procedures to be implemented to help achieve the desired rehabilitation outcomes. Coal & Allied's experience at the adjacent Alluvial Lands, where 63ha of land was successfully rehabilitated to Class 1 and 2 lands, with crop yields at least equivalent to those on nearby farms, evidences that this rehabilitation plan is achievable. This would be subject to careful land management and considerable investment by Coal & Allied.

5.4.4 Conclusions

The project area is located over lands owned by Coal & Allied. An assessment of the potential change in land capability and agricultural suitability of these lands as a consequence of the proposal was undertaken.

Land capability for most of the proposed extension area was identified as Class II and III, both of which are suitable for a range of agricultural uses. Post mining, this land will be rehabilitated back to similar to the existing capability. The majority of the out-of-pit overburden emplacement areas are Class III and VI land prior to mining. This land will be transformed into Class IV and VI land post-mining, which will require land management practices to ensure maintenance of ground cover.

Nearly 50 per cent of the proposed extension area is Class 2 agricultural land prior to mining. This land will be transformed back into Class 2 land post-mining. Extensive land and soil management and investment by Coal & Allied are proposed to achieve this rehabilitation outcome. An estimated 60 per cent of the out-of-pit overburden emplacement areas, post-mining, will be Class 4 land, and the remainder will be Class 3 land. Class 4 land is still marginally productive, suitable for low productivity grazing.

5.5 Noise and vibration

This section provides a summary of the environmental noise and vibration study prepared by EMGA Mitchell McLennan, which is presented in full in Appendix F.

5.5.1 Existing environment

The closest privately owned residences are west and south west of the project area and include one property on Lemington Road and several others along the Golden Highway (see Figure 5.4). The existing ambient noise environment at these properties is typical of rural residential locations, with influence from agricultural activities, road traffic noise, existing mining noise and natural sounds. Coal & Allied operates a network of noise monitoring equipment in and around HVO North, which provides data on existing noise levels in the local area. Coal & Allied also operates two weather monitoring stations at HVO. Local noise level and weather monitoring data are provided in the AEMRs.

5.5.2 Impact assessment

i Criteria

The Development Consent No. DA 450-10-2003 prescribes noise and blasting criteria for the existing operations, including land acquisition limits. These limits are presented in the subsequent sections.

ii Assessment approach

The noise assessment was prepared in accordance with the DECCW (2000) *Industrial Noise Policy* (INP).

The Environmental Noise Model (ENM) software was used for modelling noise emissions. This modelling software is accepted by DECCW for this purpose and takes into account distance, ground effects, atmospheric absorption and topography.

The Carrington Pit was assessed as part of the broader HVO North operations in the ERM (2003) EIS. A similar approach has been adopted for modelling and assessment for the proposal. Two operating scenarios were modelled to cover the life of the proposal, comprising operational Years 1 and 5 of the planned six years of mining. Corresponding operating years for other pits within HVO North were also included in the model. These were Year 8 and Year 14 of the modelling undertaken by ERM (2003), as these are considered to be the closest match to the expected operations during Years 1 and 5 of mining within the proposed extension area.

The mine plans and equipment locations used in the noise modelling are the worst-case operating scenarios in terms of potential noise impacts. Further, the results assume all modelled plant and equipment operate simultaneously, which in practice, is unlikely to occur. This allows a conservative assessment of the potential impacts from the proposal on the area surrounding the mine.

It is noted that specific assessment of construction noise was not undertaken as any construction-related activities will form part of the mining operations, as assessed, and accordingly, the more stringent criteria for operational noise will apply.

iii Representative receptors

A total of 13 receptors were considered representative of assessable locations surrounding the project area. The locations of these receptors are shown on Figure 5.4 and described in Table 5.10**.** Of these 13 representative receptors, nine are private residential receivers or representatives thereof (Receptors No's 1 through to 6 and 13, 14 and 39), whilst the others are owned by other mines, are within existing mine noise affectation zones or are subject to a private landholder agreement. The receptor numbering convention is consistent with the ERM (2003) EIS, and has also been adopted for the air quality assessment (Section 5.6). The noise and vibration study in Appendix F includes a figure which shows the locations of all receptors at Jerrys Plains. This figure illustrates that the representative receptors selected include the private residence in Jerrys Plains which is closest to the proposed extension area (Receptor No. 1), as well as a representative residence near the centre of Jerrys Plains (Receptor No. 13) and another near its northern limit (Receptor No. 14).

Table 5.10 Representative receptors

Receptor No.	Property Owner	MGA coordinates Easting	Northing	Direction from HVO North
1	Hayes (Jerrys Plains closest residence)	304370	6402057	SW
2	Skinner	305031	6401340	SW
3	Gee	305309	6401091	SW
4	Muller	306145	6399742	S
5	Bowman	317920	6399141	SE
6	Moxey	318008	6399952	SE
7[1]	Stapleton	315949	6403170	SE
8[3]	Ravensworth Operations Owned	313683	6403978	SE
10[2]	Moses	306916	6402126	SW
11[3]	Wambo Owned	307123	6399079	S
13[4]	Jerrys Plains Centre	303294	6402832	W
14[4]	Jerrys Plain North	302484	6403431	W
39	Warkworth Village Representative	314396	6394821	S

1. *These private residences are currently inside a zone of affectation or subject to a private land holder agreement with mines other than HVO.*
2. *These private residences are currently inside a HVO zone of affectation.*
3. *Mine owned.*
4. *Additional Jerrys Plains receptors were added to those used in the ERM (2003) EIS, to provide a better representation of the area.*

iv Calm weather results

Table 5.11 summarises the noise modelling results for calm weather conditions. These results show that mine operations will satisfy consent noise limits during calm weather conditions at all private residences that are not already within a zone of affectation. The reduction in noise levels from Year 1 to Year 5 of mining is attributable to the proposed completion of mining operations in the existing Carrington Pit by this time.

C:\GIS\EMGA\9016 Carrington West Wing Modification\Figures\May 2010

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Kilometres

Representative receptor

Proposed extension area

HVO South project approval boundary

HVO North current development consent boundary

Figure 5.4

Representative receptors

Carrington West Wing

Table 5.11 Predicted noise levels under calm weather conditions - Leq,15minute dB(A)

Location	Day, evening and night time noise levels		Consent limits
Receptor No.	Year 1	Year 5	Day/Evening/Night
1	20	19	38-40
2	21	20	39
3	23	21	39
4	30	27	36-40
5	21	19	35
6	20	17	35
7[1]	30	29	36-40
8[3]	35	34	NA
10[2]	48	45	NA (Acquisition)
11[3]	31	30	39
13[4]	14	10	40
14[4]	12	9	40
39	16	10	35

1. *These private residences are currently inside a zone of affectation or subject to a private land holders agreement with mines other than HVO.*
2. *These private residences are currently inside a HVO zone of affectation.*
3. *Mine owned.*
4. *Additional Jerrys Plains receptors were added to those used in the ERM (2003) EIS, to provide a better representation of the area.*

v Adverse INP weather condition results

Under various wind and temperature gradient conditions, noise levels may increase or decrease compared with calm conditions, ie zero wind and negligible temperature gradient. This is due to refraction of sound propagating through the atmosphere, brought about by a change in sound speed with height. Sound levels increase when the wind blows from source to receiver or under temperature inversion conditions and decrease when the wind blows from receiver to source or under temperature lapse conditions.

The predicted noise levels for adverse INP weather conditions (i.e. occur more than 30 per cent of the time) are provided in Table 5.12. It is noted that these adverse INP weather conditions only occur during the night time. The modelling results indicate that without mitigation, noise levels are predicted to exceed the consented operational noise limits at eight of the assessed locations. With respect to the consent acquisition limits, for Year 1, conservative predictions for HVO North are up to 4 decibels (dB) higher than the acquisition limits for Receptor No's 1 to 3, up to 3dB higher for Receptor No.13 and 2dB over for Receptor No.14.

The noise and vibration study found that operations at the proposed extension area would be a relatively minor contributor to the predicted noise levels at these receptors, and at Jerrys Plains in general. Notwithstanding, a review was undertaken by Coal & Allied which considered operating a reduced fleet and operating some plant in-pit during adverse INP weather conditions at night, in order to reduce noise levels. Modelling of the mitigated scenario was then undertaken, and included standing down or relocating a range of plant.

Modelling results for the mitigated scenario are provided in Table 5.12 and indicate that a reduction in received noise levels could be achieved. With these controls in place during adverse winds (which are a

feature during the night period only), noise levels are predicted to satisfy or be within 2dB of the operational consent levels at all assessed locations, and the consent acquisition levels are predicted to be satisfied at all privately owned residences that are not already within a zone of affectation. Noise differences of less than around 2dB are generally imperceptible to the human ear. Contour diagrams presented in Appendix F provide a picture of worst case predicted noise levels across the broader area. Significantly, the predicted mitigated noise levels from the combined Carrington and West Pit operations during adverse INP weather conditions are unchanged or lower than those assessed and approved as part of the ERM (2003) EIS at all representative receivers, including those at Jerrys Plains.

The noise and vibration study notes that the predicted noise levels under adverse INP weather conditions are highly unlikely to eventuate in reality due to the following.

- The ENM has been demonstrated to over-predict noise level by at least 3dB under wind enhanced conditions (eg EMGA Mitchell McLennan 2010, ERM 2002, Ishac 2010, Ishac 2007 and Ishac and Bullen 2006). The background noise at properties is also expected to rise during adverse wind conditions, eg due to wind induced vegetation noise, which would assist in masking noise from the proposal.

- The modelling for adverse INP weather conditions does not appear to register noise shielding effects of the intervening ridgeline (between the project area and Jerrys Plains) to the extent that would be expected in reality. This ridge, which is approximately 100m higher than the Carrington Pit, was found to be a significant noise barrier during calm weather conditions, and similar effects would be expected during adverse INP weather conditions. Where significant topography exists, such as this ridge, the ENM over-predictions are likely to be more than 3dB.

- The compliance noise monitoring undertaken since 2005 at Jerrys Plains demonstrates that Carrington Pit operations have been within consent limits and inaudible.

- The modelling includes conservative assumptions, such as simultaneous operation of all modelled equipment, which in practice is unlikely occur.

- Noise levels can be managed with the aid of noise and weather monitoring and operational management.

vi Sleep disturbance

Transient noise sources, such as shovel gates banging, truck engines revving fast and vehicle reversing alarms, have the potential for sleep disturbance to nearby residents.

The criteria used to assess sleep disturbance are based on the DECCW's guideline of background plus 15dB for the $L_{1,1min}$ noise level, which in this case is conservatively approximated by the maximum noise level, L_{max}.

Maximum noise levels from plant identified as having potential to cause sleep disturbance were calculated under adverse INP weather conditions for each receptor location, and are presented in Appendix F. The results indicate that under adverse INP weather conditions, the predicted noise levels are within the DECCW's conservative sleep disturbance criteria at all private residences that are not already within a zone of affectation.

Table 5.12 Predicted noise levels under adverse INP weather conditions - Leq,15minute dB(A)

Location	Year 1					Year 5					Consent Limit	
Receptor No.	Carrington (Existing & Pit Extension)		West Pit	Total – HVO North (Carrington & West Pit)		Carrington (Pit Extension Only)[5]		West Pit	Total – HVO North (Carrington & West Pit)		Operational	Acquisition
	Unmit.	Mitigated	(Yr8 - ERM 2003)	Unmit.	Mitigated	Unmit.	Mitigated	(Yr14 - ERM 2003)	Unmit.	Mitigated		
1	44	34	35	45	38	40	35	38	42	40	38-40	>41
2	44	34	34	45	37	41	36	36	42	39	39	>41
3	44	35	34	45	37	41	37	36	42	39	39	>41
4	41	35	34	41	38	39	34	34	40	37	36-40	>41
5	28	26	28	30	30	16	12	27	27	27	35	>41
6	25	23	27	29	28	22	21	26	27	27	35	>41
7[1]	35	33	36	39	38	28	24	36	37	36	36-40	>42
8[3]	43	41	42	45	44	30	26	42	42	42	NA	NA
10[2]	55	44	39	55	45	51	46	40	51	47	NA (Acquisition)	NA
11[3]	39	35	34	40	38	38	34	35	40	37	39	>41
13[4]	42	32	41	44	41	37	33	41	43	41	40	>41
14[4]	39	30	41	43	41	35	31	41	42	41	40	>41
39	25	22	30	30	31	18	16	30	30	30	35	>41

1. These private residences are currently inside a zone of affectation or subject to a private land holders agreement with mines other than HVO.

2. These private residences are currently inside a HVO zone of affectation.

3. Mine owned.

4. Additional Jerrys Plains receptors were added to those used in the ERM (2003) EIS, to provide a better representation of the area.

5. The existing Carrington Pit will not be operational in Year 5.

6. '>' means greater than.

vii Cumulative noise

Adjoining industrial activity also influences noise levels at receptors potentially exposed to the proposal. However, for the closest receptors this is limited, as HVO North constitutes the main contributor of industrial noise. Other industrial operations of significance are HVO South, Wambo Mine, Ravensworth-Narama and Ashton Coal.

The cumulative noise from these operations was added to the mitigated results for worst-case INP weather from the proposal, and the results are presented in Table 5.13. This is a conservative approach as, for example, a south easterly wind that may enhance noise from Wambo Mine at a particular location will not equally enhance noise from the proposal. Nonetheless, this approach does provide a crude method of assessing cumulative noise during adverse INP weather.

A night time cumulative noise criterion equivalent to the DECCW's night time amenity goal of 40dB(A) $L_{eq,9hour}$, is applicable for a rural residence according to the INP. The results in Table 5.13 indicate that all private residences, not currently within a zone of affectation and where HVO North makes a substantial contribution, will satisfy or be marginally (not more than 2dB) above the DECCW's amenity goal of 40dB(A). However, as discussed earlier, the noise predictions are based on worst-case $L_{eq,15minute}$ noise levels. A conservative 3dB difference is expected between the predicted worst case $L_{eq,15minute}$ and $L_{eq,9hour}$ noise level, due to the inherent downtime of plant over the nine hour night-time period as compared with a worst-case 15-minute noise emission level. This 3dB correction has not been applied to the results. Adopting a conservative 3dB correction implies that cumulative noise levels at all private residences, not within a zone of affectation, will be below the DECCW's amenity goal.

Table 5.13 Cumulative night-time L_{eq} noise levels at receptor locations

Location	Cumulative L_{eq} noise level (% contribution from HVO North), dB(A)	
Receptor No.	**Year 1 (Mitigated)**	**Year 5 (Mitigated)**
1	39 (79%)	41 (79%)
2	40 (50%)	41 (63%)
3	40 (50%)	41 (63%)
4	42 (40%)	41 (40%)
5	42 (6%)	42 (3%)
6	42 (4%)	42 (3%)
7[1]	43 (32%)	42 (25%)
8[3]	47 (50%)	45 (50%)
10[2]	46 (79%)	48 (79%)
11[3]	42 (40%)	41 (40%)
13[4]	42 (79%)	42 (79%)
14[4]	42 (79%)	42 (79%)
39	46 (3%)	46 (3%)

1. *These private residences are currently inside a zone of affectation or subject to a private land holders agreement with mines other than HVO.*
2. *These private residences are currently inside a HVO zone of affectation.*
3. *Mine owned.*
4. *Additional Jerrys Plains receptors were added to those used in the ERM (2003) EIS, to provide a better representation of the area.*

viii Blasting noise and vibration

Typically, blasting at HVO North occurs once per day, however it is not uncommon for two blasts to be undertaken in one day at larger mines or mines having multiple pits. Blasts can occur regularly on consecutive days throughout the majority of the year.

The potential noise overpressure and ground vibration from proposed blasting in the proposed extension area was determined using empirical formula that is based on a relatively significant quantity of measurement data in the broader Hunter Valley mining area. The results show that Receptor No. 10 will be too close to allow for any practical blasts to occur and hence arrangements must be made well in advance of any blasts within 900m of this residence.

The Lemington Road Bridge over the Hunter River to the south was also considered. The bridge is considered to be a relatively robust structure, given that it is serviceable and has been recently reconstructed. To achieve 10 millimetres per second (mm/s) peak particle velocity at the bridge due to blasting (10mm/s limit is considered safe and conservative), the charge mass must be approximately 5400 kilograms (kg) maximum instantaneous charge (MIC) or less, given a minimum separation distance of approximately 2500m for the closest mining area in Year 1 of the proposal. This is considered to be within the realm of practical limits for blast designers and should allow for normal blasting practices to occur.

5.5.3 Management and monitoring

Noise and vibration management is, and will continue to be, undertaken in accordance with relevant HSEQ Management System procedures, the HVO Noise Monitoring Programme and protocol for compliance, Environmental Work Instruction – Coal & Allied Noise, and the HVO Blast and Vibration Management Plan. These will be updated where necessary to reflect the proposal.

The development consent will continue to provide the mechanism for managing noise impacts by protecting the community via the regime of monitor, manage and mitigate. The option of acquisition on request will also continue to apply where applicable.

While the proposal is predicted to result in similar noise levels to the existing Carrington Pit, the approach to the management of noise from the whole of HVO North has been considered, including the implementation of both pro-active and reactive mitigation measures. Mitigation measures specific to the proposal comprise the following.

- Permanent real time directional noise monitoring at Jerrys Plains with back-to-base feed of data. The system will include trigger alarms, which are set to an appropriate trigger level for Jerrys Plains. When noise levels reach the trigger level an alarm will be sent via SMS and email to the site personnel at HVO. In the event of an alarm, the Open Cut Examiner will be notified and operational practices reviewed to minimise the potential for noise increasing beyond compliance levels.

- Participation in ongoing research towards the use of predictive weather forecast data as a definitive tool to manage noise.

- Extension of the system of mining and overburden emplacement permission rules being developed at HVO South to HVO North, once these have been developed and implemented. This system feeds real time site weather data into a wind speed and direction information system displayed on an aerial map of the site. This information can be viewed in real time by the operator of the system. The operator is provided with instructions on whether mining or emplacement is to be allowed or

restricted during certain wind conditions. This tool is particularly useful during activities in areas that have been shown to increase noise at receiver locations, especially under adverse conditions.

- Pro-active contingency mine planning to plan for events, such as prevailing wind conditions that have the potential to increase noise beyond acceptable levels. For example, the provision of alternative areas for overburden emplacement where practical, dependent on the prevailing meteorological conditions. The management and scheduling of mobile equipment will also be undertaken and may include strategically locating equipment in shielded or bunded areas during adverse conditions.

- Regular attended noise monitoring (quarterly) and as required due to community requests.

- Consultation and arrangements will be made with Receptor No. 10 in advance of any blasts within 900m of the residence.

- To achieve 10mm/s peak particle velocity at the Lemington Road bridge (due to blasting), the charge mass must be approximately 5,400kg MIC or less, given a minimum separation distance of approximately 2,500m for the closest mining area in Year 1 of the proposal.

Noise monitoring will be ongoing to assess the performance of the mining operations against the predicted noise levels. Specifically, a rigorous monitoring regime will be implemented during the early phases of the operations to validate the potential impacts at Jerrys Plains and better understand the behaviour of sound propagation over the ridge between the project area and these receivers.

5.5.4 Conclusions

The noise modelling has shown that under calm weather conditions, consent operational limits are satisfied at all private residences that are not already within a zone of affectation. During adverse INP weather conditions (which are a feature of the night period only), predicted mine noise levels without mitigation are above the operational consent noise limits for eight of the assessed locations, and marginally above the consent acquisition limits at five of the assessed locations. After applying restrictions to operation of some plant, noise levels are predicted to be satisfy or be within 2dB of the consented operational noise limits at all assessed locations, and consent acquisition limits satisfied at all private residences that are not already within a zone of affectation. The noise modelling package used typically over-estimates noise emissions by approximately 3dB for adverse INP weather conditions. Allowing for this and a number of other factors, it is considered that the predicted noise levels are highly unlikely to eventuate and in any case, can be managed through noise and weather monitoring and operational management.

Blast design and monitoring will ensure noise overpressure and ground vibration from blasting are within acceptable limits. Precautionary notification and arrangements will be undertaken with a nearby landholder prior to any blasts within 900m of that residence.

5.6 Air quality

This section provides a summary of the air quality study prepared by PAEHolmes, which is presented in full in Appendix G.

5.6.1 Existing environment

Existing air quality in the local area is influenced by dust emissions from mining activities, wind erosion of exposed surfaces and dust emissions from non-mining activities including farming, stock movements and

vehicle movements. Coal & Allied operates a network of air monitoring equipment in and around HVO North, which provides data on existing air quality in the local area. Dust deposition gauges monitor the levels of dust deposition, and high volume air samplers monitor particulate matter concentrations. Coal & Allied also operates two weather monitoring stations at HVO. Local air quality and weather monitoring data are provided in Appendix G.

5.6.2 Impact assessment

i Criteria

The relevant air impact assessment criteria used for this assessment are the DECCW (2005a) criteria. These criteria are set out in Table 5.14, and correspond with the impact assessment criteria in Condition 3 of the existing development consent. It is noted that, with the exception of the criteria for maximum 24-hour average PM_{10} and for maximum increase in deposited dust, the impact assessment criteria relate to the total dust in the air, and not just that due to HVO North. As such, dust from other sources requires consideration when applying the criteria.

In addition to the DECCW criteria, the DoP impose requirements for land acquisition or negotiated agreements if the DECCW criteria for maximum 24-hour average PM_{10} is exceeded on private property for more than 5 days in any year (a 98.6 percentile level of compliance), and /or if the DECCW annual average PM_{10} criterion is exceeded. The DoP acquisition criteria have also been considered in this assessment.

ii Assessment approach

The air quality impact assessment was undertaken generally in accordance with the DECCW (2005a) "*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*". As for noise and vibration, specific assessment of construction impacts was not considered necessary, given that any construction-related activities will form part of the mining operations.

The potential dust generating activities and wind erosion sources associated with HVO North, including the proposal, were identified.

Two operational scenarios were selected to cover the life of mining within the proposed extension area. Based on the amount of overburden removed, haul road lengths and the distance of operations from residences during the various years of mining, the worst-case scenarios were identified to be Years 1 and 5, similar to noise. Year 1 represents the early stage of mining within the proposed extension area, when mining is closest to Jerrys Plains, and the existing Carrington Pit is still operational. Year 5 represents the final stage of mining, when the exposed overburden emplacement areas are at their maximum extent. Particulate matter emissions during Years 1 and 5 were estimated using emission factors developed locally and by the United States Environmental Protection Agency. The emission estimates are presented in Appendix G.

The predicted particulate matter emissions were modelled for Years 1 and 5 using the ISCMOD dispersion model, which is a software accepted by the DECCW. The modelling took into account the local meteorology and air dispersion characteristics, including wind speeds, wind directions, atmospheric stability and mixing heights, the terrain, emission source locations, activity operating hours, and proposed dust controls.

In addition to modelling emissions from HVO North alone, modelling was undertaken using future maximum emission estimates from nearby mining operations, ie Ravensworth/ Narama, Wambo, HVO South and Cumnock Mines, sourced from past air quality impact assessments, and using background emission estimates to account for other particulate matter sources in the area, such as farming.

The predicted particulate matter concentrations and dust deposition levels were compared against the relevant DECCW and DoP air quality criteria, to enable assessment of the potential impacts.

iii Representative receptors

Air quality predictions were made at the same 13 representative receptors as those used in the noise and vibration assessment, the locations of which are described in Table 5.10 and shown on Figure 5.4.

iv Modelling results

Table 5.14 provides a comparison of the air modelling results for the representative receptors against the relevant DECCW impact assessment criteria.

The modelling results in Table 5.14 show that the annual average PM_{10}, TSP and dust deposition levels are predicted to be well below the relevant DECCW criteria at all of the receptors for the worst-case years of the proposal (Years 1 and 5). This is the case when taking into account the predicted emissions from HVO North, as well as from surrounding mines and other particulate matter sources in the area.

In Year 1 of operations, DECCW's maximum 24-hour average PM_{10} criterion of 50 micrograms per cubic metre ($\mu g/m^3$) is predicted to be exceeded at one receptor (Receptor No. 10) by $0.5\mu g/m^3$. The predicted maximum 24-hour average PM_{10} concentrations are predicted to be well below the relevant DECCW criteria at all other receptors during Year 1 and at all receptors during Year 5. Further analysis for Receptor No. 10 found that the $50\mu g/m^3$ criterion was only likely to be exceeded on one day during Year 1. Therefore, the DoP acquisition criteria are projected to be met. The second highest predicted 24-hour PM_{10} concentration at Receptor No. 10 for Year 1 is $14\mu g/m^3$ below the $50\mu g/m^3$ criterion.

Table 5.14 Air modelling results - Years 1 and 5

Receptor No.	Year 1					Year 5				
	Max. 24-hr avg. PM_{10} (µg/m^3)	Annual avg. PM_{10} (µg/m^3)	Annual avg. TSP (µg/m^3)	Annual avg. dust deposition (g/m^2/month)		Max. 24-hr avg. PM_{10} (µg/m^3)	Annual avg. PM_{10} (µg/m^3)	Annual avg. TSP (µg/m^3)	Annual avg. dust deposition (g/m^2/month)	
	HVO North only[1]	Cumulative[2]	Cumulative[2]	HVO North only[1]	Cumulative[2]	HVO North only[1]	Cumulative[2]	Cumulative[2]	HVO North only[1]	Cumulative[2]
DECCW Criteria[3]	50	30	90	2	4	50	30	90	2	4
1	15.1	17.4	42.8	0.03	1.2	13.0	17.0	42.4	0.02	1.2
2	17.2	18.0	43.4	0.02	1.2	10.8	17.7	43.0	0.02	1.2
3	18.3	18.3	43.7	0.02	1.2	10.6	18.0	43.4	0.02	1.2
4	19.6	19.7	45.2	0.02	1.3	15.5	19.3	44.9	0.01	1.3
5	13.6	20.5	46.3	0.2	1.6	9.7	19.8	45.5	0.1	1.5
6	17.1	19.1	44.7	0.2	1.4	10.5	18.2	43.7	0.1	1.4
7	29.5	20.8	46.5	0.4	1.5	19.2	18.9	44.5	0.3	1.4
8	44.4	24.5	50.9	0.04	1.9	25.3	20.4	46.4	0.6	1.7
10	**50.5**[4]	22.0	48.0	0.1	1.4	24.6	20.2	45.8	0.04	1.3
11	17.8	22.3	48.2	0.02	1.4	13.4	21.9	47.7	0.01	1.4
13	15.7	16.6	41.9	0.04	1.2	13.5	16.2	41.5	0.02	1.2
14	12.2	16.1	41.4	0.04	1.2	10.6	15.7	40.9	0.02	1.2
39	15.5	20.8	46.6	0.05	1.5	12.6	20.5	46.3	0.03	1.5

1. *The 24-hour average PM_{10} criteria and maximum deposited dust increase criteria relate to emissions from HVO North alone. Therefore background levels are not included in the predicted levels for these parameters.*
2. *The predicted cumulative levels are due to the combined emissions from HVO North and surrounding mines, ie Ravensworth/ Narama, Wambo and Cumnock Mines and HVO South (Cheshunt and Riverview Pits), as well as a background level to account for other particulate matter sources. The background levels used are 11µg/m^3 for annual average PM_{10}, 36µg/m^3 for annual average TSP, and 1g/m^2/month for dust deposition.*
3. *Criteria are from the DECCW (2005a).*
4. *Values in bold font indicate a criteria exceedences.*

5.6.3 Management and monitoring

Air quality management is, and will continue to be, undertaken in accordance with relevant HSEQ Management System procedures and the HVO Dust/ Air Quality Management Plan which will be updated as required to reflect the proposal. Dust control procedures that will be implemented for the proposal include those listed in Table 5.15.

Table 5.15 Dust control procedures

Dust-generating activity/ source	Control procedures
Areas disturbed by mining	Only the minimum area necessary for mining will be disturbed. Completed overburden emplacement areas will be reshaped, topsoiled and rehabilitated as soon as practicable after the completion of overburden emplacement.
Coal handling areas/ stockpiles	Coal handling areas/ stockpiles will be maintained in a moist condition to minimise wind-blown and traffic-generated dust.
ROM stockpiles	Water sprays will be available on ROM stockpiles and used to reduce airborne dust, as required.
Haul roads	All roads and trafficked areas will be watered as required, using water trucks, to minimise the generation of dust.
	All haul roads will have edges clearly defined with marker posts or equivalent to control their locations, especially when crossing large overburden emplacement areas.
	Obsolete roads will be ripped and re-vegetated.
Minor roads	Development of minor roads will be limited and the locations of these will be clearly defined.
	Minor roads in regular use will be watered.
	Obsolete roads will be ripped and re-vegetated.
Topsoil stripping	Access tracks used by topsoil stripping equipment will be watered.
Topsoil stockpiling	Long term topsoil stockpiles, not used for over three months, will be re-vegetated.
Drilling	Dust aprons will be lowered during drilling.
	Drills will be equipped with dust extraction cyclones, or water injection systems.
	Water injection or dust suppression sprays will be used when high levels of dust are being generated.
Blasting	Adequate stemming will be used at all times. Blasting will be restricted during unfavorable weather conditions, where practicable.

5.6.4 Conclusions

Air modelling undertaken by PAEHolmes has shown that the proposal is not predicted to result in any exceedances of the relevant DECCW or DoP criteria for annual average PM_{10}, TSP or dust deposition. This is the case when taking into account the predicted emissions from HVO North, as well as from surrounding mines and other particulate matter sources in the area.

The DoP 24-hour average PM_{10} acquisition criterion is not predicted to be exceeded. A minor ($0.5\mu g/m^3$) exceedance of the DECCW maximum 24-hour average PM_{10} criterion is predicted to occur at one privately-owned residence during Year 1 of mining. This is only predicted to occur on one day over a one

year period. It should be noted that the second highest concentration predicted at this residence is 14µg/m^3 below the 50µg/m^3 criteria. No other exceedances of the DECCW criteria for 24-hour average PM_{10} are predicted.

5.7 Aboriginal cultural heritage

This section provides a summary of the Aboriginal cultural heritage study prepared by Central Queensland Cultural Heritage Management, which is presented in full in Appendix H.

5.7.1 Existing environment

i Review of previous assessments

The proposed extension area has been the subject of a numerous previous cultural heritage investigations. These include investigations undertaken for the initial development of the Carrington Pit in the late 1990s, the first extension of mining activities in 2005, and those specifically for this proposal. The areal extents of these surveys are shown in Figure 3 of Appendix H.

ii Consultation: The Cultural Heritage Working Group

The CHWG was established in 2005 by agreement between Coal & Allied and members of the Upper Hunter Valley Aboriginal community. The CHWG provides advice on cultural heritage management for all Coal & Allied operations, develops Terms of Reference for cultural heritage investigations, considers technical reports and administers cultural heritage field work programs. It provides a regular forum for discussions on all matters pertaining to cultural heritage and regularly reviews the progress and outcomes of Coal & Allied's cultural heritage process and management programme in the Upper Hunter Valley, revising and refining elements of the process.

All consultation for the proposal has been conducted in conformance with the DECCW (2005b) Interim Community Consultation Requirements for Applicants through the auspices of the CHWG. Discussions and outcomes have been recorded in minutes of meetings, correspondence, terms of reference reports, and associated documents. The archaeological studies were conducted with the advice and active participation of the Aboriginal community and constitute the basis of the Aboriginal cultural heritage assessment. Table 3 in Appendix H clarifies how the CHWG consultation process is benchmarked against the DECCW (2005b) Interim Community Consultation Requirements for Applicants.

The CHWG met and discussed the proposal and associated heritage assessment and management issues on five occasions, 27 August 2009, 1 October 2009, 9 December 2009, 12 February 2010 and 22 April 2010. Minutes and outcomes of the discussions are provided in Appendix H.

In summary, while Aboriginal community members have expressed the view that they would prefer that no disturbance to cultural heritage sites occurred, there has been no opposition expressed to the proposed management of cultural heritage impacts of the proposal. The CHWG want it noted that the CM-CD1 site is very significant to the community and the CHWG desires a heritage offset be included in the management plan for the proposal, with the offset area needing to be outside the current mining leases and mining areas. Consultation meetings with the CHWG regarding the proposal will continue.

iii CM-CD1 Cultural Heritage Indigenous Management Agreement

Coal & Allied has entered into a series of cultural heritage agreements that cover cultural heritage places and values in the Carrington Pit mining area. Principal among these with relevance to the proposal is the 2002 *'Cultural Heritage Indigenous Management Agreement'* (CHIMA) which covers the CM-CD1 area.

The area known as CM-CD1 includes an area some 450m long and up to 25m wide, which lies in the north-eastern portion of the proposed extension area (see Figure 5 in Appendix H). This area was originally identified as having the potential to contain sub-surface cultural material that may have been of Pleistocene (ie, older than 10,000 years) antiquity. A comprehensive archaeological and geomorphological excavation programme was undertaken in several stages throughout 1999. While this work identified that sub-surface cultural material was present, the nature of the deposits and the cultural material did not allow for further insights into the antiquity of this deposit, although it is seemed unlikely that they were Pleistocene in age. Further, while it was noted that additional sub-surface material may be present, it was considered unlikely that this would be present across the entirety of the CM-CD1 area. Although all required investigations were completed at this time, the area within which CM-CD1 is located has not previously been required for mining.

Under the substantive provisions of the CHIMA, Coal & Allied agreed to exclude CM-CD1 (including the extent of the older stratum) from mining activities for a period of three years from 7 August 2002. As part of this, Coal & Allied agreed not to mine within 60m of this defined exclusion area (ie, the extent of the older stratum at CM-CD1 plus a 60m buffer – becoming the 'Exclusion Zone'). Modifications to DA 450-10-2003 approved in 2006, resulted in the size of the mining exclusion zone buffer surrounding CM-CD1 being reduced to 15m.

Following the expiration of this three year period, being on 7 August 2005, the CHIMA notes that Coal & Allied is free to apply for a *National Parks and Wildlife Act 1974* (NPW Act) s90 Consent to Destroy with the support of the Wonnarua Tribal Council (WTC), providing that all other development consent conditions have been satisfied. Further, the WTC will not require any further cultural heritage assessment within either CM-CD1 or the Exclusion Zone. It also notes that if any additional excavations be required by a third party prior to applying for a Consent to Destroy, the WTC will be afforded the opportunity to be involved in such work.

Once a Consent to Destroy has been issued for CM-CD1, the CHIMA also provides for the WTC to be afforded the opportunity to salvage artefacts from this area and to undertake video recordings, both prior to and during disturbance. The salvage process is to be agreed either directly with the WTC, in consultation with the relevant regulatory department(s), or following agreement with DECCW.

At the present time an application for Consent to Destroy CM-CD1 has not been lodged. Consultation with the CHWG regarding CM-CD1 is ongoing.

5.7.2 Impact assessment

The entirety of the proposed extension area has been the subject of Aboriginal cultural heritage investigations. From these, a total of nine cultural heritage places have been identified as being located either within, or immediately adjacent to the proposed extension area and which have not previously been destroyed under a finalised NPW Act s90 consent. These cultural heritage places are described in Table 5.16 and shown on Figure 5 in Appendix H.

Table 5.16 Cultural heritage places identified and their current management status

AHIMS ID*	Place ID	Reported	Initial Place Description	Recent Assessment / Management Notes	Status
37-2-1504	CM1	ERM Mitchell McCotter (1999)	Described as an open campsite consisting of 214 stone artefacts. It was reported to commence near a culvert alongside Lemington Road and continue north-west along a creek bank for a distance of approximately 300m.	Revisited and reassessed during the ERM 2005 study; a single stone artefact was identified. Area fenced and managed as per CHIMA. It is subject to current development consent conditions.	Extant
37-2-1505	CM2	ERM Mitchell McCotter (1999)	Described as a possible stone working area some 120m long and 50m wide and containing a large number of artefacts. Majority of surface material has previously been salvaged.	Partially destroyed under Permit #SZ311. Revisited and reassessed during the ERM 2005 study; seventeen stone artefacts, mostly within one small area, were identified. Remaining area is within the fenced CHIMA Exclusion Zone and as such is subject to current development consent conditions.	Partially Destroyed
37-2-1522	CM19	ERM Mitchell McCotter (1999)	Single large mudstone flaked piece located in natural clearing adjacent to fenceline.	Unable to be relocated by Junburra 2000 or ERM 2005 studies. General area is fenced and managed as per CHIMA. It is subject to current development consent conditions.	Extant
37-2-1535	CM32	ERM Mitchell McCotter (1999)	Described as an open campsite consisting of five mudstone flakes and one silcrete flake that has been disturbed by vehicle and stock movements. No indication of areal extent is provided.	Unable to be relocated by Junburra 2000 or ERM 2005 studies. General area is fenced and managed as per CHIMA. It is subject to current development consent conditions.	Extant
37-2-1877	CM-CD1	Huonbrook Environment and Heritage (2000)	Potential archaeological deposits within an area up to 450m long and 25m wide along the base of a low ridge below CM2. The area, including a 15m mining exclusion buffer, is enclosed by fencing.	Revisited during the ERM 2005 study. Area of the older stratum and broader Exclusion Zone is fenced and managed as per CHIMA. It is subject to current development consent conditions.	Extant
TBA	HVO-1121	McCardle Cultural Heritage	Single retouched mudstone flake and mudstone flaked	n/a	Extant

Table 5.16 Cultural heritage places identified and their current management status

AHIMS ID*	Place ID	Reported	Initial Place Description	Recent Assessment / Management Notes	Status
		(2009)	piece recorded.		
TBA	HVO-1122	McCardle Cultural Heritage (2009)	Single silcrete flake recorded.	n/a	Extant
TBA	HVO-1123	McCardle Cultural Heritage (2009)	Single retouched mudstone flake recorded.	n/a	Extant
TBA	HVO-1124	McCardle Cultural Heritage (2009)	Single mudstone flake recorded.	n/a	Extant

** = Aboriginal Heritage Information Management System Identification Number*

Cultural heritage places CM1, CM2, CM19, CM32 and CM-CD1 have been previously identified and are variously covered by the CM-CD1 CHIMA and/ or the current development consent conditions, and are actively managed accordingly. Additionally, they have been the subject of ongoing discussions through the CHWG.

Further cultural heritage investigations were undertaken in 2009 and 2010 to include the remaining unsurveyed portions of the project area. These identified five additional areas containing isolated stone artefact(s), of which four (HVO-1121-1124) are located within or immediately adjacent to the proposed extension area. Management arrangements for these have been agreed directly between Coal & Allied and the CHWG.

Following extended consultation with the local Aboriginal community of the Upper Hunter Valley through the CHWG, a series of general and specific management actions have been agreed for all of the cultural heritage places described in Table 5.16, in the highly likely event that they will be impacted by the proposal.

5.7.3 Management and monitoring

Aboriginal cultural heritage management at HVO North is, and will continue to be, undertaken in accordance with the HSEQ Management System, inclusive of the Rio Tinto Coal Australia Cultural Heritage Management System and relevant management plans.

Where possible, Coal & Allied design mining activities in such a way as to avoid cultural heritage places. With this in mind, it should be noted that for a number of areas avoidance will not be possible. It is highly unlikely that the extant cultural heritage places in the proposed extension area will be able to be avoided (ie CM1, the remaining portion of CM2, CM19 and CM-CD1, CM32, HVO-1121, 1122 and 1124).

Specific management principles have been developed in a manner consistent with the development consent conditions with respect to Aboriginal cultural heritage, for those areas that intersect with the proposed extension area. These have been developed in accordance with Rio Tinto Coal Australia's cultural heritage management standards and policies, and in consultation with the CHWG.

Any required salvage of Aboriginal objects from the proposed extension area will be undertaken on the basis of a staged approach, subject to operational requirements. As a general management principle, these stages will align with a minimum three year and maximum five year mine operating plan mitigation buffer ahead of mining impacts. Permits, as required under s90 of the NPW Act, will be sought for each salvage stage. Specific management measures for each cultural heritage place, in the event that they will be impacted by mining activities, are as follows.

i CM-CD1 Precinct

This precinct includes CM1, the remaining portion of CM2 that lies within the CM-CD1 Exclusion Zone (ie 15m surrounding), and CM-CD1. Across these three areas, ground surface visibility is low and a constraint to stone artefact identification. Coal & Allied will commit to providing an opportunity for the Aboriginal community to undertake a cultural salvage of surface stone artefacts. Following this, a series of progressive machine scrapes will be completed across these areas to provide additional opportunities for this exercise.

The details and resourcing requirements of this salvage strategy will be agreed directly with the CHWG and in consultation with DECCW and the CHIMA established in August 2002, which provides management measures specific to archaeological place CM-CD1.

ii CM19 and CM32

On several occasions the cultural heritage material originally identified and recorded at these two places has been unable to be located. In the highly likely event that these areas will be impacted, the Aboriginal community will be provided with an opportunity to inspect these areas and, should any cultural material be identified, undertake a salvage of that material.

iii HVO-1121-1124

A salvage collection of the isolated stone artefacts that have been identified and recorded at these four locations will be undertaken with the Aboriginal community.

iv Care and Control Plan Permit

The existing Care and Control permit (#2863 valid until 16 January 2013), issued by DECCW for the HVO cultural heritage places, will be modified to include the cultural material salvaged under any new permits associated with the proposal. Alternatively, a new Care and Control Permit application will be submitted for this cultural material. This will be determined in consultation with the DECCW.

5.7.4 Conclusions

The entirety of the proposed extension area has been the subject of systematic and comprehensive Aboriginal cultural heritage investigations and management/research programs across an extended period commencing in 1997.

A total of nine Aboriginal cultural heritage places are located either entirely within, or have portions within or immediately adjacent the proposed extension area. The management of five of these (CM1, the remaining portion of CM2, CM19, CM32 and CM-CD1) is variously covered by the CM-CD1 CHIMA and/ or the current development consent conditions. The remaining four (HVO-1121-1124) were identified during recent fieldwork completed in 2009-2010.

Following extended consultation with the local Aboriginal community of the Upper Hunter Valley through the CHWG, a series of general and specific management actions have been agreed for these places. Rio Tinto Coal Australia and Coal & Allied have committed to implement these management actions in full in co-operation with the CHWG.

5.8 Ecology

This section provides a summary of the ecological study prepared by Biosis, which is presented in full in Appendix I.

5.8.1 Existing environment

The study area for the ecological assessment goes beyond the boundaries of the project area and is defined by the extent of direct and indirect impacts on flora and fauna that have the potential to occur as a result of the proposal.

Numerous ecological surveys and investigations have previously been undertaken at HVO North. The results of these studies, as well as additional terrestrial ecological field investigations undertaken specifically for the proposal were used to characterise the existing ecological environment. Surveys were carried out using a combination of habitat-based assessment and targeted sampling techniques. Sampling techniques included plot based surveys and anabat recordings. Desktop aquatic habitat

assessments were carried out using available survey data (including photographic records) and applying relevant indices to assess the relative health of the aquatic habitat.

The vast majority of the study area comprises a completely modified landscape, in poor condition, with little or no native vegetation. Vegetation recorded in the study area comprises Planted Areas, Weeds and Exotic Pasture, Central Hunter Box – Ironbark Woodland, Semi-permanent Pool/ Ephemeral Unnamed Tributary, Hunter Valley River Oak Forest and Derived Native Grassland.

One Endangered Ecological Community (EEC) recently listed under the NSW TSC Act, *Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* (NSW Scientific Committee, 2010), was recorded in the study area during the surveys, and covers an area of approximately 1.06ha, of which 0.89ha is within the proposed extension area. This community is considered to be in a moderate to poor condition within the study area, given its existing fragmentation, sparse canopy, absence of the shrub layer and scattered weed infestations.

Two protected plant species were recorded in the project area, the Tiger Orchid (*Cymbidium canaliculatum*) and a River Red Gum (*Eucalyptus camaldulensis*). These species are listed under Schedule 1 of the TSC Act as part of endangered populations in the Hunter catchment. It is noted that the isolated occurrence of the Tiger Orchid and River Red Gum, within a highly fragmented landscape, adjacent to the edge of the operational Carrington Pit, means that their long term survival in the current location is already subject to considerable doubt. Habitat preferences and records suggest that Tricolour Diuris (*Diuris tricolor*) could also feasibly be present, however, it was not detected during the survey.

Fauna habitat within the study area ranges from predominantly cleared areas which are in poor condition in terms of fauna habitat, to areas including fragmented patches of native vegetation (including important habitat features such as tree hollows), riparian vegetation, rocky shelters, water bodies and buildings, which are of poor to moderate habitat quality.

Five threatened fauna species were recorded during the field surveys of the study area, comprising the Powerful Owl (*Ninox strenua*), Eastern Freetail Bat (*Mormopterus norfolkensis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), Large-footed Myotis (*Myotis macropus*) and Large-eared Pied Bat (*Chalinolobus dwyeri*). These species are State listed, and the Large-eared Pied Bat is also Commonwealth listed. No migratory species were recorded. Based on existing records and the presence of identified habitat preferences, known and/or potential habitat exists within the study area for 16 threatened and 11 migratory species.

Wildlife corridors in the study area are limited to the riparian vegetation along the Hunter River, located to the south of the project area. Some threatened species, such as the Spotted-tailed Quoll (*Dasyurus maculatus maculates*), may utilise this wildlife corridor to move between areas of habitat throughout the locality.

The ephemeral Unnamed Tributary in the eastern portion of the study area provides limited habitat for fish species and is of low aquatic significance. It contains habitats that range from poor to marginal quality for native fish and macro invertebrate species. Database searches have indicated that no known threatened fish species listed under the *Fisheries Management Act 1994* (FM Act) or EPBC Act have been recorded within a 10km radius of the study area (DPI Fisheries Database and Bionet Online Database).

No areas of critical habitat for flora or fauna have been declared within the locality.

5.8.2 Impact assessment

i Vegetation clearing

While the majority of the study area is already cleared of native vegetation, there is some remaining vegetation which will be cleared for the proposal, including approximately 0.89ha of woodland. The potential for direct impacts on fauna as a result of vegetation clearing will be managed through existing Coal & Allied environmental procedures, as outlined in Section 5.8.3. Potential impacts of vegetation clearing on any threatened species are assessed below in parts iv and v. The proposed rehabilitation scheme (see Figure 3.4) includes elements to mitigate impacts of vegetation clearing in the longer term, most notably, the rehabilitation of more than 50ha of woodland across the project area, including a nominal 4ha of Central Hunter Grey Box – Ironbark Woodland. These communities would seek to provide habitat for native species thus potentially improving the biodiversity values of the area in the medium to longer term.

ii Aquatic and riparian ecology impacts

Diversion of the Unnamed Tributary will result in the loss of some poor to marginal aquatic habitat and riparian vegetation. Direct impacts to riparian vegetation as a result of the proposal are considered to be negligible due to the current absence and/ or poor condition of existing riparian vegetation along the Unnamed Tributary, and the fact that the proposal does not include removal or direct impacts to any Hunter River riparian vegetation. With respect to potential indirect impacts, e.g. associated with changes to water flows or quality, and as set out in Section 5.3.2, WRM (2010) concluded that the proposed management measures will ensure no measurable adverse impacts on riparian and ecological values of watercourses within or downstream of the project area. As discussed in Section 5.3.3, the proposed Management Plan for the temporary diversion and reinstatement of the Unnamed Tributary will include habitat considerations, including the revegetation strategy, monitoring regime and contingency measures. Potential impacts on threatened aquatic and riparian species are assessed below in parts iv and v.

iii Indirect impacts

Some indirect minor ecological impacts may potentially result from the proposal, including changes in surface water flows and water quality, weed invasion, erosion and siltation, deposition of dust and increased noise and vibration. All of these indirect impacts currently occur in the study area. These potential minor impacts are addressed in further detail Appendix I.

iv State listed communities and species

The potential impacts of the proposal on ecological communities and threatened species listed under the TSC Act have been assessed following the DEC & DPI (2005) *Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act*.

The proposal will result in direct impacts to approximately 0.89ha of the Central Hunter Grey Box – Ironbark Woodland EEC which is listed under the TSC Act, through clearing, with a further 0.17ha potentially subject to indirect impacts. According to vegetation mapping by Peake (2005), a total of 911.6ha of this vegetation occurs within 5km of the proposed extension area.

The direct and indirect impacts from the proposal on the Central Hunter Grey Box – Ironbark Woodland EEC are considered unlikely to constitute a significant impact, on the basis that the magnitude of impacts on the extent of this community in the locality is relatively small, the proposal would not result in further fragmentation or isolation of this community, and patches of this community in the study area are already subject to indirect impacts from existing land uses. Further, the proposed rehabilitation scheme includes

rehabilitation of a nominal 4ha of Central Hunter Grey Box – Ironbark Woodland, to be located within the area of rehabilitated woodland at the out-of-pit overburden emplacement areas.

Flora species impact assessments for the Tiger Orchid, River Red Gum and the Tricolour Diuris were undertaken in accordance with the DEC & DPI (2005) Guidelines.

The proposal would impact one of the few known local occurrences of the Tiger Orchid, albeit that its long term survival in the current location is already subject to considerable doubt. Measures to avoid the disturbance of the Tiger Orchid have been investigated and are not possible. Translocation is considered the only viable mitigation option. It should be noted that approximately 1,261ha of potential habitat for the species has been mapped as occurring in the locality and that further searches within these areas of potential habitat may yield additional local records of the species. As part of Coal & Allied's broader operations in the region, a number of Tiger Orchid colonies are being conserved within existing or proposed biodiversity offset areas.

The proposal will result in the removal of a single River Red Gum specimen from a cleared agricultural landscape which currently represents poor habitat for this species. Provided that mitigation measures are implemented, including ongoing implementation of Coal & Allied's River Red Gum Rehabilitation and Restoration Strategy (Umwelt, 2010), which includes management of the nearby River Red Gum populations and commitments to protect the potential habitat adjoining the Hunter River, it is considered highly unlikely that the proposal will have a significant impact on the endangered population of River Red Gums.

Given that the initial 2009 field surveys within the project area may not have coincided with the flowering time for Tricolour Diuris, an additional targeted survey for this species was undertaken during the September 2010 flowering period. Tricolour Diuris was not detected during these surveys and is considered extremely unlikely to occur within the project area. Accordingly, it is considered that the proposal is unlikely to have a significant impact on this species.

The potential impacts of the proposal were assessed on the TSC Act-listed threatened fauna with known and/or potential habitat in the study area. Part 3A impact assessments were prepared for the seven species potentially impacted upon by the proposal comprising the Turquoise Parrot (*Neophema pulchella*), Powerful Owl, Eastern Freetail Bat, Eastern Bentwing-bat, Large-footed Myotis, Large-eared Pied Bat and Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) (refer to Appendix I). The assessments concluded the potential for significant impact to be unlikely.

No threatened fish species listed under Schedule 4 of the FM Act have been previously recorded in the vicinity of the study area. Furthermore, the study area does not provide any potential habitat for any aquatic threatened species, populations and/or communities listed under the FM Act. On this basis, impact assessment following the DEC & DPI (2005) Guidelines has not been completed for any aquatic fauna.

v EPBC Act significant impact criteria

As discussed in Section 2.5.1, actions that have the potential to impact upon a matter of environmental significance under the EPBC Act require approval from the Minster for Environment Protection, Heritage and the Arts. A self assessment has been made in accordance with the *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DEWHA, 2009), to ascertain whether the proposal has the potential for a significant impact on a matter of national significance and whether a referral would be required.

No EECs listed under the EPBC Act were recorded in or adjoining the study area. No threatened plant species listed under the EPBC Act were recorded in the study area. Tricolour Diuris was previously listed as Vulnerable under the EPBC Act and is considered to have potential habitat within the study area. However, this species was removed from the EPBC Act threatened list on 19 August 2010. Furthermore, it was not detected in the project area during field surveys.

Three fauna species listed as Endangered under the EPBC Act have potential habitat in the study area, the Regent Honeyeater (*Anthochaera phrygia*), Swift Parrot (*Lathamus discolour*) and Spotted-tailed Quoll. No breeding or foraging habitat for any of these species is expected to be impacted. Accordingly, the proposal is unlikely to have a significant impact on these three species.

Three fauna species listed as Vulnerable under the EPBC Act have known and/or potential habitat in the study area, the Australian Painted Snipe (*Rostratula australis*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and Large-eared Pied Bat (the latter recorded during field surveys). No limiting breeding or foraging habitat for these species is expected to be impacted. If present within the study area, individuals of these species are not considered 'important populations' as they are not likely to be key source populations either for breeding or dispersal, populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species range. The proposal is unlikely to have a significant impact on these three species.

No migratory species were recorded during the field survey, however, potential habitat exists in the study area for 11 migratory species. Given the low importance of potential habitat for these species within the study area and that habitat connectivity would not be impacted, it is considered that significant impacts on these species would be unlikely.

No threatened aquatic species listed under the EPBC Act have previously been recorded in the vicinity of the study area. Therefore, impact assessment in accordance with the EPBC Act significant impact criteria (DEH, 2005) are not considered necessary for any aquatic biota.

The EPBC Act self assessment indicates that a referral to the Minister for Environment Protection, Heritage and the Arts is not considered necessary for the proposal.

5.8.3 Management and monitoring

i Vegetation clearing and fauna habitat loss

Approximately 0.89ha of woodland would be removed as a result of the proposal. Fauna utilising hollows on the site will be relocated prior to clearing and during clearing. Mitigation of direct impacts on fauna will be in accordance with existing Coal & Allied environmental procedures for the management of flora, fauna, disturbance and rehabilitation. These procedures detail the requirements for pre-clearing, clearing and injured fauna.

ii Translocation of threatened flora

It is proposed to translocate the Tiger Orchid to an appropriately identified donor site. It is possible that the clumps on the tree could be successfully translocated, provided there is minimal root disturbance, as the thick fleshy roots of this species can penetrate deep into the heartwood of the host tree for several metres. Translocation of the orchid will require moving as much of the host tree as possible, or potentially the whole tree. Care will need to be taken to minimise disturbance to the orchid, particularly the root system, during translocation. Monitoring of the translocated plant will be undertaken following translocation in order to determine success.

Prior to removal of the Tiger Orchid, a translocation plan will be prepared in consultation with DECCW and relevant botanical experts and with reference to best practice guidelines such as those identified in the Vallee *et al.* (2004) *Guidelines for the Translocation of Threatened Plants in Australia*.

iii Miscellaneous management issues

Weed management, landscape disturbance and rehabilitation and sediment and erosion controls will be undertaken in accordance with Coal & Allied's existing environmental procedures. As described in Sections 3.2.3 and 5.4, a comprehensive rehabilitation strategy is proposed, including restoration of lands within the proposed extension area to be similar to the existing condition and establishment of woodland areas which provide habitat for native species. Rehabilitation objectives include 'post-mining land use compatible with surrounding land uses, capable of supporting viable grazing and ecological values and providing environmental and community benefits'. In line with this, the restoration aims to provide a net gain in woodland locally in the medium to long term and improve habitat for the local biodiversity. Management considerations for the Unnamed Tributary diversion and reinstatement are set out in Section 5.3.3.

As described previously, Coal & Allied has a River Red Gum Rehabilitation and Restoration Strategy (Umwelt, 2010) in place which aims to preserve, enhance and manage stands of River Red Gums across the locality, including at the nearby Carrington Billabong. Coal & Allied will continue to manage these populations to help enhance their long term viability and thereby contribute to maintenance and improvement of biodiversity in the area.

iv Ecological monitoring

Ecological monitoring will include monitoring of rehabilitation and the success of plant translocation efforts. General monitoring inspections will be carried out pre-clearing, during clearing, and post weed and erosion controls.

5.8.4 Conclusions

The vast majority of the study area comprises a completely modified landscape, in poor condition with little or no native vegetation.

One EEC under the TSC Act was recorded in the study area, being the Central Hunter Box – Ironbark Woodland. Of the approximately 1.06ha of the community that occurs in the study area, approximately 0.89ha will be cleared and some 0.17ha may be indirectly impacted. This EEC was considered to be in a moderate to poor condition. Given the small area involved, the current degree of fragmentation of this patch of vegetation, and the proposed post-mining rehabilitation of 4ha of this community, it is considered unlikely that the proposal would result in a significant impact on this community.

Two plant species recorded in the study area, the Tiger Orchid and River Red Gum, are listed under Schedule 1 of the TSC Act. Measures to avoid the disturbance of the Tiger Orchid have been investigated and are not possible. Translocation of the specimen is proposed to mitigate the potential impact to this species. Similarly, avoidance of the single River Red Gum specimen was investigated but not possible. Mitigation measures that include the ongoing management of the existing nearby populations will be implemented, and it is considered highly unlikely that the proposal will have a significant impact on the endangered population of River Red Gums.

5.9 Visual amenity

This section describes the visual character of the project area and its surrounds, identifies potentially sensitive viewpoints into the project area, and assesses the potential visual impacts of the proposal. Measures proposed to minimise the potential for visual impacts are also stipulated.

5.9.1 Existing environment

i Regional context

The Hunter Valley comprises a mixture of rural, built and natural landscapes, ranging from steep, forested mountain ranges to, gently undulating farmland, mining pits and infrastructure, and the river flats on the Hunter River floodplain. Dominant viewscape features are agricultural grazing lands, open cut coal mines and associated infrastructure, and power stations, set against a backdrop of forested mountain ranges.

ii Local context

Dominant visual features of the landscape immediately surrounding the project area are the existing open cut pits, mine-related infrastructure and rehabilitated former mining areas, to the north, east and south. This includes HVO North, Ravensworth/ Narama Mine, HVO South, Warkworth Mine, Wambo Mine and United Colliery. The mining areas are visible from nearby roads, industrial areas, rural properties and residences. The other key industrial facility visible in the local area is the Bayswater Power Station, located to the north of the project area.

In addition to industrial characteristics of the local viewscapes, there are expanses of agricultural grazing land on the Hunter Valley floodplain to the south of the project area, and on the steeper slopes to the west, along with scattered rural residences, farm infrastructure and tree stands. Vegetated former overburden emplacement areas are located immediately north of the project area, adjacent to Lemington Road, and there are woodland areas on ridgelines further to the north, beyond the existing Carrington Pit.

An aerial photograph of the project area and its surrounds is presented as Figure 1.2.

iii Viewpoints

There are limited viewing opportunities of the project area due to the undulating nature of the surrounding landscape.

The project area is visible to motorists on Lemington Road, for a distance of around 2.5km (viewpoint 1), and a private landholder, located to the west and south-west of the project area, on the western side of Lemington Road (viewpoint 2). It is noted that viewpoint 2 corresponds with Receptor No. 10, as shown on Figure 5.4 and used in the air and noise and vibration assessments. Viewpoints 1 and 2 afford elevated, largely unobstructed views of the project area from vantage points near to its western boundary. Further descriptions of these viewpoints are provided in **Error! Reference source not found.**. Photographs 5.1 and 5.2 show the existing views of the project area from these locations.

The project area is shielded from view of other potentially sensitive receivers, including the village of Jerrys Plains and the Golden Highway, by intervening ridgelines.

Photograph 5.1 **Viewpoint 1, Lemington Road facing east towards the project area**

Photograph 5.2 **Viewpoint 2, adjacent landholder facing north-east towards the project area**

5.9.2 Impact assessment

i Visual amenity

The potential impacts of the proposal on visual amenity have been assessed by considering the visibility of proposed project components to surrounding areas, the visual absorption capacity of the area with respect to these components, and the visual sensitivity of the viewpoints identified in Section 5.9.1 iii.

Visual absorption capacity is the ability of a landscape to be changed and still retain its existing visual characteristics, such as rural, built or natural character. It is determined by considering the visibility of the project area and the degree of contrast between a proposed development and the local and regional viewscapes.

In the short-term, the appearance of the project area will change from rural to mining. The ability of the surrounding landscapes to 'adsorb' the visible components of the proposal, ie the visual absorption capacity, is assessed as being moderate to high. Mining developments are a common feature of the local and regional setting, and the project area is contained within and immediately adjoining existing mining areas. It will only be visible from a small number of sensitive viewpoints. However, whilst the proposal will be visually consistent with surrounding land uses, the mining activities will be closer and more visible to the sensitive viewpoints, at a location which has minimal screening. It is noted that the planned rehabilitation will restore the natural and rural character of the area.

Visual sensitivity is a measure of the level of concern attached by the surrounding land users to a change in the landscape character. It is based on factors including the number of people affected, land use, visibility, the current degree of exposure to the style of development proposed, distance of viewers from the project area, and the duration of viewing time.

The visual sensitivity of the area is assessed as being low to moderate, given that only a small number of people will be affected, all of whom have existing views of active mining areas which are similar in appearance to the proposal. An analysis of the visual sensitivity of viewpoints 1 and 2 is provided in Table 5.17, along with identification of the key components of the proposal that will be visible from these locations.

Table 5.17 Visual sensitivity analysis and identification of proposed changes to viewscapes

Viewpoint	Visual Sensitivity	Key components of the proposal likely to be visible
Viewpoint 1 (Lemington Road users)	*Low to moderate.* The project area is highly visible from Lemington Road, which passes alongside its western boundary. Landform and road-side tree plantings screen views from Lemington Road at some locations, including adjacent to the proposed overburden emplacement areas, however, little to no screening exists for an approximate 2.5km stretch of road near the project area. Visual sensitivity of Lemington Road users is reduced as motorists will experience only passing views of the project area, at speeds of around 100 kilometres per hour (km/hr). There are existing views of active mining areas and pits at Ravensworth-Narama Mine, HVO North and HVO South from various locations along the road, and a significant portion of motorists on Lemington Road are mine-related.	*During mining:* • in-pit and out-of-pit mining activities and equipment, including mine machinery, pit benches, haul roads and the services corridor; • levees; and • overburden emplacement areas. *Post-mining:* • rehabilitated landform.

Table 5.17 Visual sensitivity analysis and identification of proposed changes to viewscapes

Viewpoint	Visual Sensitivity	Key components of the proposal likely to be visible
Viewpoint 2 (adjacent landholder)	*Moderate.* Viewpoint 2 is located approximately 500m to the south-west of the project area. Views of the project area from this point are elevated, with minimal screening provided by roadside trees. Visual sensitivity is reduced as there are existing views of the active pits and mining areas at Carrington, Riverview and Cheshunt Pits from these locations.	As for viewpoint 1, though overburden emplacement areas are not likely to be visible.

Mining activities and infrastructure within the proposed extension area and at the overburden emplacement areas will temporarily be closer and more clearly visible to Lemington Road users and residents at viewpoint 2 than currently occurs, as a result of the proposal. This will affect visual amenity at these locations in the short-term. Visibility of operations within the project area will be greatest at the outset when the pit is at its most westerly extent, and will decrease over time as mining progresses to the east, away from viewpoints, and rehabilitation occurs. With respect to the overburden emplacement areas, the existing vegetation screens adjacent to Lemington Road will continue to mature during the mining period, which will provide additional screening from road users. In addition, there are existing rehabilitated emplacement areas at this location, and as such this land use is consistent with the existing land use.

Given the small number of sensitive viewpoints and their low to moderate visual sensitivity, the visually consistent nature of the proposal with mining activities currently visible from these viewpoints and throughout the region, and the proposed rehabilitation and final landform management strategy (see Section 3.2.3), the proposal is not expected to have a significant visual impact. The proposed management measures set out in Section 5.9.3 will minimise visual impacts on nearby residents and road users during operations.

ii Lighting

Lighting within the project area, including from headlights, machinery and lighting plants in active mining and emplacement areas, will be visible from outside of the project area, to the sensitive viewer locations identified in Table 5.17, and as a glow on the horizon from more distant areas. Lighting is necessary to ensure the safety and efficiency of night-time operations, and is a common feature of existing mining and power station operations in the area. Lighting will be relocated throughout the life of the mining, as the locations of the active mining and overburden emplacement areas alter.

Lighting within the proposed extension area and overburden emplacement areas will form a temporary extension to the existing lit areas at Carrington Pit and within the local area. From a distance, any additional glare from lighting of the proposal components is unlikely to be discernible beyond that in the adjoining areas. The lighting will be directed away from surrounding residences and roads which will minimise the potential for nuisance and safety impacts. Coal & Allied has existing HSEQ Management System procedures which will be implemented for the proposal to minimise the effects of lighting, as discussed below.

5.9.3 Management and monitoring

Visual amenity management is, and will continue to be, undertaken in accordance with relevant HSEQ Management System procedures. These include actions for lighting, infrastructure design and maintenance, and maintenance of visual amenity through landscaping and rehabilitation. Examples of the measures which will be implemented for the proposal include:

- progressive rehabilitation, and revegetation of rehabilitated areas as soon as practical after final landforms and drainage structures are completed;
- design and placement of lighting instalments to minimise lighting impacts wherever possible, including provision of shields on floodlights, fitting lights with sensor switches or time switches and/ or directing lighting away from mine boundaries where possible;
- ensuring all external lighting complies with *AS4282-1997 Control of Obtrusive Effects of Outdoor Lighting*;
- response procedures for the advent that lighting is observed to be impacting public roads or sensitive receptors or if a complaint is received; and
- conducting an annual visual assessment of operations, including recommendations for additional mitigation measures where necessary.

5.9.4 Conclusions

The undulating nature of the local landscape limits viewing opportunities of the project area. However, during mining, in-pit and out-of-pit mining activities and equipment, levees, overburden emplacement areas and night-time lighting will be visible to some surrounding areas, most notably to passing motorists on Lemington Road and an adjacent landholder. These components will be similar in appearance to the mining areas currently visible from these locations and will not have a significant additional impact. Progressive rehabilitation will occur to restore the rural character of the area, consistent with the surrounding landscapes. Accordingly, visual impacts of the proposal will be temporary and are not expected to be significant. Management measures will be implemented throughout the life of the proposal to minimise the potential for adverse lighting and visual amenity impacts, in accordance with the HSEQ Management System.

5.10 Greenhouse gas emissions

This section provides a summary of the greenhouse gas (GHG) assessment prepared by PAEHolmes, which is presented in full in Appendix G.

5.10.1 Existing environment

Greenhouses gases occur naturally in the atmosphere, and contribute to warming of the Earth's atmosphere by trapping heat energy from the sun. The concentration of GHGs in the atmosphere, particularly carbon dioxide (CO_2), is increasing, largely due to the combustion of fossil fuels and the removal of forests (IPCC, 1996). Increasing GHG concentrations in the atmosphere can change the radiation balance of the Earth, causing further warming of the Earth's surface. Scientists predict that the major consequence of this will be climate change, which could place stresses on ecological systems that have adapted to current climate regimes. The potential magnitude and significance of the effects are not yet fully understood.

Mining activities generate GHG emissions from a number of sources, including combustion of fossil fuels in diesel powered equipment and electricity generation, and release of fugitive methane emissions from coal seams during the extraction of coal.

The relevant GHGs identified in association with the proposal are CO_2, methane (CH_4) and nitrous oxide (N_2O).

5.10.2 Impact assessment

The proposal will generate CO_2, CH_4 and N_2O emissions from the following activities:

- mining and extraction, including the extraction and processing of coal, blasting, use of diesel-powered equipment and electricity usage;
- product coal transport to the Port Waratah at Newcastle and to overseas customers; and
- product coal usage, including from combustion in power generating facilities and use in steel manufacture.

The GHG assessment considered Scope 1, 2 and 3 emissions. Scope 1 emissions are direct emissions from on-site activities. Scope 2 emissions are indirect emissions from the on-site consumption of electricity, steam or heat produced by another organisation. Accordingly, Scope 1 and 2 emissions are due to the actual operation of the proposal. Scope 3 emissions are the indirect emissions from off-site transport and end-use of the product coal.

PAEHolmes estimated the Scope 1, 2 and 3 GHG emissions likely to be generated by each of these activities using published emissions factors and information supplied by Coal & Allied. The results are summarised in Table 5.18.

Emission estimates are expressed as annual average CO_2-equivalent (CO_2-e) emissions. This is a commonly used unit for GHG accounting, and refers to the global warming potential of the various GHGs relative to CO_2. It accounts for the fact that different GHGs have different global warming potentials. It is noted that the emission estimates in Table 5.18 are based on assumptions around transport modes and distances; diesel, electricity and explosives use rates; amount of ROM coal extracted; and end use of the product coal. Actual emissions from the proposal are likely to differ in response to deviations from these assumptions, eg in response to improvements in power generation efficiencies and pollution controls.

Table 5.18 Summary of total estimated CO_2-e emissions from the proposal

Year	Annual average CO_2-e emissions (t)					
	Mining and extraction		Product coal transport	Product coal usage	TOTAL	
	Scope 1	Scope 3	Scope 3	Scope 3	Scope 1	Scope 3
1	789,944	1,637	93,674	5,737,886	789,944	5,833,197
2	789,944	1,637	93,674	5,737,886	789,944	5,833,197
3	789,944	1,637	93,674	5,737,886	789,944	5,833,197
4	789,944	1,637	93,674	5,737,886	789,944	5,833,197
5	789,944	1,637	93,674	5,737,886	789,944	5,833,197
6	533,956	1,106	63,324	3,878,811	533,956	3,943,241
				Total	4.5Mt	33.1Mt
						37.6Mt
				Annual Average	0.8Mt/yr	5.5Mt/yr
						6.3Mt/yr

Note: Some figures not exact due to rounding. Scope 2 emissions are 0.

The exact relationship between GHG levels and global warming is not yet understood, and as such, it is not possible to determine the contribution that the predicted GHG emissions from the proposal might make to global warming. However, to put the estimated emission levels into context, the following comparative statements are made:

- average annual emissions from the proposal (Scopes 1 and 2) are estimated to be approximately 0.5 per cent of the estimated total volume of NSW CO_2–e emissions in 2007 (estimated to be 162.7Mt CO_2-e) (DCC, 2009);
- average annual emissions from the proposal (Scopes 1 and 2) are estimated to be approximately 0.14 per cent of the estimated total volume of Australia's CO_2–e emissions in 2007 (estimated to be 541.2 Mt CO_2-e) (DCC, 2009); and
- average annual emissions from the proposal (Scopes 1, 2 and 3) are estimated to be 0.0002 per cent of the current volume of CO_2–e stored in the atmosphere (estimated to be 3,000Gt).

It should be noted that Scope 3 emissions from the proposal were not included in the comparisons with State and national emission levels, as Scope 3 emissions are typically attributed to the user of the coal not the producer. This is to avoid double counting of emissions and minimise the application of uncertain assumptions regarding end use of the coal.

When viewed in the context of State, national and global emission levels, it can be concluded that GHG emissions from the proposal will not have any measurable environmental effect. PAEHolmes calculated that the predicted emissions from the proposal could contribute around 0.000005 per cent to the predicted increase in global temperatures due to an increase in GHG emissions from their current levels.

5.10.3 Management and monitoring

Coal & Allied has plans and standards to minimise energy usage and GHG emissions from its operations, including HVO. This currently includes the Greenhouse and Energy Efficiency Plan for HVO and the Rio

Tinto Coal Australia Climate Change Action Plan. These plans include objectives, commitments, procedures and responsibilities for:

- researching and promoting low emission coal technologies;
- improving energy use and efficiency and reducing GHG emissions from the mining, processing and use of coal;
- designing projects to recognise climate change risks and opportunities; and
- raising awareness and building support amongst key stakeholders groups, including government agencies.

Coal & Allied has targets for GHG emissions and energy use, as well as legal requirements for monitoring and reporting on these. The existing energy saving and GHG emission reduction measures and projects will continue to be implemented at HVO, inclusive of the proposal, and will be revised as required to respond to new information, technologies and policies as they evolve.

In addition to the above plans and standards, and as mentioned in Section 3.1, waste is managed across HVO in accordance with the waste management plans which form part of Rio Tinto Coal Australia's HSEQ Management System. Waste generated from the implementation of the proposal would be managed in conformity with the same plans. Such waste management contributes to energy efficiency through measures such as the following:

- planning when purchasing items to avoid or minimise waste so that preference is given to products that are recyclable or reusable over products that are either not recyclable or reusable, as well as products that have the minimum of packaging and/or packaging which is reusable or recyclable;
- segregating waste to facilitate maximum reuse or recycling including segregation of scrap metals and waste grease and lubricants and general recyclables such as glass and paper;
- awareness through environmental training to ensure that relevant employees are aware of waste management procedures;
- a waste tracking system; and
- disposal of waste by a licensed contractor.

5.10.4 Conclusions

Estimates and assessment of GHG emissions from the proposal carried out by PAEHolmes found that GHG emissions from the proposal were unlikely to have any measurable environmental effect.

5.11 Traffic and transport

This section describes and assesses the potential impacts of the proposal on the local traffic and transport network, and identifies the measures proposed to minimise the potential for adverse impacts. Where relevant, it draws on the findings of previous traffic and transport assessments conducted for HVO North.

5.11.1 Existing environment

Mine-related traffic from operations at HVO and surrounding mines comprises a significant proportion of existing traffic volumes on the road network surrounding HVO. The public road network in the vicinity of the project area is described in the following.

- The New England Highway, located to the north of the project area, is a two lane national highway, which generally has a speed limit of 100km/ hour.
- The Golden Highway, located to the south of the project area, is a two lane State highway, which generally has a speed limit of 100km/ hour.
- Lemington Road, located adjacent to the western boundary of the project area, is a local road which is owned and maintained by Singleton Council. It connects the New England Highway and the Golden Highway, and provides access to a number of rural properties and mining areas, including HVO North. Lemington Road generally has two lanes and a speed limit of 100km/ hour. It operates at a high level of service with free flow traffic conditions. Several sections of the road have been relocated in recent years, to accommodate mining operations.

Old Lemington Road runs through the proposed extension area and currently provides access to the EnergyAustralia substation which is located adjacent to the project area. The road is no longer in use, with the exception of mine related traffic, occupiers of the project area and EnergyAustralia. The road will be decommissioned as a result of proposal. An application under the *Roads Act 1993* will be made to close the section of the road affected by the proposal.

5.11.2 Impact assessment

The proposal does not involve any changes to employee numbers or coal production, or any haulage on public roads. All vehicle movements for coal and overburden haulage will be internal and product coal will continue to be transported by rail to Port Waratah, as per the existing approved operations. There will be no increase to existing traffic volumes on road or rail networks as a result of the proposal.

A section of Lemington Road will be temporarily closed when blasting occurs in the vicinity, including during blasting within 500m of the road. During mining within the western portion of the proposed extension area, and in line with current practices, Lemington Road will typically be closed three to five times per week, with a maximum of two closures per day. Blasting related road closures will have some nuisance impacts on road users, however, they are a necessary element of Coal & Allied's blast procedures, to ensure road safety is maintained, and are common throughout the region. Temporary road closures will not have any significant traffic or transport impacts, as Lemington Road only experiences relatively low traffic volumes, each closure will be only for around 10 minutes, and closures will be managed as described in Section 5.11.3, to minimise the potential for adverse impacts.

Decommissioning of the section of Old Lemington Road which runs through the proposed extension area will not have any significant impact on access to the substation as an alternate all weather access road will be provided.

Night-time lighting within the project area will be visible to motorists on Lemington Road. However, as discussed in Section 5.9, lighting will be directed away from the road and will be located, designed and managed in accordance with the procedures in the HSEQ Management System, to minimise the potential for impacts on traffic safety.

5.11.3 Management and monitoring

The proposed temporary closure of Lemington Road during blasting which has the potential to impact road safety will minimise the potential for adverse impacts. The closed section of road will remain closed until the 'all clear' has been given and an inspection has confirmed the road is in a safe and trafficable condition, free from dust, fume affecting visibility and fly-rock. Blasting-related road closures will be managed in accordance with the relevant Coal & Allied procedures and a Road Closure Management Plan and Traffic Control Plan to be developed for Lemington Road.

The proposed management measures to minimise lighting impacts on the surrounding road network are discussed in Section 5.9.3.

5.11.4 Conclusions

The proposal will not result in any increase in traffic volumes on public road or rail networks. Temporary blasting-related closures of a section of Lemington Road will only be for around 10 minutes at a time and will not have any significant traffic or transport impacts. They will be managed with a Road Closure Management Plan and Traffic Control Plan. Potential lighting impacts on Lemington Road users will be managed through Coal & Allied's existing environmental standards and procedures. Closure of Old Lemington Road within the project area will not have any significant impact.

5.12 Non-indigenous heritage

5.12.1 Introduction

The non-indigenous heritage component of this EA was based on a review of heritage investigations previously undertaken in the area, as well as national, State and local government heritage databases and lists, to identify any heritage items and places present in the local area.

5.12.2 Existing environment

Non-indigenous heritage assessment and consultation undertaken by ERM (2005a), along with searches of national, State and local government heritage databases and lists undertaken as part of this EA, did not identify any items or places of non-indigenous heritage significance within or adjacent to the project area. The databases and lists searched comprised the Australian Heritage Places Inventory, National Heritage List, Australian Heritage Database, NSW State Heritage Inventory, Roads and Traffic Authority Section 170 Register, Hunter Regional Environmental Plan 1989 (Heritage) and Schedule 3 of the Singleton LEP 1996.

5.12.3 Impact assessment

The proposal will not impact any items or places of non-indigenous heritage significance, given that none are located within or adjacent to the project area.

5.12.4 Management and monitoring

Given that there are no items or places of non-indigenous heritage significance located within or adjacent to the project area, no management or monitoring measures in respect of non-indigenous heritage are warranted.

5.12.5 Conclusions

This assessment has found that there are no items or places of non-indigenous heritage significance located within or adjacent to the project area. Accordingly, no non-indigenous heritage management or monitoring measures are necessary.

5.13 Socio-economics

5.13.1 Introduction

The existing social and economic impacts of HVO are relatively well understood. A detailed socio-economic impact assessment was undertaken by ERM (2003), which included an assessment of potential costs and benefits of HVO North's operations to the surrounding communities. The proposal represents a continuation and extension of the existing approved operation with attendant costs and benefits. A quantitative cost-benefit analysis of the proposal has been undertaken by Gillespie Economics, and regional economic impact assessment techniques have been used to quantify the stimulus it will provide to the regional economy.

This section sets out the findings of these analyses and provides an overview of the social and economic setting of the proposal.

5.13.2 Existing environment

The coal mining industry provides substantial economic stimulus in the Hunter Valley. The Hunter Valley contains 39 per cent of NSW's recoverable coal reserves and contributes 63 per cent of NSW coal production (DPI, 2009). The 2006 census data for the Hunter Valley (Singleton Statistical Local Area (SLA), Muswellbrook SLA and Upper Hunter Shire SLA) indicated that 15 per cent of employed people in that area of the Hunter Valley were directly employed in the mining industry. The equivalent figure for the Singleton SLA was even higher at 20 per cent.

The coal mining sector has strong backward and forward linkages in the regional economy that contribute to flow-on economic activity and employment. Backward linkages arise from the purchases of goods and services by the mining companies to service mining operations (referred to as production-induced effects) as well as purchases by employees who spend a proportion of their wages on goods and services in the local community, including housing, food, clothes, leisure activities, transport and utilities (referred to as consumption-induced effects). Forward linkages include the supply of thermal coal to domestic power stations and Newcastle Port.

Existing coal mining provides benefits to the community by combining resources in ways that increase their value to society. This 'producer surplus' is the difference between the costs of the inputs used in the production process and the price received for the finished product (Bennett, 1996). Part of this producer surplus accrues to the Commonwealth Government in the form of company tax and the NSW Government in the form of royalties. The Commonwealth Government also obtains revenue through sales and income tax from employees and excise on fuel and imported equipment and goods. The State government obtains additional revenue via payroll tax on the wages of employees.

Presently, 803 people are directly employed at HVO. In addition to those personnel involved directly in the mining operations, more than 500 contract personnel are employed. This supply chain encompasses contractors working for HVO and also those personnel working at firms supplying HVO and its contractors. The majority of these personnel are employed by local contractors from the surrounding townships. The number of people who work at the Carrington Pit is flexible and depends on the workforce requirements of the pit at any given time. The workforce is drawn from the HVO workforce and the contractors who service HVO.

5.13.3 Impact assessment

i Economic efficiency

The proposal will have a range of potential economic costs and benefits. The main decision criterion for assessing the economic desirability of a proposal to society is its net benefit. Net benefit is the sum of the discounted benefits ('discounted' being the process of adjusting future benefits and costs to their equivalent present day values) to society less the sum of the discounted costs. A positive net benefit indicates that it would be desirable from an economic perspective for society to allocate resources to a proposal, because the community as a whole would be better off.

In a simple framework, the benefits to society of mining relate to the net production (producer surplus) and employment benefits, while the economic costs to society relate to any environmental impacts.

Net production benefits of the proposal are a function of expected incremental coal production, sale price and costs of production over time associated 'with' the proposal compared to –'without' the proposal. These values have been estimated from market data.

For the purposes of this cost-benefit analysis, it is assumed that:

- the proposal results in incremental mining of 17Mt of ROM coal;
- mining occurs from 2012 for a period of six years;
- mining is at a rate of 3Mtpa of ROM coal and 2.34Mtpa product coal;
- 95 per cent of the product coal will be thermal coal valued at US$97/t;
- 5 per cent will be semi-soft coking coal valued at US$167/t (NewsWire, 2010);
- there is a assumed residual value of land at the end of the pit life of $9M.

Capital costs associated with the proposal are estimated at $10M. Costs to mine, process and transport the coal to Port Waratah at Newcastle and rehabilitate the site are included, based on financial information provided by Coal & Allied, together with an opportunity cost for 137ha of land already owned by Coal & Allied, valued at $1M. While royalties are a cost to Coal & Allied they are part of the overall producer surplus benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of the proposal. Nevertheless, it should be noted that the project is anticipated to generate estimated total royalties of $122M.

At the NSW Treasury recommended central discount rate of 7 per cent, the proposal is estimated to have net production benefits to society of $482M. However, because the potential employment benefits and environmental impacts of the proposal have not been valued, the net production benefit of $482M represents a minimum threshold value. It is a minimum threshold value because the proposal would also

provide employment benefits to the community in the form of 208 direct full time jobs for a period of six years. Studies have shown that the community may have non-use economic values for these employment effects (Gillespie Economics 2008, Gillespie Economics 2009a). However, conservatively, no values for these benefits have been included in the analysis.

This minimum threshold value is the minimum opportunity cost to society of not proceeding with the proposal. Interpreted another way, any environmental impacts of the proposal, after mitigation by Coal & Allied, would need to be valued at greater than $482M to make the proposal questionable from an economic efficiency perspective. This is equivalent to each household in the Hunter Region (Upper Hunter Shire, Muswellbrook and Singleton Statistical Local Areas) having a willingness to pay over $25,000 to avoid any of the residual environmental impacts of proposal, after mitigation by Coal & Allied.

While Coal & Allied would initially bear the production costs and receive the production benefits (revenue) of the proposal, the net production benefits would be distributed between a number of stakeholders including Coal & Allied and its shareholders in the form of net profits, the NSW government in the form of royalties and the Commonwealth Government in the form of company tax.

The State Government also receives income by way of payroll tax while the Commonwealth Government would receive revenues in the form of income tax from employees.

The results are most sensitive to changes in the assumed value of the product coal, although demand for both thermal coal and metallurgical coal is expected to remain high in the future (ABARE 2010).

ii Regional Economic Impacts

The proposal will also provide direct and indirect stimulus to the regional and State economy. This stimulus arises from the additional purchases by Coal & Allied and its employees as a result of the proposal and can be estimated in terms of a number of specific indicators, such as gross regional output, value-added, income and employment. These indicators are defined as follows:

- *Gross regional output* - is the gross value of business turnover;
- *Value-added* – is the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output;
- *Income* – is the wages paid to employees including imputed wages for self employed and business owners; and
- *Employment* – is the number of people employed (including full-time and part-time).

For this assessment, Gillespie Economics used multipliers that have previously been estimated for an adjoining open cut mine using input-output analysis (Gillespie Economics 2009b). These Type 11A ratio multipliers (Type 11A ratio multipliers represent the initial impact, production-induced impacts and consumption induced impacts, ie total impact, as a ratio to the initial impact) were applied to the estimated direct output, value-added, income and employment effects of the proposal. Using this approach the estimated annual regional economic impacts of the proposal on the Upper Hunter economy are reported in Table 5.19.

Table 5.19 Estimated annual regional economic impacts of the proposal

	Direct effect	Production induced	Consumption induced	Total flow-on	TOTAL EFFECT
OUTPUT ($000)	$261,300	$56,702	$14,110	$70,812	$332,112
Type 11A Ratio	1.00	0.22	0.05	0.27	1.27
VALUE ADDED ($000)	$150,019	$24,753	$6,151	$30,904	$180,923
Type 11A Ratio	1.00	0.17	0.04	0.21	1.21
INCOME ($000)	$26,000	$32,786	$10,972	$43,758	$69,758
Type 11A Ratio	1.00	1.26	0.42	1.68	2.68
EMPLOYMENT (No.)	208	382	188	569	777
Type 11A Ratio	1.00	1.84	0.90	2.74	3.74

Based on this approach, the annual regional economic impact associated with the proposal is estimated at in the order of:

- $332M in annual direct and indirect regional output or business turnover;
- $181M in annual direct and indirect regional value added;
- $70M in annual direct and indirect household income; and
- 777 direct and indirect jobs.

The impacts on the NSW economy would be even greater because the larger NSW economy is likely to be able to supply more of the goods and services demanded by Coal & Allied and its employees (ie there would be less leakages from the economy) and would have a greater level of inter-sectoral linkages (ie bigger multipliers).

iii Community consultation and amenity

The community has been consulted during the development of the EA. Concerns that community members and organisations have raised have been addressed in this document (refer to Chapter 4). The proposal, if implemented, will not significantly impact on the amenity of the surrounding area (refer to Sections 5.5, 5.6 and 5.9).

5.13.4 Management and monitoring

The proposal will be managed to maximise the financial and economic return while minimising external impacts. The potential external environmental impacts of the proposal will be managed and monitored as described in Sections 5.2 to 5.12. Community engagement activities will be ongoing throughout the life of the proposal

5.13.5 Conclusions

The proposal will result in a range of costs and benefits to society. The net production benefits of the proposal are estimated at a minimum of $482M. These benefits accrue to Coal & Allied and its shareholders in the form of net profits, the NSW Government in the form of royalties and the Commonwealth Government in the form of company tax. Any residual environmental impacts of the proposal, after mitigation by Coal & Allied, would need to be valued at greater than $482M to make the

proposal questionable from an economic efficiency perspective. Interpreted another way, this is the minimum opportunity cost to society of not proceeding with the proposal.

The proposal is also estimated to provide direct and indirect stimulus to the regional and State economy from the additional purchases by Coal & Allied and its employees.

6 Statement of commitments

This chapter describes the commitments that will be implemented throughout the life of the proposal to manage potential impacts identified within the EA. Commitments include management, mitigation and monitoring measures.

As discussed in Section 3.1 vii, all of Coal & Allied's mining operations in the Hunter Valley currently operate under an HSEQ Management System which is certified to the international standard ISO:14001(2004) and forms the basis for rigorous and consistent environmental management. The HSEQ is a management tool implemented by the company rather than a consent requirement. It will continue to be implemented across HVO. The relevant plans, procedures and monitoring programmes contained within the HSEQ will be reviewed and modified to incorporate the commitments outlined below and reflect the changes to operations resulting from the proposal.

The technical reports recommend a number of measures to minimise the potential impacts resulting from the proposal. These measures have been considered in the context of the existing HVO North and the HSEQ. Commitments related specifically to the proposal are presented in Table 6.1.

Table 6.1 Commitments

Attribute	Commitment
Groundwater	• Prior to mining within the extension area a groundwater barrier wall will be constructed across the western arm of the paleochannel. The wall will be sufficiently deep to prevent flows of groundwater within the alluvium in either direction. • Continued monitoring will include: - two-monthly monitoring of water levels in any new standpipe piezometer in proximity to the proposed extension area and quarterly monitoring elsewhere, unless water level changes dictate otherwise; - daily or more frequent monitoring of pore pressures by installed auto recorders at some existing piezometers in order to discriminate between oscillatory groundwater movements attributed to rainfall recharge, and longer term pressure losses related to open cut and underground mining; and - construction of additional piezometers where deemed necessary, as information is generated from within the existing network, during the course of mining. Permeability testing will be completed on new piezometers in order to facilitate estimation of leakage and subsurface flows. • Continued groundwater quality monitoring will include: - two-monthly or quarterly (depending upon location) monitoring of basic water quality parameters, pH and EC, in existing and any new piezometers; and - six monthly measurement of TDS and speciation of water samples in piezometers. • Future impact analyses will include the following. - Where monitoring data shows significant departures from predictions in three consecutive readings, an investigation into the cause will be triggered. This could include a need to conduct more intensive monitoring, eg increased frequency, parameters or additional piezometers, or to review the management and mitigation measures. - Formal review of depressurisation of coal measures and comparison of responses with aquifer model predictions, conducted bienially by a suitably qualified hydrogeologist.

Table 6.1 Commitments

Attribute	Commitment
	- Annual reporting (including all water level and water quality data) in the AEMR.
Surface water	• Water quality monitoring will be continued.
	• The HVO water balance model will be updated regularly to ensure currency with the operational configuration of the mine water management system.
	• Runoff from undisturbed catchments will be diverted away from disturbed areas using surface drains.
	• Surface runoff from disturbed areas will be treated through sedimentation basins prior to discharge from the site. All new sediment dams and water management systems will be designed in accordance with relevant standards.
	• Sedimentation basins will be used to treat surface runoff from rehabilitated areas until the quality of runoff is suitable for release. These will be maintained or constructed as required and will be designed in accordance with relevant design standards.
	• Saline water from mining related activities will be collected within the mine water management system. Discharges will be managed in compliance with the HRSTS.
	• A Management Plan for the temporary diversion and reinstatement of the Unnamed Tributary will be developed in consultation with NOW and I&I NSW, and will include details of: - existing and proposed channel alignment, longitudinal section and cross-sections; - proposed locations of cut and fill; - sediment and erosion control measures to be implemented during construction; - proposed revegetation of the channel bed, banks and riparian zone; - a proposed monitoring regime to ensure ongoing stability and ecological health of the stream, which would include periodic inspection for erosion or deposition and a photographic record of key cross-section locations, supplemented by ground survey if instability is detected; and - contingency measures to be implemented to address any observed issues with establishment of the modified channel.
Soils and land use	• Management and mitigation strategies for the stripping, handling and use of topsoil, landform design, erosion and sediment control and seedbed preparation will be implemented to achieve the desired post-mining land capability and agricultural suitability outcomes. The detailed rehabilitation plans, consistent with Figure 3.4, will be documented in the REMP/ MOP, and will be tracked for progress in the AEMR.
	• Rehabilitation will aim to achieve the following objectives: - successful design and rehabilitation of landforms to ensure structural stability, revegetation success and containment of wastes; - development of a final landform with recognition of the pre-mining landform features, which incorporates the existing rehabilitated landforms and is consistent with the surrounding landscape features; and - post-mining land use compatible with surrounding land uses, capable of supporting viable grazing and ecological values and providing environmental and community benefits.

Table 6.1 Commitments

Attribute	Commitment
Noise and vibration	• Permanent real time directional noise monitoring will be undertaken at Jerrys Plains with back-to-base feed of data. The system will include trigger alarms, which are set to an appropriate trigger level for Jerrys Plains. In the event of an alarm, the Open Cut Examiner will be notified and operational practices reviewed to minimise the potential for noise increasing beyond compliance levels. • Coal & Allied will participate in ongoing research towards the use of predictive weather forecast data as a definitive tool to manage noise. • The system of mining and overburden emplacement permission rules being developed at HVO South will be extended to HVO North, once these have been developed and implemented. This system will feed real time site weather data into an information system. The operator of the system will be provided with instructions on whether mining or emplacement is to be allowed or restricted during certain wind conditions. • Pro-active contingency mine planning will be used to plan for events such as prevailing wind conditions that have the potential to increase noise beyond acceptable levels. The management and scheduling of mobile equipment will also be undertaken with consideration to prevailing meteorological conditions. • Attended noise monitoring will be undertaken quarterly and as required due to community requests. • Consultation and arrangements will be made with Receptor No. 10 in advance of any blasts within 900m of the residence. • To achieve 10mm/s peak particle velocity at the Lemington road bridge (due to blasting), the charge mass must be approximately 5,400kg MIC or less, given a minimum separation distance of approximately 2,500m for the closest mining area in Year 1 of the proposal.
Air quality	• Only the minimum area necessary for mining will be disturbed. Completed overburden emplacement areas will be reshaped, topsoiled and rehabilitated as soon as practicable after the completion of overburden emplacement. • Coal handling areas/ stockpiles will be maintained in a moist condition to minimise wind-blown and traffic-generated dust. • Water sprays will be available on ROM stockpiles and used to reduce airborne dust, as required. • All roads and trafficked areas will be watered as required, using water trucks, to minimise the generation of dust. • All haul roads will have edges clearly defined with marker posts or equivalent to control their locations, especially when crossing large overburden emplacement areas. • Obsolete roads will be ripped and re-vegetated. • Development of minor roads will be limited and the locations of these will be clearly defined. • Minor roads in regular use will be watered.

Table 6.1 Commitments

Attribute	Commitment
	• Obsolete roads will be ripped and re-vegetated. • Access tracks used by topsoil stripping equipment will be watered. • Long term topsoil stockpiles, not used for over three months, will be re-vegetated. • Dust aprons will be lowered during drilling. • Drills will be equipped with dust extraction cyclones, or water injection systems. • Water injection or dust suppression sprays will be used when high levels of dust are being generated. • Adequate stemming will be used at all times. Blasting will be restricted during unfavorable weather conditions, where practicable.
Aboriginal cultural heritage	• Any required salvage of Aboriginal objects from the proposal will be undertaken on the basis of a staged approach, subject to operational requirements. As a general management principle, these stages will align with a minimum three year and maximum five year mine operating plan mitigation buffer ahead of mining impacts. Permits, as required under s90 of the NPW Act, will be sought for each salvage stage. • Specific management measures for each cultural heritage place, in the event that they will be impacted by mining activities, are as follows. - An opportunity for the Aboriginal Community to undertake a cultural salvage of surface stone artefacts within the CM-CD1 precinct will be provided. Following this, a series of progressive machine scrapes will be completed across these areas to provide additional opportunities for this exercise. - The details and resourcing requirements of this salvage strategy will be agreed directly with the CHWG and in consultation with DECCW and the CHIMA. - If CM19 and CM32 will be impacted by the proposal, the Aboriginal community will be provided with an opportunity to inspect these areas and, should any cultural material be identified, undertake a salvage of that material. - A salvage collection of the isolated stone artefacts that have been identified and recorded as HVO-1121-1124 will be undertaken with the Aboriginal community. - The existing Care and Control permit (#2863 valid until 16 January 2013), issued by DECCW for the HVO cultural heritage places will be modified to include the cultural material salvaged under any new permits associated with the proposal. Alternatively, a new Care and Control Permit application will be submitted for this cultural material.
Ecology	• Fauna utilising hollows on the site will be relocated prior to clearing and during clearing. Mitigation of direct impacts on fauna will be in accordance with Coal & Allied's existing environmental procedures for the management of flora, fauna, disturbance and rehabilitation. • Prior to removal of the Tiger Orchid from the project area, a translocation plan will be prepared in consultation with DECCW, relevant botanical experts and with reference to best practice guidelines such as those identified in the Vallee *et al.* (2004) *Guidelines for the Translocation of Threatened Plants in Australia*. • Management of weeds, landscape disturbance and rehabilitation, and sediment and erosion control will be undertaken in accordance with Coal & Allied's existing environmental

Table 6.1 Commitments

Attribute	Commitment
	procedures.
	• Ecological monitoring will include monitoring of rehabilitation and the success of plant translocation efforts. General monitoring inspections will be carried out pre-clearing, during clearing, and post weed and erosion controls.
Visual amenity	• Disturbed areas will be progressively rehabilitated, and revegetation of rehabilitated areas will be undertaken as soon as practical after final landforms and drainage structures are completed.
	• Lighting instalments will be designed and placed to minimise lighting impacts wherever possible, including provision of shields on floodlights, fitting lights with sensor switches or time switches and/ or directing lighting away from mine boundaries where possible.
	• All external lighting will comply with AS4282-1997 Control of Obtrusive Effects of Outdoor Lighting.
	• Response procedures will be in place for the advent that lighting is observed to be impacting public roads or sensitive receptors or if a complaint is received.
	• An annual visual assessment of operations will be undertaken, including recommendations for additional mitigation measures where necessary.
GHG	• Coal & Allied's existing energy saving and GHG emission reduction plans and standards will be implemented at HVO, inclusive of the proposal, and will be revised as required.
Traffic and transport	• Blasting-related road closures will be managed in accordance with the relevant Coal & Allied procedures and a Road Closure Management Plan and Traffic Control Plan to be developed for Lemington Road.

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7 Project justification and conclusions

7.1 Introduction

This report has examined the potential environmental, social and economic impacts of the proposal to extend approved mining operations at Carrington Pit.

In this chapter the potential impacts of the proposal are weighed up to determine whether the proposal is justified on social, environmental and economic grounds, providing consideration to its consistency with the applicable objects of the EP&A Act.

7.2 Objects of the Environmental Planning and Assessment Act 1979

The consistency of the proposal with the relevant objects of the EP&A Act is discussed below.

"To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment".

The proposal encourages the proper management and development of a natural mineral resource, ie a low strip ratio coal resource, and of Coal & Allied's 'artificial' mining infrastructure resource, in that it includes the development and extraction of an economic coal resource by the extension of operations at an existing pit. It will utilise and further develop Coal & Allied's existing mining and environmental management infrastructure, technologies, experience and systems, and is supported by extensive physical and human infrastructure.

By enabling the continuation of mining within the Carrington Pit, the proposal will provide for continued local and regional economic benefits, which will promote the social and economic welfare of the community. The annual regional economic impact associated with the proposal is estimated to be in the order of:

- $332M in annual direct and indirect regional output or business turnover;
- $181M in annual direct and indirect regional value added;
- $70M in annual direct and indirect household income; and
- 777 direct and indirect jobs.

Technical assessments indicate that no significant environmental impacts are anticipated as a result of the proposal. The proposal also includes a suite of environmental management measures to mitigate, manage and monitor potential impacts on the environment, including surrounding 'agricultural land, natural areas, water and villages'. The rehabilitation strategy includes final landforms which are suitable for agricultural landuses and provide habitat resources for native species.

Therefore, it is considered that the proposal is consistent with this object.

"To encourage the promotion and co-ordination of the orderly and economic use and development of land."

The proposal includes the efficient transition of mining from within an existing mine pit into the adjoining land, which is also owned by Coal & Allied. This will be consistent with the surrounding mining landuses,

take advantage of considerable existing physical and human infrastructure at HVO, and enable the extraction of approximately 17Mt of an economic coal resource. The proposed rehabilitation will restore the post-mining lands to be suitable for agriculture, the pre-mining landuse.

The proposal will result in a range of costs and benefits to society. The net production benefits of the proposal are estimated at a minimum of $482M. These benefits accrue to Coal & Allied and its shareholders in the form of net profits, the NSW Government in the form of royalties and the Commonwealth Government in the form of company tax. Any residual environmental impacts of the proposal, after mitigation by Coal & Allied, would need to be valued at greater than $482M to make the proposal questionable from an economic efficiency perspective. As detailed in the preceding section, the proposal is also estimated to provide direct and indirect stimulus to the regional economy.

It is considered that the proposal would constitute the 'orderly and economic use and development of land', and is consistent with this object.

"To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats"

The proposal incorporates mitigation, management and monitoring measures for environmental protection, as detailed in the Statement of Commitments. This includes measures for the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.

"To encourage ecologically sustainable development"

Ecologically sustainable development (ESD) is defined by the Commonwealth government as: "using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased." The consistency of the proposal with each of the individual ESD principles, as set out in the EP&A Act, is discussed below.

Precautionary principle: this means that if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The environmental assessment of the proposal, undertaken by environmental specialists, has identified and assessed the potential environmental impacts, and appropriate mitigation, management and monitoring measures have been developed in response. Taking into account these measures, there will be no threat of serious or irreversible damage to the environment as a result of the proposal.

Social equity including intergenerational equity: impacts have to be balanced against humanity's needs, including needs for energy and material well-being. The proposal will meet these needs in a properly balanced way by providing a cost effective and efficient means of energy generation. It will result in the transformation of a geological resource into physical and human capital through investment in infrastructure and workforce training, and, indirectly, through payments to governments which will enable greater investments in public goods. Thus, while the proposal involves exploitation of a finite geological resource, the above transformation will contribute to intergenerational equity.

Conservation of biological diversity and maintenance of ecological integrity: the site will be rehabilitated, levees removed and the Unnamed Tributary will be reinstated at the completion of mining. These measures, along with other measures set out in the Statement of Commitments, aim to conserve the biological diversity of the site and its ecological integrity to a level commensurate with those existing.

Improved valuation and pricing of environmental resources: the potential environmental impacts of the proposal have been thoroughly addressed in this EA. The value of the proposal in terms of enhanced security of employment, royalty payments to government and the generation of a relatively cheap form of energy are all considered in the context of the projected environmental impacts. In this sense, the proposal assists in the valuation and pricing of environmental resources.

"To provide increased opportunity for public involvement and participation in environmental planning and assessment"

The community has been consulted during the development of the EA. This has been through existing Coal & Allied engagement tools, as well as community information sessions with project information available.

In conclusion, the proposal is generally consistent with the relevant objects of the EP&A Act.

7.3 Conclusions

It is considered that the proposal is justified, for the following reasons.

- It will allow the efficient transition from mining within the Carrington Pit into the adjacent extension area. It will enable the efficient extraction of an economic resource and provide for continued regional and local economic benefits.
- The site is suited for its proposed purpose and all lands are owned by the proponent.
- No significant adverse economic, social or environmental impacts are anticipated, subject to the implementation of the mitigation, management and/ or monitoring measures presented herein.
- The proposal is generally consistent with the relevant objects of the EP&A Act, including the principles of ESD.

In conclusion, the benefits of the proposal sufficiently outweigh its costs.

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References

ABARE (2010) **Australian Commodities, June Quarter**, AGPS, Canberra.

Bennett, J. (1996) **The Economic Efficiency of RACAC Resource Allocation Options: A Conceptual Framework.** Prepared for the Resource and Conservation Assessment Council.

DCC (2009) **State and Territory Greenhouse Gas Inventories 2007**.

DEC & DPI (2005) **Draft Guidelines for Threatened Species Assessment - Part 3A of the Environmental Planning and Assessment Act 1979**.

DECCW (2000) **NSW Industrial Noise Policy**.

DECCW (2005a) **Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales**.

DECCW (2005b) **Interim Community Consultation Requirements for Applicants.**

DEWHA (2009) **Significant Impact Guidelines 1.1: Matters of National Environmental Significance.**

DPI (2009) **New South Wales Coal Industry Profile**, NSW Department of Primary Industries.

EMGA Mitchell McLennan (2010) **Mount Thorley Warkworth Operations Modification – Proposed Warkworth Extension Acoustic Assessment.** Prepared for Coal & Allied (Rio Tinto Coal Australia).

ERM (2005) **Carrington Pit Extended: Statement of Environmental Effects**.

ERM (2003) **The West Pit Extension and Minor Modifications Environmental Impact Statement (EIS).**

ERM (2002) **Extension of Warkworth Coal Mine – Noise and Vibration Study.** Prepared for Coal & Allied.

ERM Mitchell McCotter Pty Ltd (1999) **Carrington Mine Environmental Impact Statement**.

Gillespie Economics (2008) **Managing the Impacts of a Mine in the Southern Coalfield: A Survey Of Community Attitudes.** Prepared for Helensburgh Coal Pty Limited.

Gillespie Economics (2009a) **Bulli Seam Operations Socio-Economic Assessment**. Prepared for Illawarra Coal Holdings Pty Limited

Gillespie Economics (2009b) **Ravensworth Operations Project Economic Assessment**. Prepared for Ravensworth Operations Pty Ltd.

Huonbrook Environment & Heritage Pty Ltd (2000) **Archaeological and Geomorphological Excavations at the proposed Carrington Mine Site, Hunter Valley, NSW**.

IPCC (1996) **Climate Change 1995 – The Science of Climate Change – Contribution of Working Group 1 to the Second Assessment Report of the Intergovernmental Panel on Climate Change**.

Ishac, N. (2010) **Improving Environmental Noise Predictions** ICA 2010 Conference Paper.

Ishac, N. (2007) **Experimental Outdoor Sound Propagation and ENM** 14th International Congress on Sound & Vibration Conference Paper.

Ishac, N. and Bullen, R. (2006) **Experimental Outdoor Sound Propagation** 13th International Congress on Sound & Vibration Conference Paper.

Junburra Aboriginal Consultancy Services (2000) **Wonnarua Cultural Heritage Assessment for Carrington Mine, Hunter Valley, NSW**.

Llyall and Associates (2005) **Hydraulic Analysis – Hunter River and Floodplain for Carrington Mine Extension.**

McCardle Cultural Heritage Pty Ltd (2009) **Carrington West Extension Study Area Indigenous Archaeological Assessment**.

MER (2005) **Carrington Extended Water Management Studies.**

NewsWire (2010) **Coal & Allied reveals and almost doubling of coal sale price**, www.industrysearch.com.au/News/Coal-and-Allied-reveals-almost-doubling-of-coal-sale-price, accessed 20/8/2010.

NOW (2005) **Management of Stream/Aquifer Systems in Coal Mining Developments – Hunter Region.**

Peake TC (2005) **The Vegetation of the Central Hunter Valley, New South Wales. A Report on the Findings of the Hunter Remnant Vegetation Project. Final Draft Version 1**.

Vallee, Laura, & Australian Network for Plant Conservation (2004) **Guidelines for the Translocation of Threatened Plants in Australia**.

WBM (2008) **Tuflow User Manual, GIS Based 2D/1D Hydrodynamic Modelling' Build 2008-08-AA BMT.**

Acronyms

%	per cent
µg/m^3	micrograms per cubic metre
µS/cm	micro Siemens per centimetre
AEMR	Annual Environmental Management Report
ARI	average recurrence interval
AU	Authorisation
Coal & Allied	Coal and Allied Operations Pty Limited
CCC	Community Consultative Committee
CH_4	methane
CHIMA	Cultural Heritage Indigenous Management Agreement
CHWG	Cultural Heritage Working Group
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
dB(A)	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB	decibels
DEC	Department of Environment and Conservation (now DECCW)
DECCW	Department of Environment, Climate Change and Water
DEH	Department of Environment and Heritage (now DEWHA)
DEWHA	Department of Environment, Water, Heritage and the Arts
DoP	Department of Planning
DPI	Department of Primary Industries (now I& I NSW)
EA	Environmental Assessment
EARs	Environmental Assessment Requirements
EC	electrical conductivity
EEC	endangered ecological community
EIS	Environmental Impact Statement
EL	Exploration Licence
ENM	Environmental Noise Model
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPL	Environment Protection Licence
ERM	Environmental Resources Management
ESD	ecologically sustainable development
FM Act	Fisheries Management Act 1994
GHG	Greenhouse Gas
ha	hectares
HRSTS	Hunter River Salinity Trading Scheme
HSEQ	Health, Safety, Environment and Quality
HVCCP	Hunter Valley Coal Preparation Plant
HVLP	Hunter Valley Load Point
HVO	Hunter Valley Operations
I&I NSW	NSW Industry & Investment
INP	Industrial Noise Policy
IPCC	Intergovernmental Panel on Climate Change
ISCMOD	Computer based dispersion model which is a modified version of the US EPA ISCST3 model
kg	kilograms

Acronyms

km	kilometres
km/ hour	kilometres per hour
km^2	square kilometres
L_1	The noise level exceeded for 1% of a measurement period
LEP	Local Environmental Plan
L_{eq}	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LGA	Local Government Area
L_{max}	Maximum Noise Level
m	metres
m^2	square metres
m^3	cubic metres
MER	Mackie Environmental Research
mg/L	milligrams per litre
MGA	Map Grid of Australia
MIC	Maximum Instantaneous Charge
ML/day	mega litres per day
mm	millimetres
mm/s	millimetres per second
MOP	Mining Operation Plan
Mt	million tonnes
Mtpa	million tonnes per annum
N_2O	nitrous oxide
NCPP	Newdell Coal Preparation Plant
NOW	NSW Office of Water (part of DECCW)
NPW Act	National Parks and Wildlife Act 1974
NSW	New South Wales
PM_{10}	Particulate matter with equivalent aerodynamic diameters of 10 µm or less
POEO Act	Protection of the Environment Operations Act 1997
REMP	Rehabilitation Environmental Management Plan
REP	Regional Environmental Plan
ROM	Run of Mine
s90	Section 90 permit under the NPW Act
SEE	Statement of Environmental Effects
SEPP	State Environmental Planning Policy
SLA	Statistical Local Area
t	tonnes
TDS	total dissolved solids
tph	tonnes per hour
TSC Act	Threatened Species Conservation Act 1995
TSP	total suspended particulates
WMA	Water Management Act 2000
WTC	Wonnarua Tribal Council