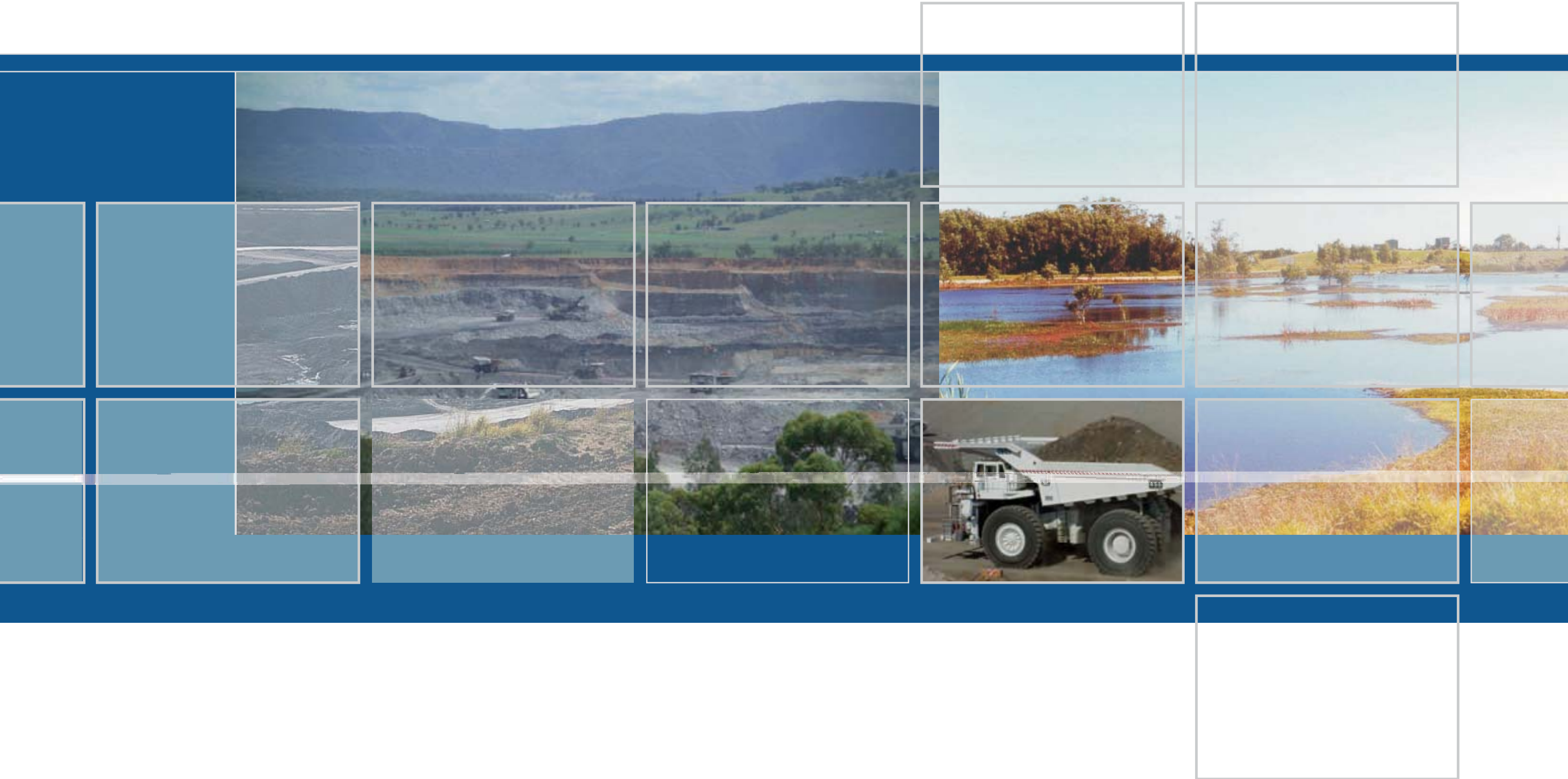

Coal & Allied Operations Pty Ltd

Hunter Valley Operations South Coal Project

Environmental Assessment Report

Volume 1

Printed January 2008

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ACRONYMS

Abbreviation	Description
ABS	Australian Bureau of Statistics
ACARP	Australian Coal Association Research Programme
ACHMP	Aboriginal Cultural Heritage Management Plan
ADCC	Aboriginal Development Consultative Committee
AGO	Australian Greenhouse Office
ARTC	Australian Rail Track Corporation
BOD	Biochemical Oxygen Demand
CCAP	Climate Change Action Plan
CCC	Community Consultative Committee
CH_4	Methane
CHAC	Cultural Heritage Advisory Committee
CHMS	Cultural Heritage Management System
CFMEU	Construction, Forestry, Mining and Energy Union
CMA	Catchment Management Authority
CNA	Coal & Allied Operations Pty Limited
CO_2	Carbon dioxide
COD	Carbon Oxygen Demand
CRA	Conzinc Rio Tinto of Australia Ltd
CVA	Conservation Volunteers Australia
DECC	Department of Environment and Climate Change (formerly Department of Environment and Conservation)
DEH	Department of the Environment and Heritage
DGRs	Director-General's Requirements
DIPNR	Department of Infrastructure, Planning and Natural Resources
DITR	Department of Industry Tourism and Resources
DoP	Department of Planning
DPI-MR	Department of Primary Industries and Mineral Resources
DWE	Department of Water and Energy (formerly Department of Natural Resources)
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EMPs	Environmental Management Plans
EMS	Environmental Management System
ENM	Environmental Noise Model
EPIs	Environmental Planning Instruments
EPL	Environment Protection Licence
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERM	Environmental Resources Management Australia Pty Ltd
ERP	Estimated Resident Population
ESAP	Energy Savings Action Plan
ESD	Ecologically Sustainable Development
FM Act	Fisheries Management Act 1994
GDP	Ground Disturbance Permit
GSSE	GSS Environmental
GIS	Geographic Information Systems
GPS	Global Positioning Systems
Ha	Hectares
HCMT	Hunter Catchment Management Trust
HCPP	Howick Coal Preparation Plant

Abbreviation	Description
HFCs	Hydrofluorocarbons
HREP	Hunter Regional Environment Plan 1989
HRLPB	Hunter Rural Lands Protection Board
HRSTS	Hunter River Salinity Trading Scheme
HVAS	High Volume Air Samplers
HVCPP	Hunter Valley Coal Preparation Plant
HVGC	Hunter Valley Gliding Club
HVLP	Hunter Valley Load Point
HVO	Hunter Valley Operations
INP	Industrial Noise Policy
ISCMOD	ISC model
km	kilometres
LCPP	Lemington Coal Preparation Plant
LIDAR	Light Detection and Ranging
LGAs	Local Government Areas
ML	Megalitres
mm/s	millimetres per second
MOP	Mining Operations Plan
m/s	metres per second
Mt	Millions of tonnes
MTCL	Mount Thorley Coal Loader
Mtpa	Million tonnes per annum
MTW	Mount Thorley Warkworth
NCPP	Newdell Coal Preparation Plant
NEPC	National Environmental Protection Council
NEPM	National Environment Protection Measures
NGGI	National Greenhouse Gas Inventory
NLP	Newdell Load Point
NPW Act	National Parks and Wildlife Act 1974
NSW	New South Wales
NV Act	Native Vegetation Act 2003
N_2O	Nitrous oxide
OLC	Overland Conveyor
PFCs	Perfluorocarbons
PFM	Planning Focus Meeting
$PM_{2.5}$	Particulate matter with equivalent aerodynamic diameter of 2.5 μm
PM_{10}	Particulate matter with equivalent aerodynamic diameter of 10 μm
POEO Act	Protection of the Environment Operations Act 1997
ppv	peak particle velocity
RASS	Radio Acoustic Sounding System
RCT	Ravensworth Coal Terminal
RFI Act	Rivers and Foreshores Improvement Act 1948
RLPB	Rural Lands Protection Board
ROM	Run of Mine
RTA	Roads and Traffic Authority of NSW
RTCA	Rio Tinto Coal Australia
SCADA	Supervisory Control and Data Acquisition
SCM	Singleton Coal Measures
SD	Statistical Division
SEPP	State Environmental Planning Policies
SEPP-MP	State Environmental Planning Policy - Major Projects

Abbreviation	Description
SF_6	Sulphur hexafluoride
SMP	Subsidence Management Plan
SSC	Singleton Shire Council
tph	tonnes per hour
ToR	Terms of Reference
TSC Act	Threatened Species Conservation Act 1995
TSFs	Tailings Storage Facilities
TSP	Total Suspended Particulate (matter)
TSS	Total Suspended Solids
TWMS	Total Waste Management System
UHVAC	Upper Hunter Valley Aboriginal Community
US EPA	United States Environmental Protection Authority
$\mu g/m^3$	microgram/cubic metre
μm	micron (millionth of a metre)
WM Act	Water Management Act 2000
WOOP dump	Western Out Of Pit Overburden Emplacement

Note: Current notation for government departments used throughout this report – not necessarily correct name at time of assessment.

EXECUTIVE SUMMARY

Background

Coal & Allied Operations Pty Limited (CNA) owns the Hunter Valley Operations (HVO) mining complex located 18 km west of Singleton.

HVO has expanded through a process of extension of existing mines and acquisition of additional mines. As a result there are numerous separate development approvals that apply to the operation.

The mining and processing activities at HVO are geographically divided by the Hunter River into HVO South and HVO North with movements of coal, coarse and fine reject, overburden, topsoil, equipment, water for operations, materials and personnel between the two areas. While HVO South and HVO North each have separate approvals, HVO is managed as an integrated operation.

HVO North comprises the active West, Carrington and North Pits and the mined out Alluvial Lands. In addition, three coal preparation plants are located in HVO North; Hunter Valley Coal Preparation Plant, Newdell Coal Preparation Plant and Howick Coal Preparation Plant. There are two train load out areas; Hunter Valley Load Point and Newdell Load Point. In addition, Ravensworth Coal Terminal is utilised.

In 2003, under Part 4 of the *Environmental Planning and Assessment Act 1979* (*EP&A Act*) an Environmental Impact Statement was prepared for the extension of West Pit, the consolidation of 18 separate consents that related to HVO North and the integration of operations within HVO North *(West Pit Extension and Minor Modification EIS,* ERM 2003*).*

HVO South comprises the Cheshunt, Riverview and Lemington Pits and the Lemington Coal Preparation Plant. Coal from the Lemington operations can currently be trucked to Mount Thorley Coal Loader for train transport to Port Waratah (Newcastle). The key features of HVO are depicted in *Figure E.1*.

There is now a similar opportunity to replace the current 25 separate consents and 10 associated modifications that apply to HVO South (at September 2006) with a single Project Approval. These consents have been issued by both the Singleton Shire Council and the Department of Planning. The granting of a Project Approval by the Minister for Planning for HVO South under the new Part 3A process (*EP&A Act*) will result in one approval for the operation and allow the surrender of the existing consents. This Environmental Assessment has been prepared in accordance with the environmental assessment requirements provided by the Director General under section 75F of the *EP&A Act*. CNA seeks Project Approval for a 21 year project life.

The environmental assessment process for this proposal commenced in July 2006 with a Planning Focus Meeting held with the relevant regulatory agencies. The assessment and preparation of technical reports covers the period August 2006 to September 2007. Mine plans for the proposal were completed in September 2006 and all assessments have been undertaken reflecting these mine plans. The mine plan and mining methods utilised for the purposes of this assessment provide an indicative worst case analysis. In the course of operational implementation, alternative mine plans and mining methods may be utilised, provided that in all cases the environmental impacts remain within the envelope of effects assessed in this report.

Legend

Project Application Area

Current Development Consent Boundary
(HVO North only)

Figure E.1

HVO South in its Local Setting

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_02 Suffix No: R1
Date:	19.09.2006 Drawing Size: A3
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

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Environmental Resources Management Australia Pty Ltd
Building C, 33 Saunders St, Pyrmont, NSW 2009
Telephone +61 2 8584 8888

ERM

Proposal

To allow for the replacement of existing consents with a single Project Approval, the proposal will seek approval for the continuation of all current operational and environmental activities at HVO South, as well as the following:

- ongoing opencut and highwall mining of coal reserves as currently approved and the extension of opencut and highwall mining (increasing the currently approved mining surface disturbance footprint by 250 ha and mining of all coal seams within HVO South to unlimited depth);

- mining of up to 16 Million tonnes per annum run of mine coal by a combination of draglines, shovels, excavators and associated haul trucks;

- integration of operations allowing for operational efficiencies and improved economies of scale. These relate to mining and processing rates, equipment use and relocation, rejects and tailings disposal and coal handling;

- modification, upgrades and / or reconstruction of existing infrastructure including increase of processing capacity of the Lemington Coal Preparation Plant to 16 Million tonnes per annum and relocation of Comleroi Road and other infrastructure across HVO South;

- construction of new coal loading infrastructure to facilitate transfer of product coal to the Wambo rail spur;

- transportation of product coal to the Wambo rail spur via either a rail loop, conveyor or trucks; and

- relocation or reconfiguration of the Hunter Valley Gliding Club airstrip and facilities (if agreed with the Club), to accommodate the integration of the Riverview Pit with South Lemington Pit 2.

A detailed project description is presented in *Chapter 5* of the Environmental Assessment Report. *Figure E.2* provides an overview of proposed operations.

Need for the Proposal

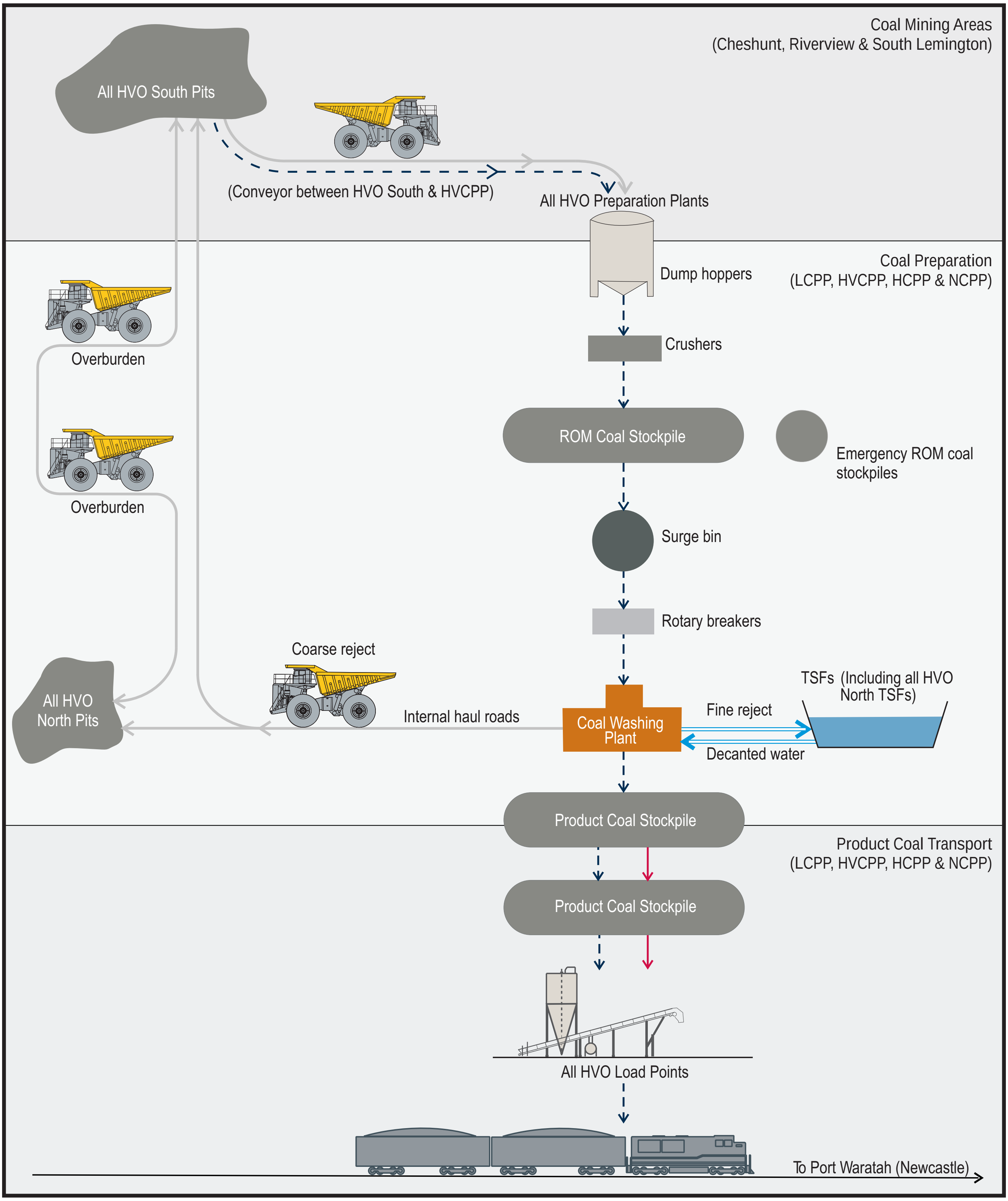
The proposal will improve many of the environmental, social and economic outcomes of HVO South including:

- the opportunity to achieve better environmental outcomes through flexibility in the operations which can be adapted to varying meteorological conditions. For example the increased flexibility will allow operations to better adapt to adverse wind conditions enabling improved dust management practices;

- greater efficiencies to reduce the impacts of noise, dust and greenhouse gas emissions due to decreased haulage distances and energy use per tonne of ROM coal processed;

- recovery of additional coal reserves by an existing mining operation which will result in significant government royalties; and

- job assurance to HVO employees. This will make their current place of employment more secure and will benefit the well-being of the local and regional communities.



Legend
- Internal Road Haulage
- Conveyor
- Intermittent Road Haulage

Figure E.2

Flowchart of Proposed Operations

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
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Date:	10/09/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	N/A		

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ERM

Stakeholder Engagement and Identification of Key Issues

CNA has an existing comprehensive stakeholder consultation strategy for all operations. An additional consultation strategy was developed during the planning phase of the environmental assessment process to allow issues raised by government, non-government and community stakeholders to be incorporated and addressed in the Environmental Assessment Report.

The community consultation strategy for the proposal was structured to provide open and transparent communication with the local community and key stakeholders throughout the environmental assessment process and included: project newsletters, face to face meetings, four project information sessions, formal briefings, presentations and ongoing information sharing.

Issues with a greater potential to impact on the environment were confirmed through liaison with relevant government agencies (and formalised in the Director General's Requirements), the local community and through the risk assessment process undertaken by the environmental assessment team. Identification of key issues has allowed for a focussed assessment of those issues. Higher risk category issues include noise and vibration, air quality, groundwater and landscape management. In addition, surface water, ecology, greenhouse gas and energy, subsidence, heritage, traffic and transport, waste, visual, land use and socio-economic assessments were undertaken.

Social and Environmental Interactions

The Environmental Assessment Report has been prepared under conservative worst case scenarios for all technical assessments to develop a range of environmental and social parameters against which the proposal can be assessed. The worst case scenarios have been used to generate an environmental envelope to provide maximum flexibility for mining operations within acceptable environmental parameters. The mining operations can therefore retain some flexibility within the constraints of the identified environmental envelope.

Table 1 provides the environmental aspects assessed, a summary of key assessment results and assessment outcomes.

Table 1 - Environmental Aspects Assessed, Summary of Key Assessment Results and Assessment Outcomes

Environmental Aspect	Key Results	Outcome
Noise and Vibration	Predicted future HVO South mining noise levels vary marginally around existing noise levels for the majority of surrounding locations. Under calm weather conditions all private residential properties not currently located within a zone of affectation experience noise levels below the operational noise limits and below the likely acquisition criteria (with stipulated mitigation strategies that will be implemented). Under adverse weather conditions (for all private residential properties not currently located within a zone of affectation), exceedances of the operational limits are predicted within Maison Dieu and one location towards Jerrys Plains. With stipulated mitigation strategies applied, the likely acquisition limit will not be exceeded at any locations not currently within a zone of affectation or where a private agreement exists with the land holder. Cumulative industrial noise assessment demonstrates that the proposal is a significant contributor at Maison Dieu residences during westerly winds as expected, although the operations are not the sole industrial source at these locations. For Warkworth Village the proposal becomes significant at one of five of the nominated residences under adverse easterly winds. Noise levels are only marginally above Industrial Noise Policy cumulative amenity targets under such conditions and the residences are either owned or are located within the affectation zones of existing mines.	The proposal provides the opportunity for improved operational management and improved environmental control over a large source of industrial noise. It will be a significant and positive step toward noise management, and will also provide operational flexibility. In addition to the standard noise and vibration control measures, night time operations in South Lemington Pit 1 will be monitored for the potential for unacceptable noise impacts resulting from meteorological conditions, with operational response as required. Blast design and monitoring will be undertaken to minimise any potential impacts to highwall stability and groundwater.

Environmental Aspect	Key Results	Outcome
Air Quality	The predicted annual average PM_{10}, TSP and deposition levels in the Maison Dieu area all comply with the relevant assessment criteria. Residences in the Maison Dieu area will experience some short term exceedances of the Department of Environment and Climate Change 50 $\mu g/m^3$ 24-hour assessment criterion during adverse winds. These will be managed via the existing monitoring network. Some locations in the Warkworth Village area are also predicted to experience 24-hour PM_{10} levels above the Department of Environment and Climate Change 50 $\mu g/m^3$ 24-hour and 30 $\mu g/m^3$ annual average PM_{10} assessment criterion. However, on this occasion, the exceedances are due to cumulative effects and emissions from HVO South play a relatively minor role in the total exceedances. It is important to note that residences within Warkworth Village are either within a zone of affectation or a private agreement exists with the land holder. Residences in the west and in the Jerrys Plains area are not predicted to exceed the assessment criteria.	The proposal provides the opportunity for improved operational management and improved environmental control for air quality emissions. It will also be a significant and positive step toward managing air quality and will provide operational flexibility. In addition to standard control measures, CNA will review the mine plan with a view to controlling dust emissions, including minimising exposed areas and shortening haul routes where practicable.
Groundwater	The proposal is not predicted to result in significant alteration to the regional or local groundwater resources. Flows in the Hunter River are not predicted to be significantly impacted by mining. This includes mining up to 100 m of the inferred or surveyed limit of alluvium of the Hunter River. Under worst case conditions, the number of days the Wollombi Brook is dry may increase by up to 6%. This increase in dry days will potentially impact areas owned by CNA as CNA own a significant portion of the land on either side of the Brook. An assessment of the potential impacts to ecological values, specifically of the River Red Gums located along the river bank, found that these species will not be significantly impacted by the proposal. Seepage into the Cheshunt Pit is predicted to range from 0.7 ML/day to 7.3 ML/day, dominated by water contained within the material disturbed by mining rather than from the	Groundwater management will be included in the site Water Management Manual. The Manual will include a detailed management plan and monitoring programme that will monitor results and compare actual versus predicted impacts. Deviations away from predicted impacts will be assessed, and if predictions are exceeded, management measures will be implemented. This multilayered approach to groundwater management will minimise the potential for impacts to the regional and local groundwater systems.

Environmental Aspect	Key Results	Outcome
	Hunter River. This range may vary by 100% in initial stages of mining. All other impacts are considered minimal.	
Surface Water	The proposal will not significantly impact the regional or local surface water systems. The main changes that may influence surface water management include: • increased water usage for the new or upgraded LCPP and support facilities; • retention of South Lemington Pit 2 levee; • revision of the mine plan resulting in a final void in the Deep Cheshunt Pit; and • modification to final landforms and changes to catchments.	Improvements will be made to the storages and drainage networks and a water management plan developed for inclusion in the HVO Water Management Manual. Extension of modified landforms into new areas will require review and modification of existing drainage systems only and will not require new systems. It was determined that the current water licences for HVO will be adequate for the proposal.
Ecology	Field surveys undertaken during the assessment identified one species listed as vulnerable under the *Threatened Species Conservation Act*, the Grey-crowned Babbler, and one population listed as endangered under the *Threatened Species Conservation Act*, *Eucalyptus camaldulensis* (River Red Gum) in the Hunter Catchment. The assessment of extension areas concluded that no threatened or endangered species or communities will be significantly impacted by the proposal. Threatened or endangered species or communities recorded in previous assessments will not be significantly impacted by the proposal.	The flora and fauna within and surrounding HVO South have been extensively studied in the past. Currently, the area of disturbance due to mining and infrastructure inside the Project Application area is 2980 ha. This proposal would increase the area of mining and infrastructure disturbance by 250 ha. Of this, 48 ha is remnant vegetation and 92 ha is regenerated vegetation. However, this proposal will promote the retention and enhancement of areas of remnant vegetation.
Aboriginal Cultural Heritage	Aboriginal cultural heritage investigations undertaken as part of this environmental assessment resulted in the discovery and recording of 138 sites at which Aboriginal cultural heritage material was identified. Six sites were determined to have high significance, with the majority of the sites having low-moderate or low significance.	Management measures have been and will be developed in consultation with the Upper Hunter Valley Cultural Heritage Working Group and include avoidance of cultural sites, cultural salvage and/or controlled collection.
Historic Heritage	Ten registered historically significant heritage items and nine non-registered potentially significant historic heritage items were identified within or adjacent to the Project Application area. The Warkworth Airfield is the only item located within the disturbance footprint of the proposed operations that has potential to be affected by the proposal. The assessment concluded that the proposal will have no effect on the heritage value of the Airstrip and associated facilities.	Existing management measures will continue to be implemented across HVO South, to ensure that significant heritage items are not adversely impacted by the proposal.

Environmental Aspect	Key Results	Outcome
Visual Assessment	The proposal includes extensions to an existing operation, with certain areas becoming increasingly visible to a small number of receptors. Proposed new and modified infrastructure including the Lemington Coal Preparation Plant and rail spur and loop will not be highly visible from Maison Dieu and can be screened with appropriate tree plantings if required. Other infrastructure upgrades are minor, and are not expected to significantly impact the visual amenity of the site. The proposed extension of mining within HVO South is not considered to significantly alter the existing viewscape.	HVO is a well established landscape feature with mining commencing over 50 years ago. Retention of much of the original vegetation and landscape features together with tree screening (if required) and other mitigation measures will minimise short term impacts to the visual amenity of the locality. Progressive rehabilitation will ensure longer term impacts are also reduced.
Traffic and Transport	The impacts to traffic and transport as a result of the proposal are likely to be minor in nature and in general require no specific management measures. The small increase in the number of permanent and temporary personnel (including contractor equivalents) during the construction phase will not result in a decrease in the level of service currently experienced on Lemington Road or Jerrys Plains Road. Temporary road closures will occur as a result of the proposal; however, these closures will be managed through CNA's existing Road Closure Management Plan.	The proposal will not significantly impact the regional or local road network. This Project Application will allow for the surrender of the approval to haul product coal on Jerrys Plains Road.
Waste Management	Volumes of wastes produced across HVO South may increase marginally as a result of the proposal.	CNA's Environmental Management Strategy will continue to be implemented and the plans, procedures and monitoring programmes relevant to waste management will be reviewed and modified if required to reflect the changes resulting from the proposal.
Energy Use and Greenhouse Gases	The proposal will result in a 21% increase in greenhouse gas emissions over the life of the mine compared to the business as usual scenario over the same period. Between project inception and peak production the impact of the proposal will range from 0.01% to 0.04% of global energy related emissions.	Energy efficiency and greenhouse gas reduction initiatives are currently implemented and will continue to be developed by CNA and Rio Tinto Coal Australia. These will aid in the minimisation of greenhouse gas production and add to the industry knowledge base on greenhouse gas reduction initiatives.

Environmental Aspect	Key Results	Outcome
Land Use and Management	Land capability assessments show that the extension areas range between Class IV and VII, classified as suitable for native vegetation establishment or grazing with significant limitations.	CNA currently implement land resource management procedures and plans as part of ongoing mining operations. These plans have been modified concurrently to the preparation of the Environmental Assessment Report to reflect changes resulting from the proposal and to enable increased ease of implementation. These plans will form part of the mine landscape strategy that will provide for enhanced landscape outcomes.
Socio-economics	The integration and extension of HVO South will ensure that mining operations will continue for at least 21 years. This additional resource will ultimately provide a benefit to the local and regional community and economy by: • ensuring ongoing employment in the mining sector at HVO; • increasing employment by 795 individuals through direct, indirect and induced employment effects (150, 150 and 495 individuals respectively); • additional sales revenue and royalties; and • significant flow-on effects into the local, regional, state and national economies.	Throughout its operations CNA will continue to develop relationships with the local community, as seen through the HVO Community Consultative Committee and by proactive management of complaints. The involvement and consultation with the community has also been evident through the various information sessions, meetings with residents and site tours. Programmes such as the CNA Community Trust, sponsorships and donations have provided support to the local community. The proposal will ensure that these efforts continue, and that the community continue to benefit from the operation of the mine.

Conclusions

This Environmental Assessment Report has presented the findings of assessments undertaken for the HVO South Coal Project.

The site that the proposal applies to is a brownfields operation and the Project Application is for the activities proposed to be undertaken at HVO South, an existing mine that currently operates under 25 separate development consents and 10 associated modifications. Existing operations are currently consented to occur until approximately 2021.

The existing equipment, infrastructure and transport facilities will continue to be utilised for the ongoing mining operations. Project Approval will provide for a 21 year time frame for mining activities from the date of approval. At the peak of operations, HVO is currently predicted to employ up to 830 people (including contractor equivalents), a possible increase of 150 people over current employment levels if market conditions are favourable (including during construction and operation).

This proposal will allow for the replacement of all of the current consents and associated modifications with a single Project Approval. Therefore the proposal seeks approval for all current operational and environmental activities to continue. It will also provide for the extension of mining within HVO South of the Hunter River and will assist with improvements in operational efficiencies (in relation to mining and processing rates, equipment use and relocation, reject and tailings disposal and coal transport and handling), infrastructure upgrades and modifications, and operational integration within HVO as a whole.

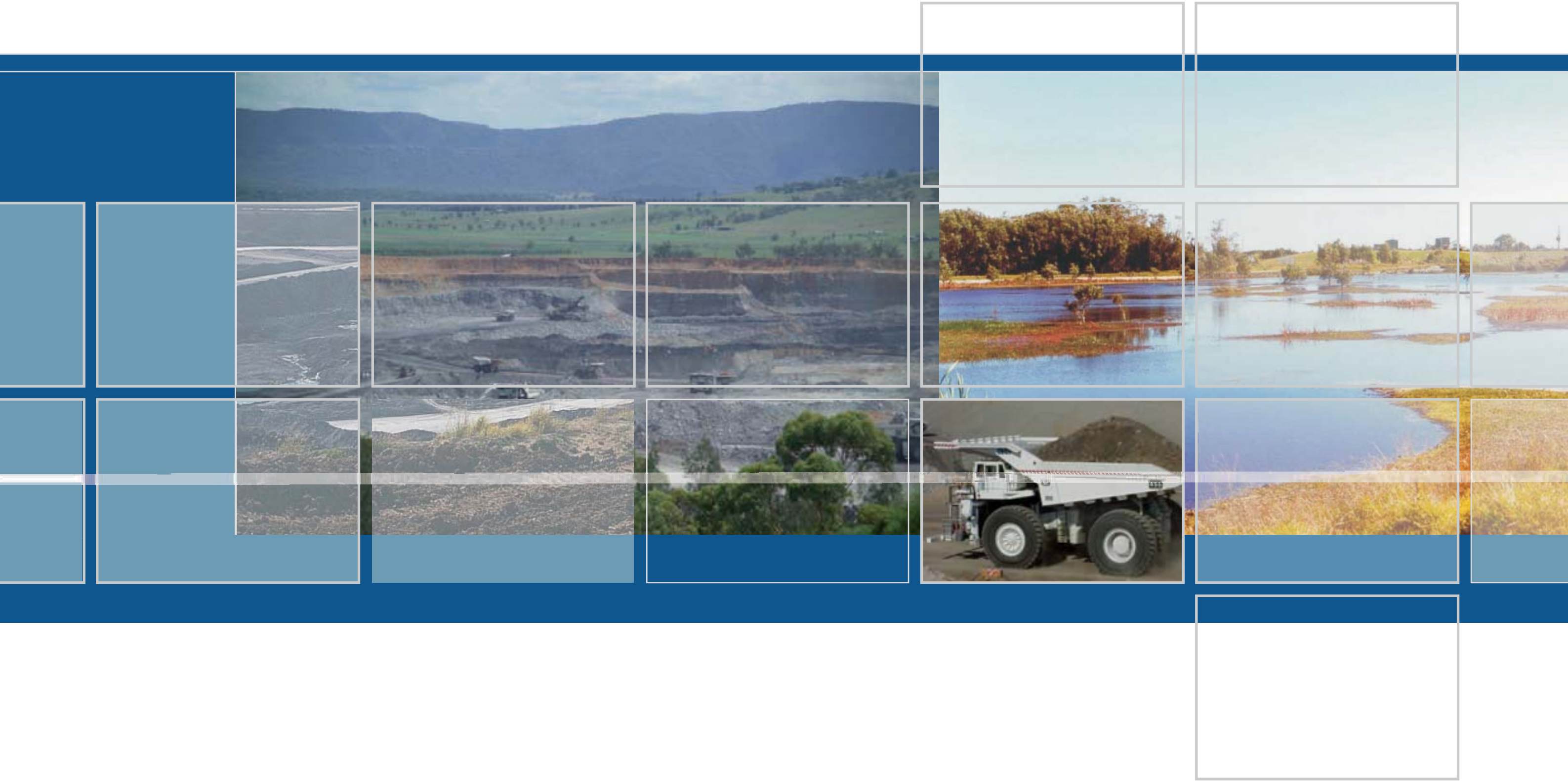
The environmental assessment has been prepared under conservative worst case scenarios for all technical assessments to develop a range of environmental and social parameters against which the proposal can be assessed. The worst case scenarios have been used to generate an environmental envelope to provide maximum flexibility for mining operations within acceptable environmental parameters. The mining operations can therefore retain some flexibility within the constraints of the identified environmental envelope. The results from the assessments are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been assessed and approved.

Any results obtained during the assessment process that indicated a potentially unacceptable impact to the environment necessitated a modification of the proposal. Key changes occurred to highwall mining areas and the location of the rail spur. In addition, modifications to operations will be undertaken to minimise potential impacts to noise, air quality and groundwater.

As a consequence, the proposal has been developed such that there are no resulting significant environmental impacts that cannot be mitigated by appropriate safeguards and management measures. Recommended management measures have been incorporated into the statement of commitments for the proposal. These will support the Project Approval conditions that will be a result of the Part 3A government assessment and approval process.

This proposal addresses meeting society's needs through the provision of a valuable resource, with consideration given to the potential impacts on the physical and social environment of not only the local and regional areas but also the national and global implications associated with greenhouse gas emissions. The proposal also provides justification for the proposed HVO South Coal Project.

If Project Approval is not obtained the current HVO South activities can continue in their current form, however operations will be restricted in the ability to improve environmental, social and operational efficiencies and will not be able to maximise the recovery of the coal resource within the Project Application area.



Coal & Allied Operations Pty Ltd

Hunter Valley Operations South Coal Project

Environmental Assessment Report
Part A - Background

1 BACKGROUND TO THE PROPOSAL

This chapter introduces the proposal, defines the regional setting and Project Application area, and outlines the need for the project. In addition, this chapter describes the basis under which the proposal will be assessed under the Environmental Planning and Assessment Act 1979 and the format of the Environmental Assessment Report.

1.1 INTRODUCTION

Coal & Allied Operations Pty Limited (CNA) owns the Hunter Valley Operations (HVO) mining complex located 18 km west of Singleton.

HVO has expanded through a process of extension of existing mines and acquisition of additional mines. As a result there are a number of separate development approvals that apply to the operation.

The mining and processing activities at HVO are geographically divided by the Hunter River into HVO South and HVO North with movements of coal, coarse and fine reject, overburden, topsoil, equipment, water for operations, materials and personnel between the two areas. While HVO South and HVO North each have separate approvals, HVO is managed as an integrated operation.

HVO North comprises the active West, Carrington and North Pits and the mined out Alluvial Lands. In addition, three coal preparation plants are located in HVO North; Hunter Valley Coal Preparation Plant (HVCPP), Newdell Coal Preparation Plant (NCPP) and Howick Coal Preparation Plant (HCPP). There are two train load out areas; Hunter Valley Load Point (HVLP) and Newdell Load Point (NLP). In addition, Ravensworth Coal Terminal (RCT) is utilised.

In 2003, under Part 4 of the *Environmental Planning and Assessment Act 1979* (*EP&A Act*) an Environmental Impact Statement (EIS) was prepared for the extension of West Pit, the consolidation of 18 separate consents that related to HVO North and the integration of operations within HVO North *(West Pit Extension and Minor Modification EIS,* ERM 2003*).*

HVO South comprises the Cheshunt, Riverview and Lemington Pits and the Lemington Coal Preparation Plant (LCPP). Coal from the Lemington operations can currently be trucked to Mount Thorley Coal Loader (MTCL) for train transport to Port Waratah (Newcastle).

As with HVO North, there is now an opportunity to replace the current 25 separate consents and 10 associated modifications that apply to HVO South (at September 2006) with a single Project Approval. These consents have been issued by both the Singleton Shire Council (SSC) and the Department of Planning (DoP). The granting of a Project Approval for HVO South under the new Part 3A process (*EP&A Act*) will result in one approval for the operation and allow the surrender of the existing consents.

The proposal, known as the HVO South Coal Project, seeks approval for all current operational and environmental activities to continue and will include:

- opencut and highwall mining of coal reserves as currently approved and the extension of opencut and highwall mining (increasing the currently approved mining surface disturbance footprint by 250 ha);

- mining of all coal seams within HVO South to unlimited depth;

- mining up to 16 Million tonnes per annum (Mtpa) run of mine (ROM) coal by a combination of draglines, shovels, excavators and associated haul trucks;

- modification, upgrades and / or reconstruction of existing infrastructure including increase of processing capacity of the Lemington Coal Preparation Plant to 16 Mtpa, additional stockpiles and new coal loading infrastructure; and relocation of Comleroi Road and other infrastructure across HVO South;

- infrastructure to facilitate transfer of product coal to the Wambo rail spur via either a rail spur and loop, overland conveyor (OLC) or trucks, or any combination;

- the full integration of operations at HVO South allowing for operational efficiencies and improved economies of scale. These relate to new activities as well as upgrades and modifications to existing approved operations, mining and processing rates, equipment use and relocation, water, reject and tailings disposal and coal handling;

- relocation or reconfiguration of the Hunter Valley Gliding Club (HVGC) airstrip and facilities (if agreed with the Club), to accommodate the integration of the Riverview Pit with South Lemington Pit 2.

- the granting of a Project Approval to replace all existing consents.

A full description of the proposal is provided in *Chapter 5*.

The proposed project has been declared as a project to which Part 3A of the *EP&A Act* applies and for which approval of the New South Wales (NSW) Minister for Planning is required. CNA seeks Project Approval for a 21 year period.

Environmental Resources Management Australia Pty Ltd (ERM) has been commissioned by CNA to undertake the environmental assessment and prepare the associated report for the proposal in accordance with the environmental assessment requirements provided by the Director General under section 75F of the *EP&A Act*.

1.2 COMPANY PROFILE

1.2.1 Overview

HVO is owned by Coal & Allied Operations Pty Limited. Rio Tinto is a major shareholder of CNA. Rio Tinto Coal Australia (RTCA) provides management services to all CNA operations.

CNA is one of Australia's largest producers and exporters of black coal and one of the largest mining companies within the Upper Hunter Valley. The company currently operates and manages three active opencut operations in the Hunter Valley: HVO, Mount Thorley Warkworth (MTW), and Bengalla Mine. The Mount Pleasant Mine is consented but not yet operational.

Chapter 21 provides an overview of CNA's operational, environmental and social approach, and company performance.

1.2.2 HVO Coal Market

The total saleable coal production for HVO (North and South) in 2006 was 12 Million tonnes (Mt). The total saleable coal comprised 22% semisoft and 78% thermal coal. The destinations of the HVO coal sold (by volume) included Japan (37%), Mexico (16%), Korea (10%), Taiwan, Australia, Malaysia, Italy, the United Kingdom, Scotland, Netherlands and Chile (37% total).

If it is assumed that the sales for HVO coal following Project Approval remain generally the same as 2006 sales, it is anticipated that the market destinations will remain generally the same.

1.3 HISTORY OF HVO

The mining complex at HVO has grown through a process of expansion and acquisitions since CNA commenced mining at Hunter Valley No. 1 (now part of HVO North) in 1979. The following is a brief history of the operations within HVO:

- mining originally commenced in the area around West Pit (formerly known as Howick) in 1949 and has continued until present times;
- activities in HVO South commenced at Lemington Mine in 1971;
- CNA commenced mining at Hunter Valley No. 1 Mine in 1979;
- Kembla Coal and Coke, a wholly owned subsidiary of Conzinc Rio Tinto of Australia Ltd (CRA) and operated by Novacoal, a newly established business unit of CRA, purchased the Howick Mine in 1989;
- Novacoal and CNA merged in 1998. Howick became part of HVO and was renamed West Pit;
- Lemington Mine was purchased from ExxonMobil by CNA in December 2000;
- CNA operated HVO as a single entity with a corporate centre in the Hunter Valley servicing the operation;
- in 2004 RTCA became the management company of CNA and HVO, resulting in the relocation of the corporate office to Brisbane, Queensland; and
- through similar mergers and acquisitions MTW is also managed by CNA. Operations at HVO and MTW have the ability to interact, in particular with water management and equipment movements.

1.4 REGIONAL SETTING AND PROJECT APPLICATION AREA

HVO is located approximately halfway between the towns of Singleton and Muswellbrook in NSW. Smaller villages in close proximity include Jerrys Plains, Warkworth and Bulga along with the community of Maison Dieu.

Local industry and agricultural activities include power stations, coal mines, dairy farming, horse studs and wineries.

HVO is located within two local government areas (LGAs). The majority of HVO is located within the Singleton LGA. A small section of the northern part of HVO is located within Muswellbrook LGA.

The Project Application area is adjoined by:

- HVO North including the active Carrington, North and West Pits to the north;
- Ravensworth - Narama and Ashton coal mines to the north east;
- grazing land to the east and west;
- grazing properties, residences and MTW mine to the south east; and
- United Colliery and Wambo mines to the south west.

HVO South includes and is surrounded by a range of remnant woodland, regrowth and pastured areas that have experienced different disturbance regimes in the past such as clearing, grazing and fire. The area supports a range of native flora and fauna species, as well as introduced plant species.

The location of HVO South in its regional and local settings is shown in *Figure 1.1* and *Figure 1.2*.

In this Environmental Assessment Report any reference to HVO South refers to any proposed activities and all the HVO opencut pits located south of the Hunter River including Cheshunt Pit, Riverview Pit, South Lemington Pits 1 and 2 and the LCPP.

1.4.1 Project Application Area

The Project Application area has been selected to:

- encompass the existing active Mining Leases, which include areas of privately owned land;
- where possible follow easily identifiable features to assist operations with recognising the proposed approval perimeter;
- allow for monitoring and maintenance activities to be undertaken; and
- allow for installation or relocation of minor infrastructure and ancillary equipment (eg electricity supply and distribution network, pipelines, water management infrastructure, communication cables and associated infrastructure).

The Project Application area is shown in *Figure 1.2*. All land within this Project Application area line is the subject of this Project Application.

The Project Application area line abutting the Hunter River was defined by tracing a 2006 aerial photograph. The intention of the Project Application area line where abutting Hunter River is to be the bank of the river.

1.4.2 Land Ownership

Land ownership within and surrounding the Project Application area is shown in *Figure 1.3*. Details of land ownership are provided in *Annex A*. The majority of land within the Project Application area is owned by CNA (*Table 1.1*). All property identification is based on publicly available information.

The Project Application area includes parcels of land, some with associated coal reserves, not owned by CNA. The parties potentially affected by the proposal include the Hunter Valley Gliding Club (HVGC), the Construction, Forestry, Mining and Energy Union (CFMEU), United Collieries, Xstrata Coal, Wambo Mining Corporation (rail spur), SSC and the Rural Lands Protection Board (RLPB).

Table 1.1 Land Ownership and Classification within the Project Application Area

	Currently Consented Area (ha) [1]	**New Project Application Area (ha)** [1]	**Total Area (ha)** [1]
CNA	4492	754.4	5246.4
Maison Dieu Community	193.5	-	193.5
Warkworth Village	215.2	-	215.2
CFMEU[2]	11.6	47.6	59.2
HVGC	24.3	1.8	26.1
Cheshunt Property (Stapleton)	27.6	-	27.6
Other non-CNA owned	21.5	11.2	32.7
Crown Land	55.7	27.8	83.5
Roads	58.9	14.4	73.3
River	105.8	-	105.8
			6063

1. Areas listed have not been surveyed and are therefore approximate only.
2. Includes land owned by John Maitland, Robert Graham and George Coates.

Discussions are in progress with the relevant parties with respect to commercial arrangements, including:

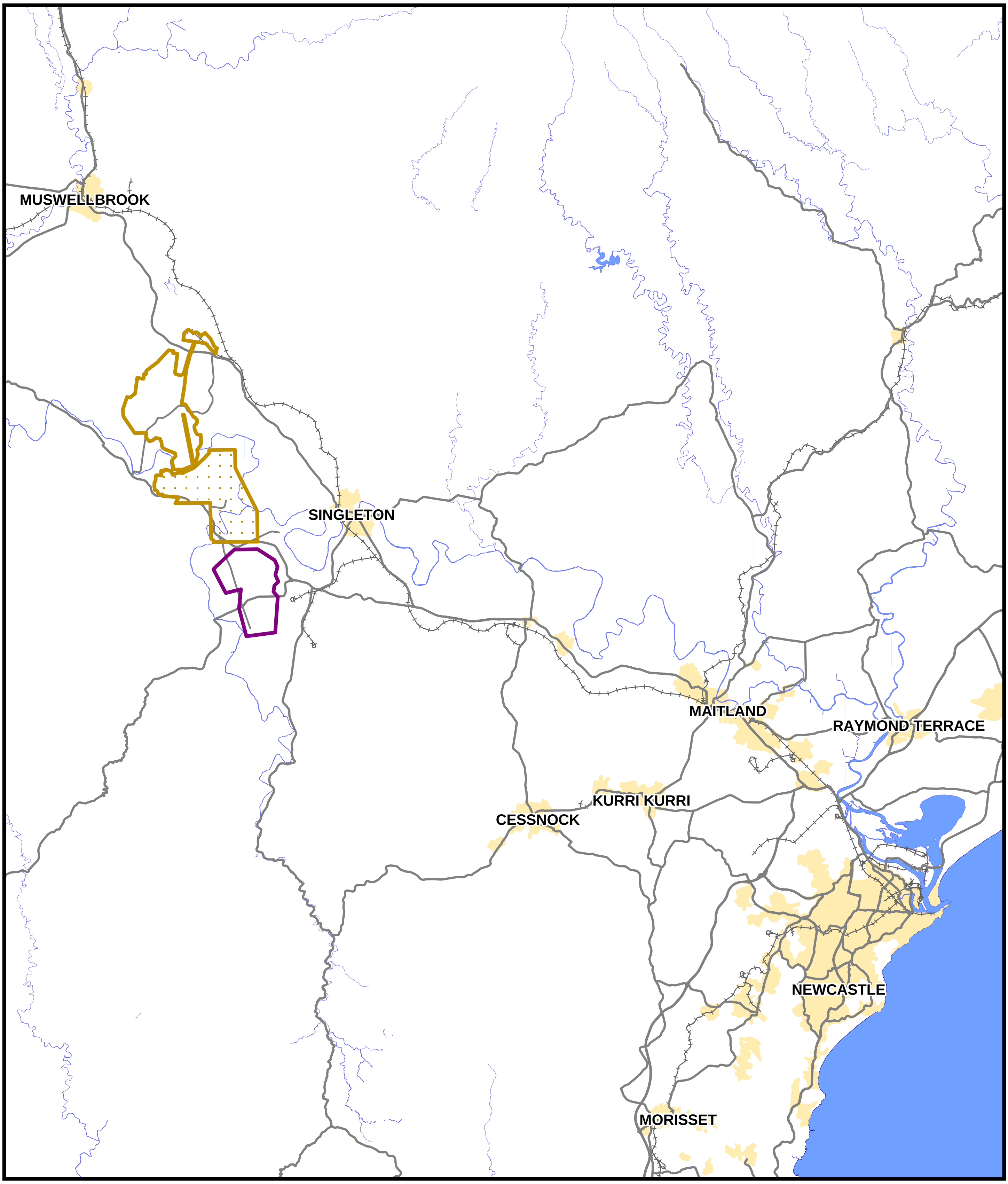
- formalising existing CNA entitlements to access land areas; and
- seeking commercial options with the parties to allow access or purchase of land and coal rights.

In addition there are a number of Crown roads within the Project Application area. Where required for operational purposes, CNA will seek approval from the Department of Lands for the transfer of Crown land reserves and closure of Crown roads within the Project Application area.

To the extent native title has not or may not have been extinguished on the Crown land within the Project Application area, the proponent will be required to comply with relevant native title legislation in carrying out the project.

At the commencement of the environmental assessment, the properties located within the zone of affectation for HVO and specifically activities South of the Hunter River were the neighbouring properties 'Cheshunt' (since purchased by CNA, now referred to as the Cheshunt Pit Extension), 'Wandewoi' and 'Oaklands' (since purchased by Xstrata).

If the environmental assessment studies identify any changes to this zone resulting from the activities associated with the proposal, CNA will comply with relevant Project Approval conditions for property acquisition.



Legend

- HVO North
- HVO South
- MTW

Figure 1.1

Location of HVO South in its Regional Setting

Client:	Caol & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_01 Suffix No: R3
Date:	24.08.2007 Drawing Size: A4
Drawn By:	DH Reviewed By: LS
Source:	MapInfo Aus Ltd Pty
Scale:	Refer to Scale Bar

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Legend

Project Application Area

Current Development Consent Boundary (HVO North only)

Figure 1.2

HVO South in its Local Setting

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_02 Suffix No: R1
Date:	19.09.2006 Drawing Size: A3
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

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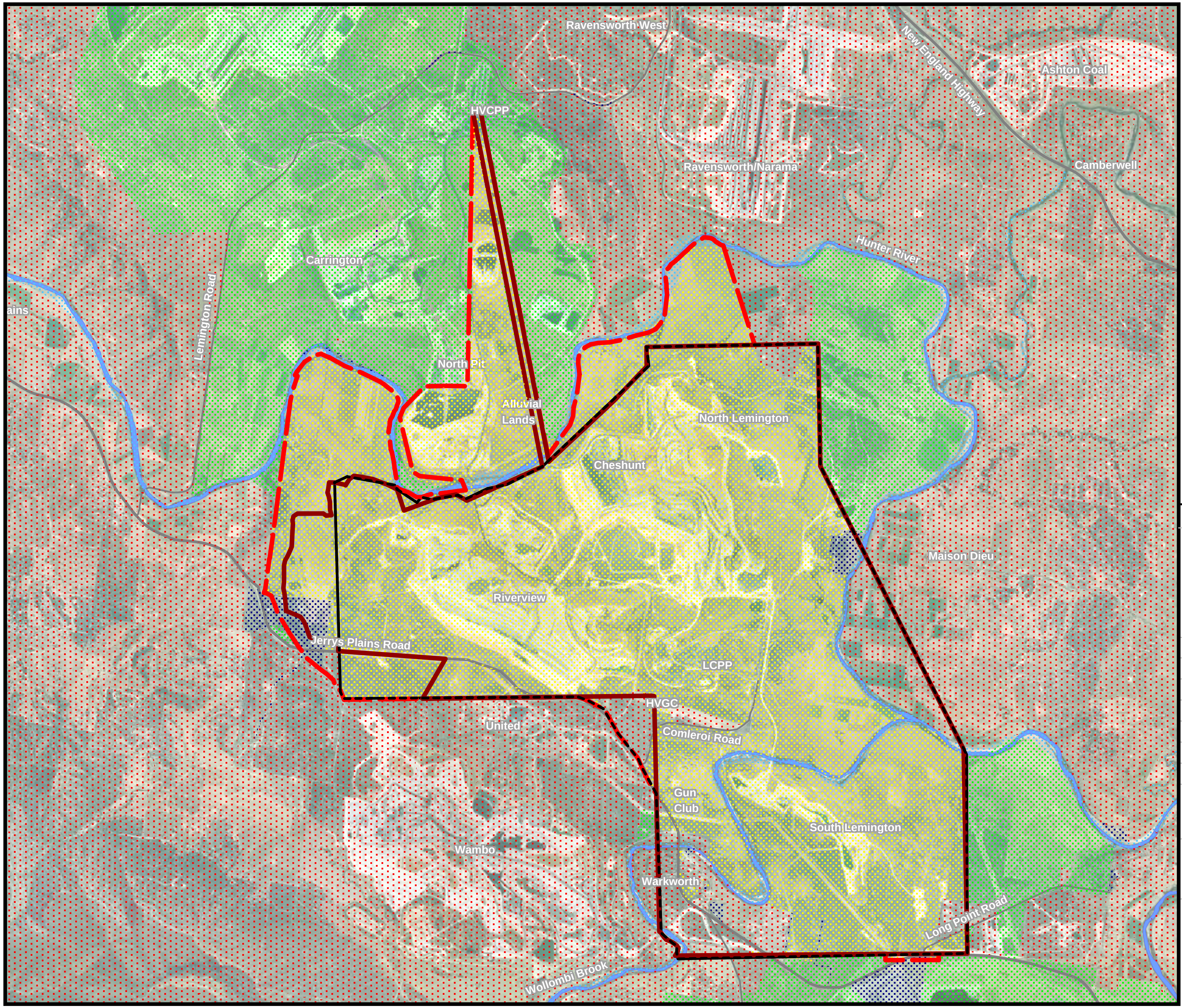

Legend

Land Ownership

- Privately Owned Land
- CNA Owned Land (outside PA area)
- CNA Owned Land (within PA area)
- Crown Land

- Project Application Area
- Current Mining Lease Boundary
- Proposed Mining Lease Boundary Merged
- Current Development Consent Boundary Merged

Figure 1.3

Property Ownership, Project Application Area and Mining Lease Boundaries

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_03	Suffix No:	R5
Date:	04.10.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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1.5 *NEED FOR THE PROJECT*

The proposal will improve many of the environmental, social and economic outcomes of HVO South. The major proposal related benefits are outlined below.

Environmental benefits include:

- better assessment of cumulative issues. Reporting for a consolidated HVO South in conjunction with the consolidated reporting for HVO North will improve CNA's ability to manage cumulative impacts across all HVO;

- an increased understanding of groundwater and surface water interactions across HVO South. Detailed groundwater and surface water studies have been undertaken as part of this environmental assessment. The studies have assessed potential impacts across all of HVO South and incorporated boundary conditions. Past assessments have generally focused on areas within HVO South in isolation;

- reduction in energy use per tonne of ROM coal processed. The proposed increase in LCPP capacity would allow less ROM coal from HVO South requiring transport to HVO North for processing; and

- continued assurance of 'best practice' final landscape design. The proposal provides an opportunity to present a conceptual landscape strategy that includes rehabilitation to pre-mining land capability, wildlife corridors, final voids and final landform, ensuring that approved fundamental features or landforms are in place for mine closure.

Social benefits include:

- security of employment. Increasing the financial strength of the operation will provide assurance to HVO employees that their current place of employment is secure. This benefits the well-being of the local and regional communities;

- improved amenity outcomes. Greater efficiencies and flexibility in operations will improve environmental outcomes and may reduce the impacts of environmental aspects such as noise and dust emissions; and

- the local and regional communities will benefit from a consolidated approach to mine closure. The fundamentals for mine closure are presented in *Chapter 19 – Mine Landscape Planning*. The holistic approach to closure enables the development of a final landform that integrates biodiversity, the Synoptic Plan – Integrated Landscapes for Coal Mine Rehabilitation for the Hunter Valley of NSW (DMR 1999) objectives, strategic land use ie agricultural versus biological benefits including the restoration of previous land capability through progressive rehabilitation, and integration of landscape characteristics such as final voids and slopes. Current and future planning will continue to consider the expectations and preferences of local community, to ensure acceptance of a practical post-mining land use.

Operational and economic benefits include:

- enhancing the economic position of HVO South. The approval for integration and continuation of mining will make HVO South financially stronger with the flexibility to mine coal from different seams in different pits to suit market demand. In addition, operational efficiency will be increased in line with the greater flexibility in mining operations;

- recovery of additional (deeper) coal reserves by an existing mining operation. This includes coal reserves which occur within the existing approved Cheshunt Pit mining footprint, Riverview coal reserves to the south west and south east and South Lemington Pit 1 to the west. The deeper coal reserves below the currently consented Cheshunt Pit would otherwise be sterilised;

- government royalties. Approval to mine additional coal reserves will prolong the life of operations within HVO South and enhance overall HVO net present value. The overall intent is to prevent sterilisation of valuable coal reserves. This will ensure that the NSW Government will continue to receive royalties;

- reduction in administration time. The Project Approval will remove some of the anomalies and unnecessary approval conditions that are a legacy of the 35 separate approvals gained through a process of expansion and acquisition. In addition, the existence of the 35 approvals, issued by different consent authorities with varying conditions, reporting requirements and different approval periods, is an impediment to both rational mining operations and administrative practices. This hinders not only CNA personnel but also the consent authorities. A single comprehensive approval will also promote transparency to the community; and

- cost saving for both CNA and the government. Past experience with minor changes to proposals or operations is that they require modification to the consent conditions. The proposed approach to mining will greatly reduce the need to seek incidental consent modification, thus reducing costs and saving time for both CNA and the determining authority.

1.6 PURPOSE OF THE ENVIRONMENTAL ASSESSMENT

The proposal will be assessed in accordance with the *EP&A Act* and the *Environmental Planning and Assessment Regulation 2000* which provide the framework for environmental assessment of developments in NSW.

This environmental assessment has been undertaken to assess the significance of the potential social and environmental impacts associated with the construction and operation of the proposed project.

The proposed project has been declared by State Environmental Planning Policy - Major Projects (SEPP-MP) 2005 as a Project to which Part 3A of the *EP&A Act* applies. This environmental assessment has been prepared in accordance with the requirements of section 75F of the *EP&A Act*, the requirements of the Director General of the DoP and acknowledges issues raised by relevant government agencies, non-government organisations and the community.

Issues with a greater potential to impact the environment were confirmed through liaison with relevant government agencies, the local community and through the risk assessment process undertaken by the environmental assessment team. Identification of key issues has allowed for a focussed assessment of those issues. Higher risk category issues identified by the assessment team include noise and vibration, air quality, groundwater and landscape management. The Director-General's Requirements (DGRs) were developed by DoP in conjunction with a range of other government agencies to focus the assessment on the significant aspects of the proposal, which include surface water, flora and fauna, greenhouse gases, subsidence, heritage, traffic and transport, visual, social and economic in addition to the aspects identified as higher risk by the assessment team. The DGRs are presented in *Annex B* and are discussed further in *Chapter 6*.

The mine plan and mining methods utilised for the purposes of this assessment provide an indicative worst case analysis. In the course of operational implementation, alternative mine plans and mining methods may be utilised, provided that in all cases the environmental impacts remain within the envelope of effects assessed in this report. The mining operations can therefore retain some flexibility within the constraints of the identified environmental envelope.

The Environmental Assessment Report will accompany the Project Application (refer to *Annex B*) submitted to the Minister for Planning for determination.

1.7 STRUCTURE OF THE ENVIRONMENTAL ASSESSMENT

The Environmental Assessment Report contains three volumes incorporating the main text of the environmental assessment in Volume 1 with supporting specialist technical studies in Volumes 2 and 3. Volume 1 has been prepared to ensure that the existing activities and proposed changes are described adequately; the potential environmental impacts assessed are detailed; and existing mitigation measures and additional measures proposed are detailed. It is divided into four parts, as follows.

Volume 1

Part A – Background

Part A contains three chapters; it provides an introduction to the development, describes existing operations and related consent conditions and provides the statutory framework under which the proposal will be assessed.

Part B – Proposal

Part B contains two chapters; it provides an overview of alternatives assessed as part of the development of the proposal, and a justification for the preferred proposal components. In addition, a detailed description of the proposal is provided.

Part C – Social and Environmental Interactions

Part C contains 15 chapters; it describes the interactions between the proposal and the biophysical and social environments.

It outlines the issues identification and consultation process undertaken with government and community stakeholders. In addition, it provides an assessment of the potential environmental impacts associated with the proposal and a description of the management and monitoring measures proposed to manage any identified impacts.

Part D – Conclusions

Part D contains three chapters; it provides an overview of CNA's social and environmental performance, the draft Statement of Commitments which consolidates the proposed provisions to manage impacts or minimise harm to the environment for all operations within HVO South, and an assessment of the proposal against the principles of ecologically sustainable development.

Volume 2 contains nine annexes as follows:

Annex A – Land ownership details

Annex B – Director General's Requirements

Annex C – *HVO South Coal Project, Planning and Regulatory Framework Report, ERM 2008*

Annex D – Summary of existing consented operations

Annex E – Indicative mine plans (2006)

Annex F – *Preliminary Assessment of Highwall Mining Extraction Layouts at Riverview (North and South Sections), Cheshunt and Lemington South Pits, Hunter Valley Operation, Strata Engineering 2007*

Annex G – Sample consultation material

Annex H - *HVO South Coal Project, Noise and Vibration Assessment Report, ERM 2008*

Annex I - *HVO South Coal Project, Air Quality Assessment Report, Holmes Air Sciences 2008*

Volume 3 contains nine annexes as follows:

Annex J – *HVO South Coal Project, Groundwater Assessment Report, ERM 2008*

Annex K - *HVO South Coal Project, Surface Water Report, ERM 2008*

Annex L - *HVO South Coal Project, Ecological Assessment Report, ERM 2008*

Annex M – *HVO South Coal Project, Cultural Heritage Community Consultation and Survey Results*, *RTCA 2008*

Annex N – *Heritage Impact Assessment Warkworth Aerodrome, Weir and Phillips 2007*

Annex O - *HVO South Coal Project, Greenhouse and Energy Assessment, Rio Tinto 2007*

Annex P – *Soil Survey and Land Resource Assessment, GSSE 2007*

Annex Q – Draft Land Management Plans

Annex R – Project Team

A list of acronyms and references used throughout the report are provided at the front and rear of Volume 1 respectively. Descriptions of climate parameters are presented where relevant to assessments within Volumes 1, 2 and 3 of the Environmental Assessment Report.

2 EXISTING OPERATIONS

Chapter 2 provides an overview of the current approvals for HVO South for which Part 3A approval is sought. In addition, it describes the coal reserve within HVO South and describes existing operations in terms of mining methodology, coal preparation and movements and existing infrastructure. A brief overview of HVO North is provided and existing interactions between HVO South, HVO North and MTW are discussed.

2.1 HVO SOUTH

2.1.1 Cheshunt and Riverview Pits Overview

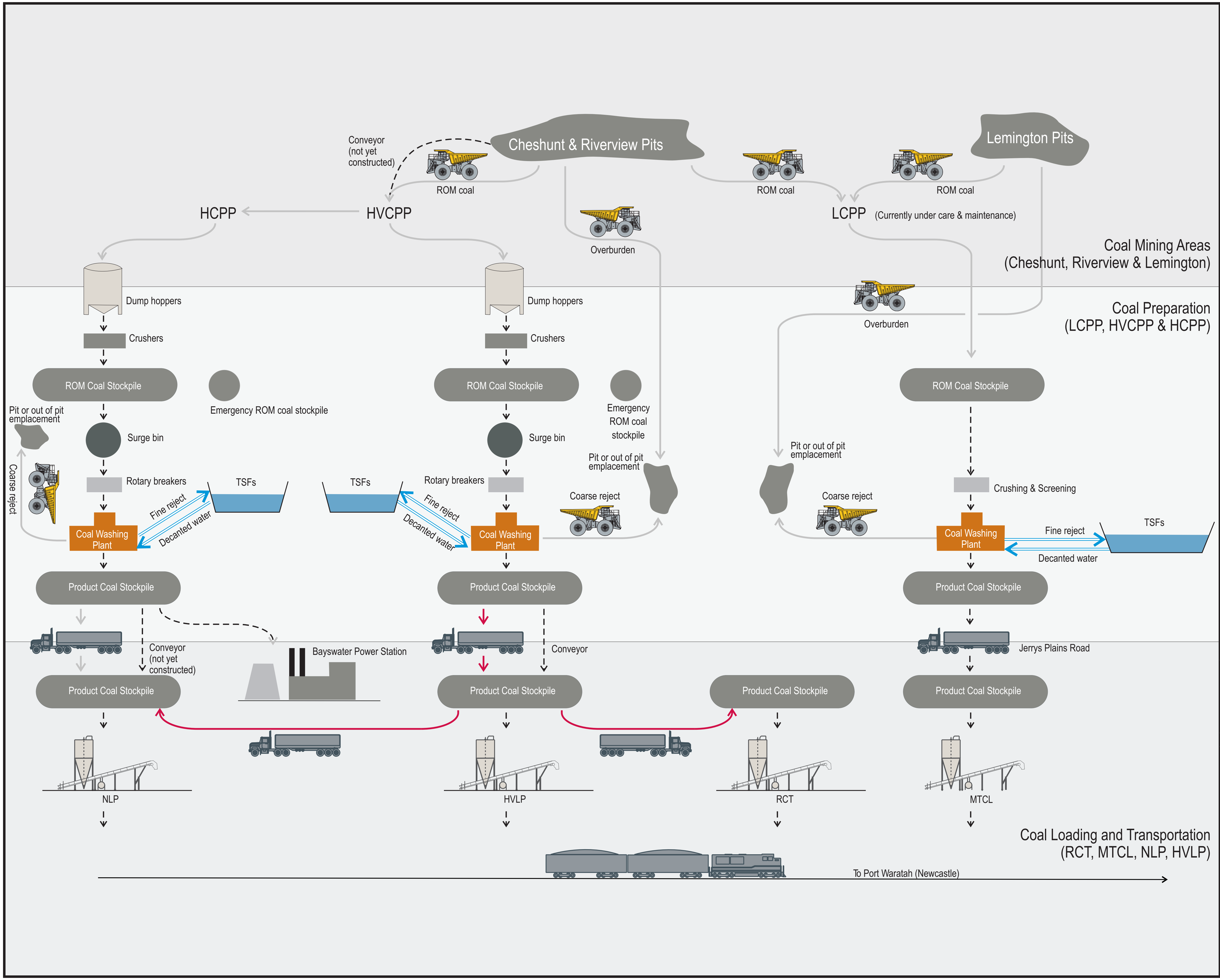
Cheshunt and Riverview Pits were consented for mining as Hunter Valley No. 2 mine in 1986 under DA 85/27. Mining was conducted initially by truck and shovel with dragline mining approved in 2002. The re-alignment of Jerrys Plains Road and the western out of pit overburden emplacement (WOOP dump), were approved under DA 37/90 in 1990. The overland conveyor to HVCPP was approved under DA 114-12-98 but has not yet been constructed.

Since the original approval the area south of the Hunter River has undergone a number of name changes. It has been referred to previously as Hunter Valley No. 1 South Pit, Hunter Valley No. 2 Mine and South Pit.

The mines are now approved under the South Pit Consent DA 114-12-98, with modifications to mine plans, operational requirements, equipment and development timing made in 2001, 2002, 2003 and 2006. The existing approval to mine including all modifications covers an area of 2980 ha, from surface to the bottom of the Vaux seam. *Table 2.1* provides a summary of the current approvals.

The current mine plan has two pits operating concurrently; Cheshunt Pit located in the north east corner of the Mine Lease area, and Riverview Pit, located in the south west section. Coal is approved for transport to LCPP and HVCPP (DA 114-12-98 M2).

The total production approved from the Cheshunt and Riverview Pits is 8 Mtpa of ROM coal. Coal is currently transported by internal haul roads to the HVCPP prior to being conveyed to the HVLP for rail transport to the Port of Newcastle. Under DA 181-8-2005, an extension to the Cheshunt Pit allows for an additional 8 Mt of ROM coal to be mined. Mining in the Cheshunt Pit extension area commenced in August 2006 and is expected to last for approximately two years. An overview of currently approved operations is presented in *Figure 2.1*.



Legend

- Road Haulage
- Conveyor
- Pipeline
- Intermittent Road Haulage

Figure 2.1

Flowchart of Currently Approved Operations

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_IC_01_R4
Date:	26/09/2007 — Drawing size: A3
Drawn by:	GC — Reviewed by: LS
Source:	-
Scale:	N/A

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Table 2.1 Summary of Approvals for Cheshunt and Riverview Pits

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
85/27	Consent	4/5/1986	DEP(1)	• Development of Hunter Valley No. 2 Mine; • Transport of 4.5 Mt ROM coal from south of the Hunter River to HVCPP, Liddell coal preparation plant or HVLP; and • Short and long term re-alignments of Jerrys Plains Road to the south.
37/90	Consent	18/10/1990	SSC(2)	• Western out of pit emplacement of overburden in conjunction with development of Hunter Valley No. 2 Mine; • Rescheduling of mining of Riverview Pit.
81/828	Mod 1(3) of DA 85/27	12/11/1990	SSC	• Permanent re-alignment of Jerrys Plains Road.
144/96	Consent	24/1/1997	SSC	• Small extension (56 ha) to the south west of South Mine (formerly Hunter Valley No. 2 Mine) to re-orientate mining strips to increase mining efficiency.
144/96 (37) M1	Mod 1 of DA 144/96	27/8/1997	DUAP(4)	• Modification of DA 114/96 to take weather measurements prior to blasting.
114-12-98	Consent	15/3/2000	DUAP	• Increase rate of mining to 8 Mtpa and development of the Cheshunt Pit with mining to progress south west through Riverview Pit; • Out of pit emplacement of overburden on the Lemington Mine site; and • Overland conveyor from HVO South to HVCPP.
85/27 M2	Mod 2 of DA 85/27	2/10/2001 (Expired)	DUAP	• Interim coal transport from Riverview Pit to LCPP for processing prior to CNA approval for revised Cheshunt and Riverview mine plans.
14-01-01-M1	Mod 1 of DA 114-12-98	2/11/2001	DUAP	• Change in mining schedule to seven day operations from year one rather than year nine; and • Amendment to Dewatering Management Plan and timing of submission of Environmental Management Plans (EMPs).

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
114-12-98-M2	Mod 2 of DA 114-12-98	11/3/2002	DUAP	• Altering mine plan including concurrent mining at Cheshunt and Riverview Pits; • Operation of dragline at Riverview Pit; and • Haulage of coal from Cheshunt and Riverview Pits to either or both the LCPP or the HVCPP.
114-12-98-M3	Mod 3 of DA 114-12-98 (S02/02690)	23/1/2003	SSC	• Establish 13 month blasting schedule from Feb 2003.
181-8-05	Consent	31/3/2006	DoP	• Extension of opencut coal mining from the Cheshunt Pit through the Barry Property enabling the extraction of approx 8 Mtpa of ROM coal.
114-12-98-M4	Mod 4 of DA 114-12-98	11/5/2006	DoP	• Extension of opencut coal mining to the south west of the Riverview Pit.

1. Department of Environment and Planning which is now DoP
2. Singleton Shire Council
3. Mod = Modification
4. Department of Urban Affairs and Planning which is now DoP

Works that have been approved, but not yet constructed for the Cheshunt and Riverview Pits are summarised in *Table 2.2*.

Table 2.2 ***Summary of Works Approved but not yet Commenced***

Approval No.	Summary of Approved Activity
114-12-98	Overland coal conveyor to HVCPP, highwall and auger mining

Annex D provides more detail on the activities described in previous environmental assessment documents to be included in this Project Approval.

2.1.2 Lemington Mine and Coal Preparation Plant Overview

Lemington Mine was acquired by CNA from ExxonMobil in December 2000.

Lemington Mine commenced operations in 1971 with Lemington opencut mine and Underground Mine No. 1. In 1976 development of Underground Mine No. 2 commenced. Production from Underground Mine No. 2 ceased in 1987 but the access was maintained for ventilation to Underground Mine No. 1. All underground mining ceased in 1991.

In 1998 mining in the South Lemington area was approved with opencut truck and shovel operations consented under DA 84/115, DA 215/97 and DA 405/98. The existing approval to mine under all current consents and associated modifications covers an area of approximately 263 ha with extraction by opencut methods to the Bowfield seam. The Mt Arthur and Piercefield seams have previously been mined by underground methods (*Annex D*).

The mining strategy approved for the South Lemington Pits was to mine two small opencuts, followed by a scraper slot and trench mining, each supplemented by highwall mining. South Lemington Pit 1 is located to the south east of Wollombi Brook and South Lemington Pit 2 (not yet commenced) is located to the west of Wollombi Brook. The opencut pits were designed to be mined using an electric rope shovel to remove overburden in 180 m long strips by 100 m wide blocks and transported using 240 tonne trucks. The coal was to be ripped by dozer and then loaded by a front end loader onto a fleet of trucks for transport to the LCPP.

The majority of the North Lemington Pit (with the exception of the south western corner) has been mined out and rehabilitation works have been undertaken on the northern and eastern sides of the overburden dump. The south western corner is planned be mined to a greater depth and would be incorporated into 'Deep Cheshunt' under this proposal.

Mining in South Lemington Pit 1 was suspended in 2001 and the remaining void is currently used for temporary storage of mine water from both HVO and the adjacent MTW operation. Mining will recommence under this proposal.

The No. 1 LCPP was established as part of the initial development of Lemington in 1971. Later expansion and development of Lemington Underground Mine No. 2 in 1976 resulted in the construction of the No. 2 coal preparation plant. The No. 1 LCPP was closed and decommissioned in 1987. The No. 2 plant is referred to as LCPP throughout this report.

The existing LCPP has approval to process 660 tonnes per hour (tph) of ROM coal (DA 79/48) which equates to 5.5 Mtpa. Approval to process coal from Lemington Mine (opencut and underground) was obtained under DA 215/97.2 and DA 405/98.2, and from the Cheshunt and Riverview Pits under DA 114-12-98 M2. The LCPP is currently under care and maintenance.

Approval for the transport of product coal via road haulage to Branxton rail siding was part of the original Lemington Mine consent granted in 1971. Road transport was redirected to the MTCL after its construction in 1978. Coal transportation is currently consented under DA 215/97 and DA 405/98. *Figure 2.1* provides an overview of currently approved operations. A summary of the significant approvals relating to the Lemington Mine and LCPP are provided in *Table 2.3*. Works consented but not yet commenced are detailed in *Table 2.4.*

Table 2.3 Summary of Approvals for Lemington Mine and Coal Preparation Plant

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
Unknown	Consent	24/6/1971	SSC(1)	• Establish opencut mine and No. 1 underground mining complex with 1 Mtpa ROM coal limit; and • Construct LCPP.
88/76	Consent	24/2/1976	SSC	• Extend mining into No. 2 underground mining complex area and increase ROM coal to 2 Mtpa; and • Construct second (current) LCPP at 440 tph of ROM coal.
78/42	Consent	27/10/1978 (Expired)	SSC	• Extract 3,000 tonne bulk sample (trial pit) over 12 month period.
79/48	Consent	17/6/1980	SSC	• Extend opencut and underground mining operations within Buchanan-Lemington Colliery; • Construct haul road from South Lemington to Lemington across Wollombi Brook; and • Increase capacity of No. 2 LCPP to 660 tph ROM coal.
80/71	Consent	24/11/1980	SSC	• Extend opencut mining operations within Buchanan-Lemington Colliery Holding.
80/70	Mod 1(2) to DA 80/71	10/8/1981	SSC	• Increase product coal production to 3 Mtpa.
83/145	Consent	3/1/1984	SSC	• Erect an office block for mine administration.
83/153	Consent	10/2/1984	SSC	• Establish and rehabilitate out of pit overburden dump within a Crown Road Reserve and the Colliery Holding.
80/961 (equivalent DEP(3) 84/115)	Consent	19/8/1985	SSC	• Northern extension of opencut mining within Buchanan-Lemington Colliery Holding.
84/115 (equivalent SSC 80/961)	Consent	19/8/1985	DEP	• North west extension of Lemington Mine.
86/75	Consent	24/07/1986	DEP	• Establish Lemington bathhouse.
86/104	Consent	4/11/1986	SSC	• Extensions to No. 2 Mine workshop.
86/119	Consent	4/11/1986	SSC	• Erection of a 40 unit carport.

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
87/42	Consent	18/12/1987 (Lapsed)		• Establish new opencut and underground mine within the Lemington Colliery Holding and partial replacements of existing operations.
115/90	Consent	20/9/1990	SSC	• Conversion of part of an existing carport into a laboratory.
73/91	Consent	10/7/1991	SSC	• Erect a store building extension to the existing opencut mobile equipment workshop.
101/92	Consent	9/7/1992	SSC	• Establish V-demountable offices.
225/92	Consent	29/1/1993	DEP	• Install a coarse reject transport conveyor. Fill and progressively rehabilitate underground mine No. 2 portal using coarse reject from LCPP (over 4-5 years).
214/97	Consent	10/12/1997 (Expired)	SSC	• Increase in production from 3 Mt to 3.2 Mt for a 12 month period.
215/97	Consent	17/7/1998	SSC	• Establish mining in South Lemington – two opencut pits, a scraper slot and trench, supplemented by highwall mining operations to 0.6 Mtpa product; • Total combined product limit of 3 Mtpa; and • Removal of 82 ha of Warkworth Sands Woodland (not listed under *TSC Act* at that time).
84/115 M2 (N93/00245/009)	Mod 2 of DA 80/961	23/1/1998	DUAP(4)	• Minor modification of DA 84/115 regarding required apprentice ratios.
405/98	Mod 1 of DA 84/115 and DA 215/97	11/1/1999	SSC	• Increase production to 3.5 Mtpa of product coal (north to 2.9 Mtpa and south to 0.6 Mtpa).
195/2000	Certificate	6/2/2001	SSC	• Establishment and occupation certificate for Comleroi Farm hay shed.
215/97.2 and 405/98.2	Mod 1 of DA 405/98 and DA 215/97	9/1/2001	SSC	• Increase saleable(5) production to 4.4 Mtpa (north to 3.2 Mtpa and south to 1.2 Mtpa).
396/2001	Consent	22/10/2001	SSC	• Temporary crossings and relocate dragline and electric shovel.
114-12-98 M2	Mod 2 of DA 114-12-98	11/3/2002	DUAP	• Second modification of DA 114-12-98 to allow permanent transport of ROM coal to LCPP in addition to HVCPP.

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
651/2001	Consent	13/2/2002	SSC	• Temporary shovel crossing (Wollombi Brook).
215/97.3 and 405/98.3	S.96(1A) Mod 2 of DA 405/98 and DA 215/97	22/11/2002	SSC	• Modification for the extension of time limit for the road haulage of 0.9 Mtpa product coal from Lemington South only, from LCPP to MTCL until 9/1/2006 (Coal from North Lemington treated at LCPP can still be transported by haul road to MTCL).
58/2007	Consent	27/2/2007	SSC	• Installation of one bore on CNA land west of South Lemington Pit 1.

1. Singleton Shire Council
2. Mod = Modification
3. Department of Environment and Planning which is now DoP
4. Department of Urban Affairs and Planning which is now DoP
5. Saleable equivalent to Product coal = ROM coal multiplied by 75%

Table 2.4 Summary of Works Approved but not yet Commenced

Approval No.	Summary of Approved Activity
215/97	South Lemington Pit 2, scraper slot and trench, highwall mining

Annex D provides more detail on the activities described in previous environmental assessment documents to be included in this Project Approval.

2.2 HVO NORTH

HVO North comprises:

- the operational West Pit, Carrington Pit and North Pit. West Pit is currently consented to produce 12 Mtpa of ROM coal and Carrington 10 Mtpa of ROM coal. Mining has ceased in North Pit however overburden from Cheshunt Pit is being used to backfill the pit, along with coarse reject and tailings. Some areas are undergoing rehabilitation;

- Alluvial Lands (portion of North Pit), where mining has been completed, is currently undergoing rehabilitation;

- Coal preparation plants located at West Pit (referred to as Howick Coal Preparation Plant - HCPP), Hunter Valley (HVCPP) and Newdell (NCPP). HCPP is currently consented to accept a total of 6 Mtpa of coal from all pits north and south of the Hunter River. HVCPP is currently consented to accept coal from all pits north and south of the Hunter River to 20 Mtpa. Of this 20 Mtpa, a maximum of 16 Mtpa of coal may be hauled from HVO South Pits (Cheshunt and Riverview). The NCPP is not currently used to wash coal, but is used to stockpile and load trains;

- Load points located at Newdell (NLP) and Hunter Valley (HVLP) which are train loading facilities. In addition Ravensworth Coal Terminal (RCT) is utilised; and

- other related infrastructure.

Operations north of the Hunter River were consolidated in 2003 (DA 450-10-2003). In general, activities undertaken within HVO North are not part of this proposal. However, the ability to transport ROM and product coal, overburden, topsoil, water and rejects between HVO North and HVO South will be addressed in this proposal.

A summary of the approvals relating to HVO North are provided in *Table 2.5*.

Table 2.5 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[1]	• Extension of opencut mining to the east of existing development; • Production of 12 Mtpa ROM coal from West Pit and 10 Mtpa ROM coal from Carrington Pit; • Coal haulage of 16 Mtpa from mining areas south of the Hunter River to HVCPP; • 20 Mtpa throughput at HVCPP; • Movement of coal and rejects between areas of HVO, including south of the Hunter River; • Temporary heavy equipment crossings of the Hunter River; and • Consolidation of 15 existing development approvals applying to HVO north of the Hunter River, into a single consent.
884/2004	Consent	02/2/2005	SSC[2]	• Construction and use of access road to Energy Australia Substation.
450-10-2003 M1	Mod[3] 1 of DA 450-10-2003	16/8/2005	DoP	• Upgrade of HVLP to increase the loading rate from 4000 tph to an average of approximately 5100 tph with a peak load rate of 7200 tph.
450-10-2003 M2	Mod 2 of DA 450-10-2003	25/6/2006	DoP	• Extension of opencut mining to the south and east of Carrington Pit to access 19 Mt of ROM coal.

1. Department of Planning
2. Singleton Shire Council
3. Mod = Modification

Annex D provides more detail on the activities described in previous environmental assessment documents to be included in this Project Approval.

2.3 HVO SOUTH AND NORTH INTERACTIONS

As stated in the West Pit EIS (ERM, 2003), HVO North and South generally form a single operation in which water management, coal preparation and transport, equipment and personnel are shared across the natural boundary formed by the Hunter River.

Currently water from Cheshunt and Riverview Pits is pumped into the North Pit for storage and use in the HVCPP. Up to 16 Mtpa of ROM coal is approved for transport across the Hunter River by haul truck to the HVCPP for processing and subsequent transport via the Belt Line Conveyor to the HVLP for transport to the Port of Newcastle.

HVO has a single general manager responsible for the management of all operations north and south of the Hunter River and a single workforce and equipment fleet which may be allocated across any part of HVO as required and permitted under the various consents. A single Environment Protection Licence (EPL) covers all of HVO.

In accordance with the West Pit consent, moving coal, heavy mining equipment, coarse and fine rejects, overburden and water from HVO South to mining areas and facilities within HVO North is approved. With this proposal, approval is sought for the movement of the same equipment, materials and people from HVO North to HVO South.

This Project Application for the HVO South Coal Project seeks to replace the existing consents with one Project Approval to allow for production of up to 16 Mtpa of ROM coal across HVO South.

In addition, the Project Approval will include the ongoing approval for the construction of a conveyor to transport ROM coal from pits south of the Hunter River to the HVCPP.

2.4 HVO AND MTW INTERACTIONS

HVO and MTW are separate operations with different ownership although both are managed by RTCA. Interactions between the operations are limited to the transfer of water and the movement of haul trucks.

The South Lemington Pit 1 void is currently used for temporary storage of mine water from both HVO and MTW. A water main links the two operations allowing for water to be pumped in either direction as occurs on a routine basis.

An average of approximately three haul trucks per year are transferred between the operations. Trucks are driven between mines via a bridge over the Wambo rail spur (at the end of the private Lemington Haul Road) used to cross the new rail line.

This proposal seeks approval for the ability to relocate heavy equipment including draglines, trucks and shovels across Jerrys Plains Road both to and from MTW and HVO.

2.5 COAL RESERVE

There are some ten coal seams underlying HVO South that are the target of extraction operations. A brief description of these seams and their key characteristics are provided in *Table 2.6*.

Table 2.6 HVO South Coal Seams

Seam	Total Seam Thickness (m)	Indicative Product Ash (%)	Product Potential	Description
Glen Monroe	2.5	9	Coking	• Two working sections; • Present in the Riverview, and South Lemington Pits.
Woodlands Hill	2.6	9.5	Coking/ Thermal	• Three working sections; • Present in the Riverview and South Lemington Pits.
Arrowfield	2.5	10	Thermal	• Two working sections; • Present in the Riverview and South Lemington Pits.
Bowfield	4.0	10	Thermal	• Two working sections; • Present in the Cheshunt, Riverview and South Lemington Pits;
Warkworth	3.8	13	Thermal	• Four working sections; • Present in the Cheshunt and Riverview Pits.
Mt Arthur	7.5	12	Thermal	• A number of sections, some not economically viable; • Present in the Cheshunt Pit; • Contains a major sedimentary wedge.
Piercefield	4.5	8	Coking	• Six working sections; • Present in the Cheshunt Pit; • The main coking coal reserve at HVO South; • These sections split in various places.
Vaux	2.5	10	Coking/ Thermal	• Three basic working sections; • One thin layer of thermal coal surrounded by thicker layers of coking coal; • Currently mined in the Cheshunt Pit.
Broonie	6.5	11	Coking/ Thermal	• Approximately six sections; • Occurs below the Cheshunt Pit; • Lower sections in contact with the Bayswater Seam.
Bayswater	8	16	Thermal	• Present in the Cheshunt area as an opencut reserve, in Riverview as an underground reserve.

The above coal seams are listed in order of depth, from shallowest to deepest. The coal seams generally dip to the south west at a grade of 2.5 to 3% and thicknesses vary from 0.3 to 6.5 m. All except the Bayswater and Broonie seams are approved to be mined at HVO South. These additional deeper seams are planned to be extracted in the Cheshunt Pit as part of the proposed extension of operations known as Deep Cheshunt. *Figure 2.2* shows a geological cross-section of the Project Application area and displays the relative positions of each of the seams.

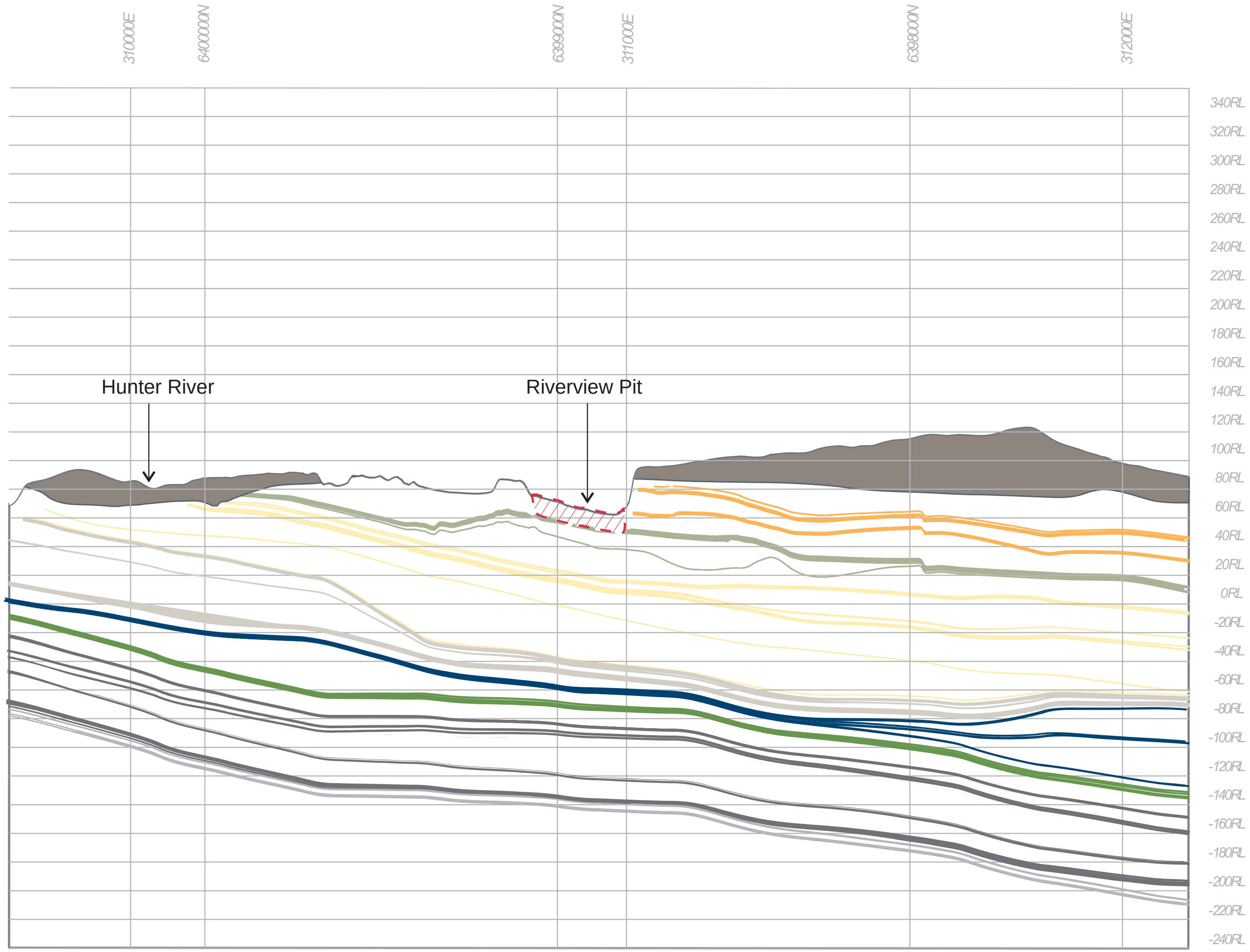
A Reserve Statement provides a summary of the production estimates expected for the reserves being mined. The amount of coal reserves present is reported on a pit by pit basis, and is divided into proved, probable and marketable amounts. Proved reserves are those that have been confirmed with a very high level of certainty, while probable reserves are those confirmed with slightly less certainty. Marketable reserves are the tonnes of coal available for sale once it has been processed in a coal preparation plant. *Table 2.7* presents reserves (as of December 2006) that can be extracted by opencut mining as probable and proved and references additional resources.

Table 2.7 Coal Reserve

Pit Name	Proved Coal Reserve (Mt) ROM	Probable Coal Reserve (Mt) ROM	Total (Mt ROM)	Marketable Coal Reserves (Mt)
Cheshunt[1]	100.2	0	100.2	71.5
Riverview (including extensions)	25	12.6	37.6	28
South Lemington	3.6	0.0	3.6	2.3

1. Cheshunt Reserves include the Cheshunt Pit to the Piercefield seam floor. Not included are:
   - the Deep Cheshunt and highwall mining resource of approximately 78 Mt; or
   - approximately 4.6 Mt ROM coal gained by mining 50 m closer to the limit of Hunter River alluvium.

A more detailed description of the geology of the Project Application area (including structural and hydrogeological features) is provided in *Chapter 9*.



Legend

- Glen Monroe Seam
- Woodlands Hill Coal Seam
- Arrowfield Coal Seam
- Bowfield Coal Seam
- Warkworth Coal Seam
- Mt Arthur Coal Seam
- Piercefield Coal Seam
- Vaux Coal Seam
- Broonie Coal Seam
- Bayswater Coal Seam
- Sandstone and Shale Interburden
- Unconsolidated Clays and Claybound Sands & Gravels
- RL Metres Relative to Australian Height Datum
- Indicative Mine Spoil Location

Figure 2.2

Stratigraphy of Coal Seams in the HVO South Area

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_IC_05_R2		
Date:	04/10/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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0 300m

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2.6 *MINING METHODOLOGY*

The mining sequence employed at the Cheshunt and Riverview Pits and approved for the South Lemington Pits is depicted in *Figure 2.3* and comprises:

- vegetation stripping and topsoil removal;
- opencut mining to remove overburden, interburden and coal; and
- overburden shaping and rehabilitation.

This proposal seeks approval for the ongoing mining of coal reserves in accordance with standard mining practices.

2.6.1 *Vegetation Clearing and Topsoil Management*

The method of vegetation clearing is common across all HVO mining areas and is undertaken in accordance with CNA Environmental Management System (EMS) Flora and Fauna procedure and the Topsoil Stripping and Stockpiling Management Plan. Management plan objectives are detailed in *Chapter 18*. The objective of the CNA EMS Flora and Fauna procedure is to ensure the protection and management of any significant flora and fauna communities within the mining area. The procedure includes requirements for flora and fauna impact assessments in pre-development and mining approvals, protocols for pre-clearing and clearing activities and general management measures for the weed and pest control.

A pre-clearing survey is undertaken before vegetation is cleared and topsoil stripped. The purpose of the pre-clearing survey is to identify habitat trees and understorey habitats such as fallen logs.

Before clearing, trees suitable for timber are selectively marked and removed. Tree stands providing a viable seed source are harvested where practical. Vegetation may be chipped for rehabilitation mulch. The topsoil stripping and stockpiling management plan is produced as part of detailed mine planning and incorporated in the Mining Operations Plan (MOP). A MOP requires mining operations to actively consider environmental and rehabilitation outcomes and to provide management systems to integrate these outcomes, mine planning and production (DPI-MR 2006).

Topsoil is removed according to this plan ahead of mining, using dozers whenever possible. Soil is stripped at least 15 m outside the design excavation limit to allow for access tracks. Where possible, stripped soil will be placed directly onto areas where the landform reconstruction is complete, otherwise soil will be stockpiled for later use. The former option is preferable to minimise the need for storage and rehandling. Vegetation management and topsoil stripping are discussed further in *Chapter 18*.

2.6.2 *Opencut Mining Process*

Mining occurs concurrently at the Cheshunt and Riverview Pits, with mining approved to the Vaux seam.

Cheshunt Pit

Cheshunt Pit is mined with shovels to remove overburden and interburden and a front end loader to remove coal. Coal is currently transported by haul truck to the HVCPP. Mining commenced in the north eastern corner of the site and is progressing to the south west in 120 m wide strips. Mining currently occurs down to the Vaux seam. The overburden to coal strip ratio is approximately 4.5:1.

Riverview Pit

The Riverview Pit is mined using a dragline and shovel to remove overburden and interburden and front end loader to mine coal and is progressing to the south in 100 m wide strips. Mining currently occurs down to the Bowfield Seam. Seams dip at an average of 3 degrees to the south west. The current overburden to coal strip ratio is approximately 6:1.

South Lemington Pits 1 and 2

The approved mining strategy for South Lemington was to mine two opencut pits, followed by a scraper slot and trench mining, each supplemented by highwall mining. This proposal seeks ongoing approval for the above with the exception of the scraper slot. Pit 1 is located to the east and south of Wollombi Brook and Pit 2 (not yet commenced) is to be located to the west of Wollombi Brook. The opencut pits were designed to be mined using an electric rope shovel to remove overburden in 100 m wide strips and transported using trucks. The coal was to be ripped by dozer and then loaded by a front end loader onto a fleet of trucks for transport to the LCPP.

Mining in South Lemington Pit 1 commenced to the south east of Wollombi Brook and was mined in 300 m wide strips to the west. The overburden to coal strip ratios for South Lemington Pits 1 and 2 will be approximately 6:1 and 1.7:1 respectively.

The proposal involves mining all coal seams in Cheshunt and Riverview Pits, and South Lemington Pits 1 and 2 using mining methodology as described in *Section 5.3*.

2.6.3 *Continuous Highwall and Auger Highwall Mining*

Highwall mining enables the extraction of coal beyond the economic limit of surface mining. Highwall mining is currently approved to the north of Riverview Pit and within the south eastern section of the Riverview Pit. Highwall mining is also approved in areas directly to the north west and south west of South Lemington Pit 2, and to the west and south of South Lemington Pit 1. Highwall mining has not yet commenced at HVO South.

Two different highwall mining techniques are currently approved at HVO South: Continuous Highwall Mining and Auger Highwall Mining. Areas approved and proposed for highwall and auger mining are depicted in *Figure 5.3* in *Chapter 5*.

Continuous Highwall Mining

In thicker seams, a continuous highwall mining machine under remote control is driven into the seam exposed by previous opencut operations. A continuous haulage system carries the coal from the miner to an open-air installation for stockpiling and transport. This process forms a series of parallel, unsupported drives. Coal pillars remaining between adjacent drives are capable of supporting the overburden structure. Straight, parallel openings at the tightest separation consistent with geotechnical design are achieved by the mining machine's position and heading, determined and controlled remotely. Generally, the miner makes a nominal 5 m wide by 2 to 3.5 m high entry into the exposed highwall at the pit floor. Currently highwall miners can extend into the coal face to approximately 500 m.

Auger Highwall Mining

Seams that are too thin or irregular for continuous miners may be suitable for auger mining. The auger machine produces a round entry with a diameter 1.2 or 1.5 m and is limited to a length of 100 or 85 m respectively. Extracted coal is loaded into trucks by front end loader and transported to the conveyor receival bin or coal preparation plant.

Highwall mining is, and will continue to be designed to minimise ground subsidence through the retention of a suitably wide pillar of supporting material between each entry. *Figure 2.4* depicts the highwall mining methodology that is likely to be implemented at HVO South for the currently approved and proposed highwall mining areas.

2.6.4 Overburden Management

Overburden is the term given to the strata between the top most coal seam and the surface which is unsuitable for processing. Almost all overburden is drilled and blasted. Interburden is a layer of material unsuitable for processing which occurs as a layer within the reserve deposit. Interburden is either ripped or drilled and blasted. Both overburden and interburden are removed by dragline, shovel, excavator or front end loader, depending on the thickness, for haulage to designated out of pit emplacements or to areas where mining is complete within the pit.

Overburden is produced as part of the opencut mining process. It is transported and disposed of within mined out sections of the opencut mine to create a final landform or designated out of pit emplacement areas. The placement of overburden occurs in accordance with the mine plans for Cheshunt, Riverview and Lemington Pits within HVO South, and for West Pit, Carrington Pit and North Pit in HVO North.

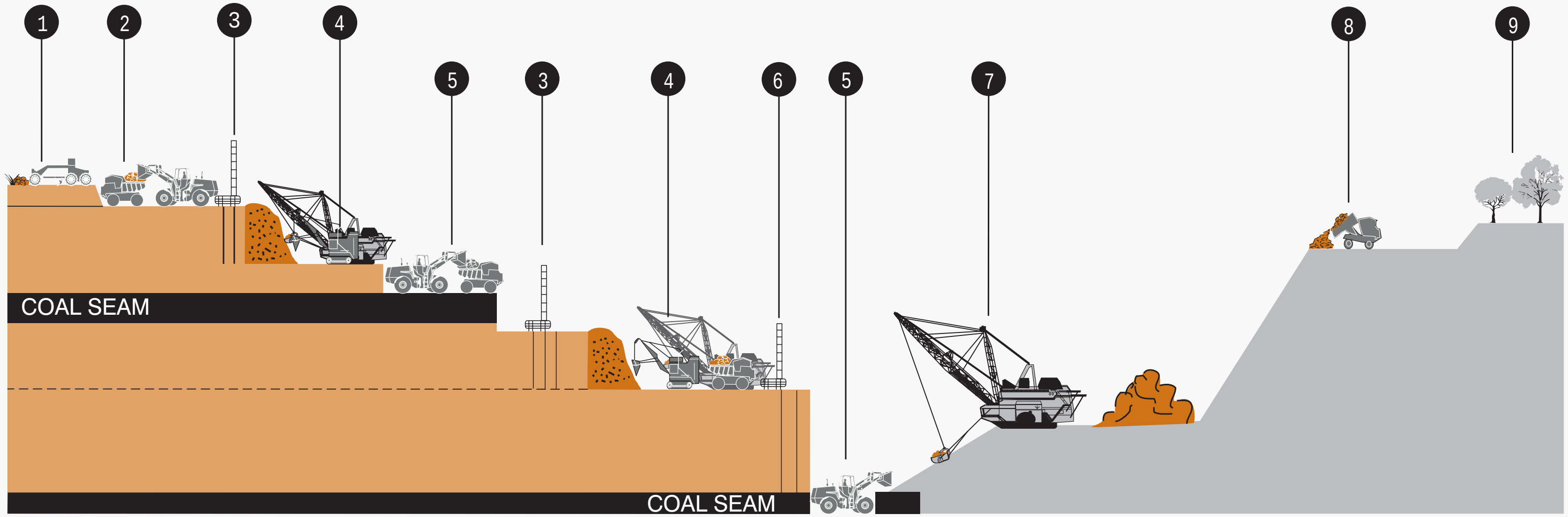
Potentially acid forming material in overburden can lead to impacts to water quality. Net acid producing potential, pH and total sulphur are used to determine the acid generating potential of overburden materials. No acid forming material has been found in materials tested. Extract pH levels were greater than 7.0 and sulphate concentrations were low. Acid generation in these soils is therefore unlikely. Should acidic overburden be identified, it will be disposed of at depth to minimise potential impacts to groundwater quality.

Overburden Shaping and Rehabilitation

Rehabilitation of the mining operation footprint is considered an integral component of the mining operations and is conducted progressively over the life of the mine. Rehabilitation plans are produced as part of detailed mine planning. These plans are prepared as part of the MOP and approved by the Department of Primary Industries and Mineral Resources (DPI-MR).

The mining activities currently authorised under various consents for Cheshunt, Riverview and Lemington Pits are currently scheduled for completion by 2021 and 2019 respectively. Rehabilitation and landscape management practices are detailed in *Chapter 19*.

The West Pit consent (DA 450-10-2003), approves the movement of overburden material between mining areas and facilities of HVO. This proposal seeks to maintain this activity and enhance the integration between HVO South and HVO North by approving the transfer and movement of ROM and product coal, fine and coarse rejects, water, equipment, overburden and topsoil between HVO South and HVO North in both directions.



1 Vegetation clearing and topsoil removal.

2 Overburden removal using front-end loader, shovel or excavator and trucks.

3 Overburden drilling and blasting.

4 Overburden removal using shovel or excavator and trucks or dragline.

5 Coal will be either drilled and blasted or ripped with dozers, depending on the thickness. Coal removal using front-end loader or excavator and trucks.

6 Overburden drilling and blasting, including highwall pre-split and throw blasting.

7 Dragline, shovel, excavator or front-end loader and truck operations.

8 Overburden placed into completed mine areas by trucks.

9 Shaping, topsoiling and revegetation.

Figure 2.3

Opencut Mining Methodology

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_IC_02_R2		
Date:	24/08/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	N/A		

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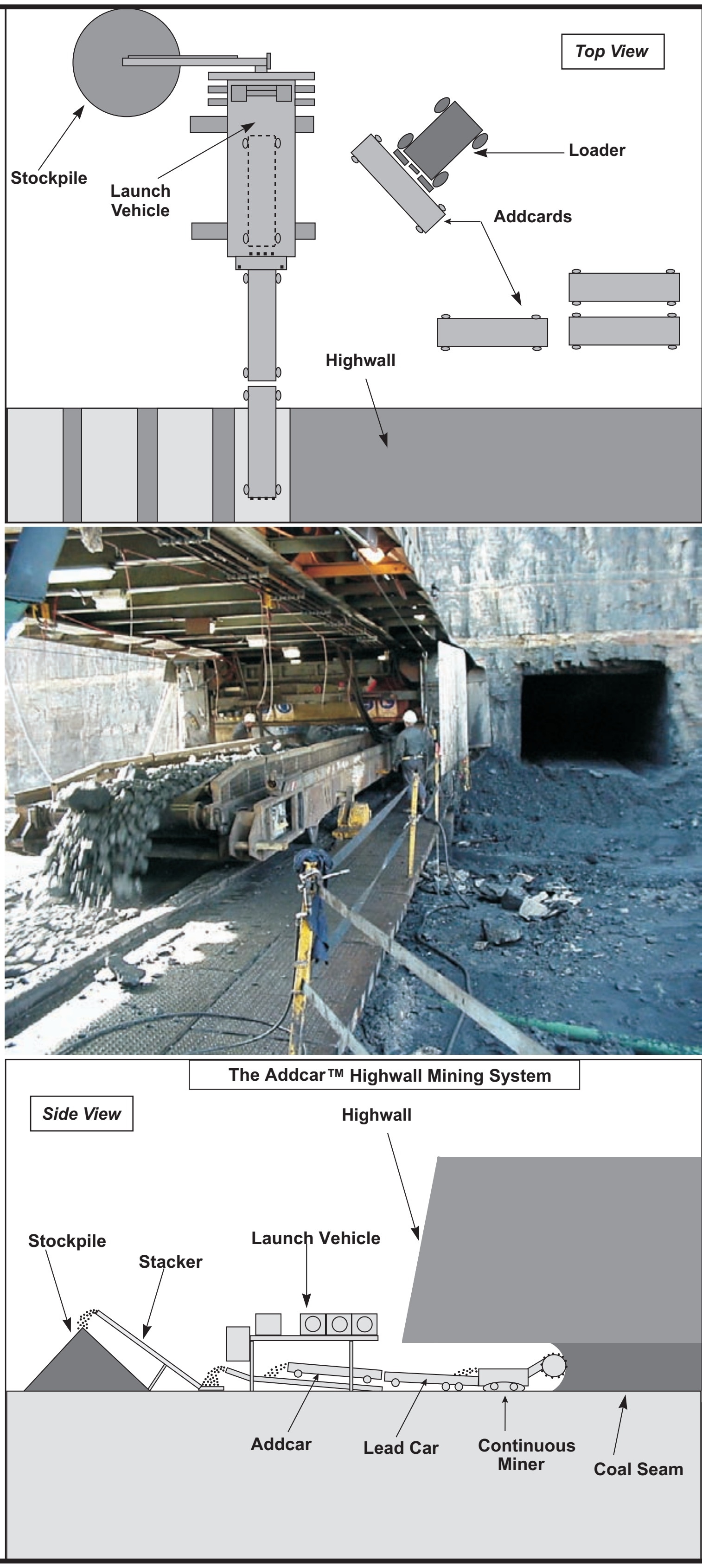

Figure 2.4

Indicative Highwall Mining Methodology

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_IC_06_R3		
Date:	26/09/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	N/A		

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2.7 COAL PREPARATION

One coal preparation plant, the LCPP, is located within HVO South. It is currently under care and maintenance. An overview of the LCPP history and approved processing capacity are provided in *Section 2.1.2*.

As part of this proposal the plant may be upgraded or replaced to increase processing capacity from the approved 5.5 Mtpa to 16 Mtpa resulting in significant changes to the form of the LCPP and accordingly approval is sought for this. An overview of the currently approved operations including coal processing methodology is presented in *Figure 2.1*.

Although a range of equipment is used across the coal preparation plants, the basic coal washing process is similar. Washing relies on the fact that coal has a lower specific gravity than non-coal material. ROM coal is initially cleaned by gravity separation in a magnetite and water mixture referred to as dense medium. Coal is then processed in two streams depending on size.

In the large coal circuit, product coal is crushed, then conveyed to stockpiles. Smaller diameter product coal is drained and rinsed, de-watered in a centrifuge and then discharged to the product conveyor.

The large coal circuit relies on relatively simple gravity separation, with coal particles floating on the dense medium and heavier particles of non-coal material sinking. The separation is enhanced for medium coal particles by pumping dense medium and ROM coal together through cyclones.

Fine ROM coal is cleaned in a process circuit that does not use dense medium. It is mixed with water and pumped through classifying cyclones to remove very fine particles which generally contain a high proportion of non-coal material including clays. It is then fed to spiral separators which separate materials by gravity, taking advantage of the different centrifugal effects produced on coal and non-coal particles as they wind their way down the spiral pathways. After thickening in coal cyclones, the fine coal product stream is de-watered in centrifuges before being discharged to the product conveyor.

The LCPP has a third processing circuit based on flotation, which is a different process to density based separations in the fact that particles are separated on the basis on their surface chemistry and degree of hydrophobicity (water repellency).

Product coal is conveyed to a loading point for stockpiling and rail loading, before rail transportation to Port Waratah in Newcastle.

The coal preparation process for which this Project Application seeks approval is generally as described above.

2.8 REJECT DISPOSAL

Reject material is produced as a by-product of the coal washing process. ROM coal often contains part of the rock strata above and below the coal seam. This rock is removed from the product coal through the washing process in the coal preparation plant. As a result, two types of reject as by-product are formed; coarse and fine reject.

Coarse Reject

Coarse reject is made up of larger rock which is drained, rinsed and directed to a rejects bin. The reject is then transported by haul truck and disposed of into voids left by mining in much the same way as overburden as per *Section 2.6.4*.

CNA's Coarse Reject and Tailings Disposal procedure states that coarse reject materials must be:

- disposed of amongst non-carbonaceous overburden material;
- placed into the overburden emplacements in a manner that must ensure adequate mixing with the overburden material and minimise potential instability; and
- covered with overburden material to a depth of at least 1 m at HVO.

Fine Reject

Fine reject (tailings) has high water content and is pumped into Tailings Storage Facilities (TSFs) for settling and dewatering. The reject slurry represents approximately 7 to 10% of the coal preparation plant feed. Water from the TSFs is retrieved and reused in the water management system. When these TSFs reach capacity, they are allowed to dry out, then are capped with overburden and rehabilitated to an appropriate land capability in accordance with the mine plan. Historically, these methods have been used to successfully rehabilitate Lemington TSFs No's 1a, 1b, 2, 3 and 4a (refer to *Chapter 10 – Surface Water*).

In addition, CNA's EMS Coarse Reject and Tailings Disposal procedure provides requirements for design and construction of TSFs, tailings disposal, procedures for inspection and monitoring and closure.

Chapter 10 references tailings management and the location of current and proposed TSFs required to meet the outputs of an upgraded LCPP.

The West Pit consent (DA 450-10-2003), approves the movement of coal and rejects between mining areas and facilities of HVO. This proposal seeks to maintain this activity and enhance the integration between HVO South and HVO North by approving the transfer and movement of ROM and product coal, fine and coarse rejects, water, equipment, overburden and topsoil between HVO South and HVO North in both directions.

2.9 COAL MOVEMENTS

2.9.1 ROM Coal Transport

Up to 16 Mtpa of ROM coal is currently approved to be hauled from Cheshunt, Riverview and Lemington Pits. ROM coal extracted from the Cheshunt and Riverview Pits is currently transported north to the HVCPP. As approved under the West Pit consent, ROM coal may be transported from the HVCPP to HCPP. Conveying of ROM coal from HVO South to HVO North to the HVCPP is also approved, however the conveyor is not yet constructed.

The LCPP is approved to accept 8 Mtpa of ROM coal from the Cheshunt and Riverview Pits. In addition, 3.2 Mtpa of ROM coal and 1.2 Mtpa of ROM coal is approved for transport to the LCPP from North Lemington and South Lemington respectively *(Figure 2.5)*.

The HVCPP is approved to accept 20 Mtpa of ROM coal from both HVO North and HVO South.

ROM coal is trucked using established haul routes.

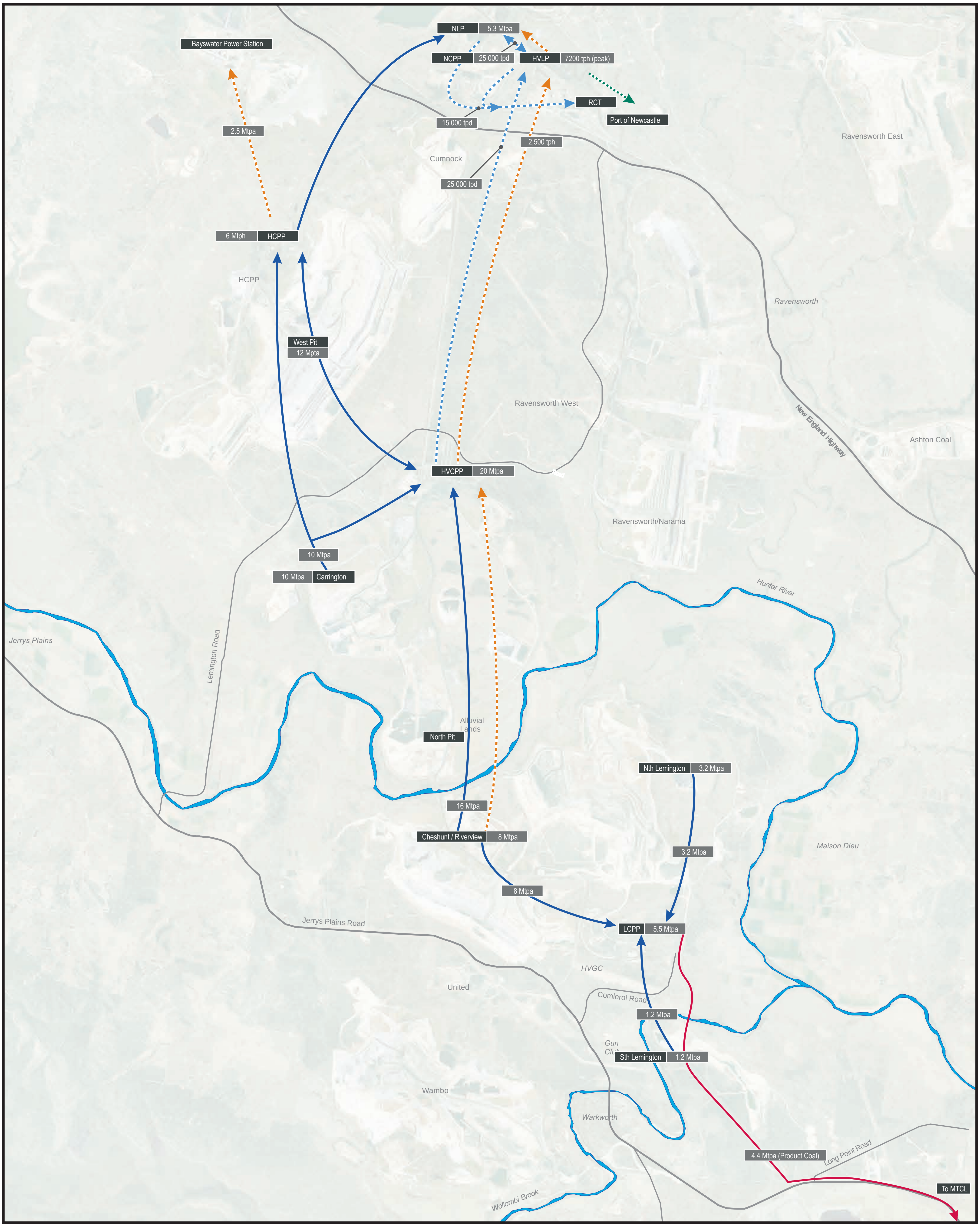
2.9.2 Product Coal Transport

The transport of 4.4 Mtpa of product coal from the LCPP to the MTCL is currently consented through DA 215/97 and DA 405/98. When operational, product coal was loaded into 'on-highway' trucks for transport to the MTCL, located 17 km to the south east along Jerrys Plains Road, via private haul road and Comleroi Road. The coal was loaded onto trains and railed to Port Waratah at the Port of Newcastle approximately 84 km away. As the LCPP is currently under care and maintenance, no ROM coal is processed within HVO South.

Product coal from the HVCPP is transported approximately 7.4 km by overland conveyor to the HVLP for transport to the Port of Newcastle. The HVLP consists of two 200,000 t stockpiles and a train loading facility with a capacity of 4,000 tph. Trains of varying capacity from 2,000 to 8,000 t are loaded with coal for transport to ship loading facilities at Newcastle. A modification to the West Pit consent was granted in 2005 allowing the HVLP to be upgraded to load trains at a rate of 5,100 tph. This upgrade is yet to be completed.

Product coal from the HCPP is either transported to the Bayswater and Liddell Power stations by a conveyor with a capacity of 2.5 Mtpa or to the NLP via Pikes Gully Road. The NLP consists of a 400,000 t stockpile and train loading facility with a capacity of 3,500 tph. Intermittent haulage of product coal is permitted between the HVCPP and HVLP and between the HVLP, NLP and RCT (via highway rated trucks).

The West Pit consent (DA 450-10-2003), approves the movement of coal between mining areas and facilities of HVO. This proposal seeks to maintain this activity and enhance the integration between HVO South and HVO North by approving the transfer and movement of ROM and product coal, fine and coarse rejects, water, equipment, overburden and topsoil between HVO South and HVO North in both directions.



Legend

- Haul Road
- Conveyor
- Railway
- Intermittent Road Haulage
- Product Coal from LCPP (Road Haulage)

Figure 2.5

Approved Coal Movement Volumes

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_IC_04_R4		
Date:	21/12/2007	Drawing size:	A3
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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2.10 *SITE INFRASTRUCTURE*

Site infrastructure across HVO South includes amenities, buildings, transmission lines, switchyards, sub stations, phone lines, pipelines, fuel and explosive magazine storage facilities, haul roads, mine access roads, stockpiles and bridges.

Annex D depicts the existing infrastructure that this proposal seeks to include in this Project Approval.

Amenities

The key infrastructure located at HVO South includes:

- Cheshunt bathhouse;
- Cheshunt workshop;
- Cheshunt administration building;
- Lemington bathhouse;
- Lemington workshop;
- Lemington offices;
- Lemington store; and
- LCPP.

The Cheshunt bathhouse and mine offices contain kitchen, bathroom and office facilities. As identified in *Chapter 5*, expansion of the Cheshunt bathhouse and facilities and its possible relocation as mining in the Cheshunt Pit progresses is already approved. The LCPP has associated administration offices, general stores, bathhouse, fuel farm and workshop.

Mobile crib and amenity facilities including sewage treatment facilities are also provided for employees working in opencut areas. These facilities are trailer mounted and located near active working areas on an 'as needs' basis. Existing and proposed infrastructure for which this proposal seeks approval is illustrated in *Chapter 5*.

The primary administration facility for HVO is located within HVO North.

Chapter 5 identifies the potential modifications to amenities that this proposal seeks approval for.

Electricity Supply

Electricity is supplied by existing 66 kV transmission lines and associated substations and switchyards. Electricity is supplied to mining equipment such as draglines, electric rope shovels, employee amenities and coal preparation and handling facilities. In addition, 330 kV transmission lines pass through HVO.

Chapter 5 identifies the potential modifications to electricity supply that this proposal seeks approval for.

Water Supply

Potable water for employee amenities is supplied by truck from the Singleton municipal system. Non-potable water for dust suppression, washing and cleaning is preferentially drawn from in-pit sumps, a series of onsite storage dams and South Lemington Pit 1 (refer to *Chapter 10* for further details). Supplementary water is pumped first from HVO North and MTW then from the Hunter River under licence from the Department of Water and Energy (DWE). Pipelines are established across HVO South for the transport of this water.

Chapter 5 identifies the potential modifications to water supply that this proposal seeks approval for.

Water Management

Dams, pipelines and levees provide for the capture, storage, transport and segregation of mine affected and non-mine affected water at HVO (refer to *Chapter 10* for existing, approved and proposed dams and levees).

Chapter 5 identifies the potential modifications to water management that this proposal seeks approval for.

Fuel Supply

Fuel storage tanks are located at the Lemington workshop within HVO South. Fuel is also provided for in-pit operations by 70,000 litre mobile fuel tankers that transport fuel from an existing bulk storage facility located within HVO North.

Chapter 5 identifies the potential modifications to fuel supply that this proposal seeks approval for.

Explosives

There is currently no explosives storage within HVO South.

Chapter 5 identifies the potential modifications to provide for explosives storage as part of this proposal.

Sewage

Sewage from in-pit mobile facilities is periodically pumped out by licenced contractor and disposed off-site. Permanent site facilities are periodically pumped out prior to onsite treatment by aerated treatment plants. The treated effluent is spray irrigated onto evaporation areas. Sewage from the Cheshunt bathhouse passes through an extended aeration package treatment plant and the purified effluent is disinfected and directed to mine water storage dams where it is recycled. As identified in *Chapter 5*, this proposal seeks approval for upgrade, modification or relocation of sewage related facilities.

HVO South Road Network

Haul roads are established throughout the HVO South site. The Cheshunt bathhouse access road is a compact sealed private road that will be mined as part of this proposal.

One sealed public road, Comleroi Road, is located within HVO South. Comleroi Road which connects to Jerrys Plains Road will be relocated as part of this proposal (refer to *Chapter 5*).

Three bridges have been constructed within HVO South. One links activities across the Hunter River and the other two bridges (high level and low level) over Wollombi Brook link South Lemington to the Cheshunt area.

Chapter 5 identifies the potential modifications to the road network that this proposal seeks approval for.

Other Infrastructure

The HVGC is located within HVO South, directly to the east of the Riverview Pit. Relocation or reconfiguration of the HVGC facilities and airstrip may be required as mining progresses. This component of the proposal is discussed in *Chapter 5*.

3 *PLANNING AND REGULATORY FRAMEWORK*

This chapter outlines the statutory considerations and the environmental determination process that applies to the proposal. Further details are provided in the full Planning and Regulatory Framework Report prepared by ERM and presented as Annex C.

3.1 *ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979*

Part 3A of the *EP&A Act* details the approval of major infrastructure and other significant 'projects'. It applies to:

"… the carrying out of development that is declared under this section to be a project to which this Part applies:

(a) by a State environmental planning policy, or

(b) by order of the Minister published in the Gazette" (Section 75(b)).

If the Minister forms the opinion that development is development of a kind described in the Schedules to State Environmental Planning Policy Major Projects (SEPP MP) 2005 the development is declared to be a project to which Part 3A of the *EP&A Act* applies. This project requires approval under Part 3A from the Minister for Planning (as confirmed by the DoP at the April 13, 2006 meeting).

Under Section 75R of the *EP&A Act,* Environmental Planning Instruments (EPIs) (other than State Environmental Planning Policies (SEPPs)) do not apply to an approved 'Major Project' under Part 3A except to the extent that any EPI wholly prohibits the development. A discussion of the SEPPs applicable to the proposed development is found in *Table 3.1*. The development is permissible under Singleton Local Environmental Plan.

This Environmental Assessment Report, which assesses the likely impact of the proposal on the environment, has been prepared in accordance with Section 75F of the *EP&A Act* and the DoP Director-General's environmental assessment requirements.

Pursuant to Section 75V of the *EP&A Act*, authorisation of a Mining Lease under the *Mining Act 1992* or an Environment Protection Licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* (for any of the purposes referred to in section 43 of that Act) cannot be refused if it is necessary for carrying out a project approved under Part 3A of the *EP&A Act* and it is substantially consistent with the Project Approval.

The Part 3A approvals process is set out in *Figure 3.1*.

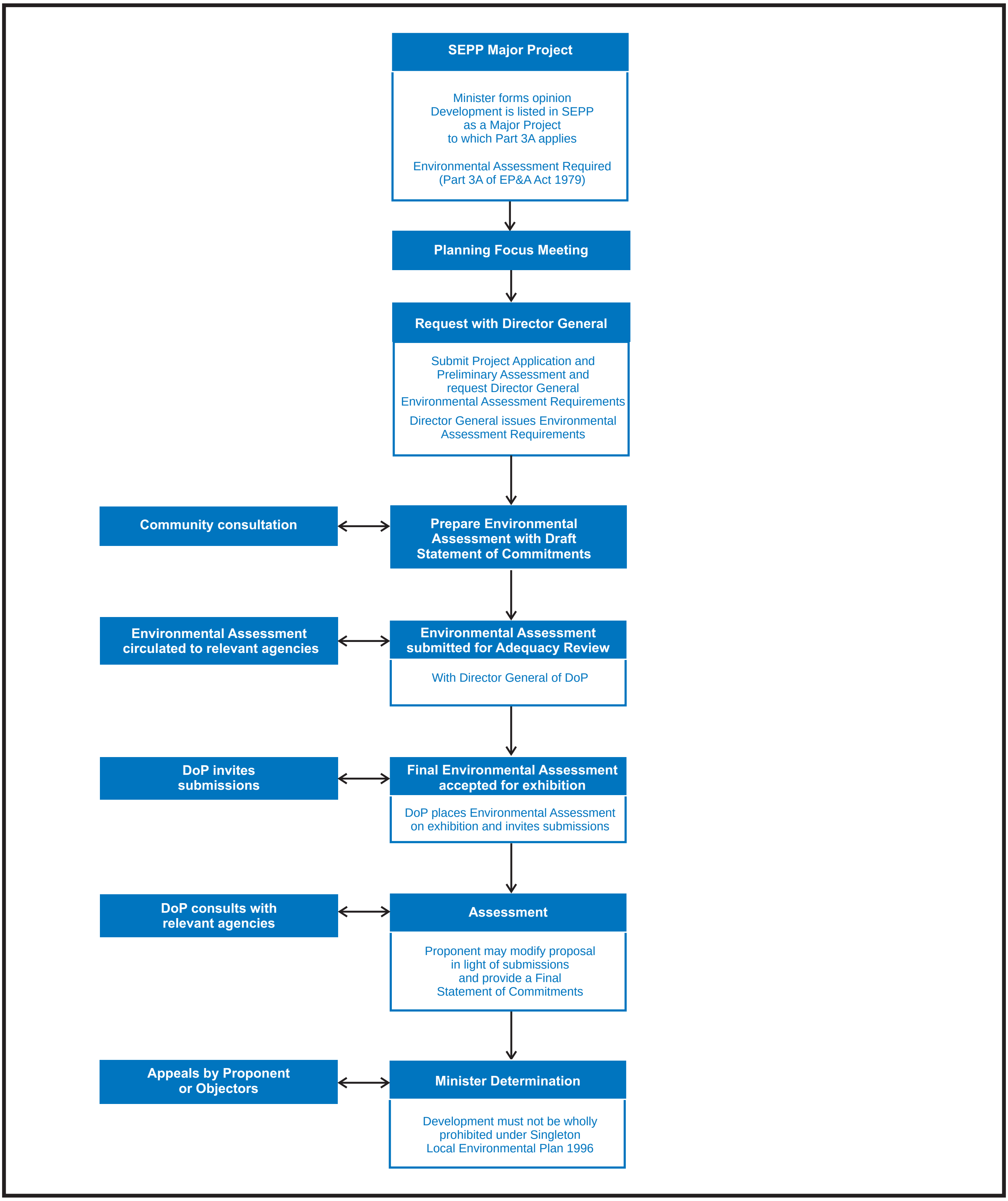

Figure 3.1

Environmental Assessment Process Under Part 3A of the EP&A Act

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_IC_08_R3		
Date:	26/09/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	N/A		

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3.2 STATUTORY FRAMEWORK

Table 3.1 summarises legislation required for this Project Application in addition to Part 3A approval. Other legislation relevant to this proposal is summarised in *Annex C*.

Table 3.1 Statutory Framework

Legislation	Standard / Requirement	Comment
Commonwealth		
New South Wales		
EP&A Act 1979	Refer to *Section 3.1*	Refer to *Section 3.1*
Protection of the Environment Operations Act 1997 (POEO Act)	Section 48 of the *POEO Act* requires scheduled activities listed in Schedule 1 to hold a premises-based Environment Protection Licence (EPL).	A premises-based EPL applies across HVO as a whole. This EPL will be reviewed and updated as necessary to reflect changes to HVO South resulting from the proposal. If the proposal is granted Project Approval under the Part 3A planning process, approval must not be refused by the DECC and must be substantially consistent with the terms of the Project Approval.
State Environmental Planning Policies		
State Environmental Planning Policy (Major Projects) 2005 (SEPP MP)	Mining is included in Schedule 1 to the SEPP MP and enables the Minister to form the opinion that the development is a Project to which Part 3A of the *EP&A Act* applies.	The proposal requires consent from the Minister for Planning under Part 3A of the *EP&A Act*.
State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007	Repeals SEPP 45. Mining is permissible with development consent under clause 7. Consent authority must consider land use compatibility; key natural resources; the efficiency of resource recovery; the transport of material via public road; and rehabilitation of the land.	Mining is permissible. An assessment of the proposed impacts of the proposal on surrounding land uses and natural resources including surface and groundwaters, biodiversity and greenhouse gas emissions has been undertaken. The proposal will surrender existing road transport consents and has considered the final land use of the site following the cessation of mining.
State Environmental Planning Policy No. 11 – Traffic Generating Developments (SEPP 11)	Under Section 7 of SEPP 11 a consent authority is required to forward a copy of any application for mining to the RTA.	As the proposal requires an approval under Part 3A, the DoP is required to forward the application to the RTA for comment.
State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33)	SEPP 33 seeks to determine whether a development is a hazardous or offensive industry and require development consent for	All hazardous materials will continue to be managed in accordance with existing CNA EMS procedures that are currently implemented

Legislation	Standard / Requirement	Comment
	proposed hazardous or offensive development.	successfully at HVO South. The existing EPL for HVO will be updated to reflect changes to HVO South resulting from the proposal. The proposal is not considered to be an offensive industry.
State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44)	SEPP 44 affects land in Singleton local government area and encourages the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free – living population over their present range and reverse the current trend of koala population decline.	No evidence of koala activity has been recorded in previous assessments at HVO South and no direct or indirect evidence (such as scats or scratches on tree trunks) were recorded during ERM May 2006 surveys. The remnant vegetation at HVO South is not considered to represent core koala habitat, as defined under SEPP 44.
Other plans that apply to the site but do not limit development in a Part 3A application pursuant to Section 75R of EP&A Act		
Hunter Regional Environment Plan 1989 (HREP)	The HREP applies to land in a number of local government areas including Singleton. Relevant requirements in the HREP include land use and settlement, transport and natural resources.	The Environmental Assessment Report assesses the soil and land capability and agricultural suitability, and impacts on transport, ground and surface water quality and flow characteristics, air quality, acoustical environment, and relevant Total Catchment Strategies.
Singleton Local Environment Plan 1996	The Project Application area is zoned Rural 1(a). An objective of this zone is "…*to allow mining where environmental impacts do not exceed acceptable limits and the land is satisfactorily rehabilitated after mining,…".* The existing Gun Club and HVGC are permissible in the Rural 1(a) zone.	The proposed relocation or reconfiguration of the HVGC will require Project Approval as part of the current proposal.

Coal & Allied Operations Pty Ltd

Hunter Valley Operations South Coal Project

Environmental Assessment Report

Part B - Proposal

4 OPTIONS CONSIDERATION AND JUSTIFICATION

This chapter provides an overview of the alternatives that were considered and those that have been assessed as part of the development of the proposal. The advantages and disadvantages of each option are discussed and a justification for the preferred option provided.

4.1 PROPOSAL ALTERNATIVES

Due to the acquisition and expansion activities across HVO, it became apparent that there would be significant environmental, social and economic advantages in the provision of a single Project Approval for HVO South activities. Proposal benefits have been described in *Chapter 1* and include the ability for CNA to respond to changing market conditions and needs of customers in relation to coal quality and quantity, extension of the mining operation, and the provision of ongoing employment of personnel. The proposal was first canvassed in 2003 as part of the Life of Mine planning process, however, due to the economic conditions, the proposal was suspended at that time.

Recent mine planning reviewed current and potential activities at HVO South to identify likely future requirements. This assessment captures those activities such that further modifications are not required if future operations are consistent with the new approval issued under Part 3A of the *EP&A Act*.

A number of options have been canvassed for components of the HVO South proposal. *Table 4.1* provides an overview of the options assessed for major components of the proposal and the advantages and disadvantages of each option.

Table 4.1 Summary of Options Assessed for Major Proposal Components

Component	Description	Comment
Mine Plan	Extension of opencut mining into Deep Cheshunt, including mining 50 m closer to the limit of Hunter River alluvium, to the south east and south west of Riverview Pit, and to the west of South Lemington Pit 1. Highwall mining of areas directly to the south west of the Riverview Pit, to the north east of the Cheshunt Pit and supplementary areas to the south west of South Lemington Pit 1.	• Access to more coal reserves. • Avoids sterilising coal reserves in the Bayswater seam under Cheshunt Pit. • Mine plan is adjusted to avoid impacts to Redbank Creek alluvials within Wollombi Brook buffer zone (south of South Lemington Pit 2) otherwise impacted by current approved mine plan. • Loss of coal reserves already approved for mining in Wollombi Brook buffer zone. • Opportunity to streamline consents and leases and associated administration. • Increases production capacity. • Final landform will not be realised until at least 2028 and adverse social amenity impacts will extend to 2028. **This is the preferred option as it allows for the extension of mining into areas outside of the existing approval area and allows for selective highwall mining. A flexible mining approach also provides the opportunity to achieve better environmental outcomes by reducing the impacts of environmental aspects such as noise and dust.**
	Extension of opencut mining into Deep Cheshunt, including mining 50 m closer to the limit of Hunter River alluvium, to the south east and south west of Riverview Pit, and to the west of South Lemington Pit 1. Highwall mining of areas directly to the south west of the Riverview Pit, to the north west of the Riverview Pit, to the north east of the Cheshunt Pit and supplementary areas to the south west of South Lemington Pit 1.	• Access to more coal reserves. • Avoids sterilising coal reserves in the Bayswater seam under Cheshunt Pit. • Mine plan is adjusted to avoid impacts to Redbank Creek alluvials within Wollombi Brook buffer zone (south of South Lemington Pit 2) otherwise impacted by current approved mine plan. • Loss of coal reserves already approved for mining in Wollombi Brook buffer zone. • Opportunity to streamline consents and leases and associated administration. • Increases production capacity. • Final landform will not be realised until at least 2028 and adverse social amenity impacts will extend to 2028. • Potential impacts to groundwater. This option is not preferred due to the potential impacts of highwall mining in the north west of the Riverview Pit to groundwater.

Component	Description	Comment
	Do nothing – continue mining as approved in Cheshunt and Riverview Pits as approved until 2022 (DA 114-12-98) and in South Lemington Pits and scraper slots as approved until 2019 (DA 215/97).	• No change to current operational impacts on social amenity. • Coal reserves left out of the existing consent will be sterilised. • No potential to increase employment levels. • HVO will have reduced operational flexibility. • Impacts to Redbank Creek (south of South Lemington Pit 2) due to current approved mine plan. • Continued management of multiple complex consents and leases and associated administration. This option reduces the potential to improve operational efficiency and means that operations will continue under the current 35 development consents and associated modifications. It could also lead to the sterilisation of some coal reserves.
	Extension of opencut mining into Deep Cheshunt, to the south east and south west of Riverview Pit, and to the South Lemington Pit 1. Combination of highwall, auger, punch longwall and conventional underground longwall mining of areas covering much of the HVO South area with the exception of Deep Cheshunt.	• As per the preferred option above plus: • Potential to recover additional reserve through highwall mining and reduce sterilisation of coal. This option requires more detailed assessment that has not yet been considered by the company.
Final Void	Single final void located in Deep Cheshunt Pit.	• Only one final void will remain instead of two. • Final void will be larger and deeper than is currently approved. • Final void will be located further north of Jerrys Plains Road. • Backfill or potential tailings disposal to South Lemington Pit 1. • The void will act as a groundwater sink and capture point for spoil leachate. **This is the preferred option as determined by detailed mine planning options assessment and allows the extraction of Deep Cheshunt coal reserves.**

Component	Description	Comment
	Two final voids located in Deep Cheshunt Pit and South Lemington Pit 1.	• Two final voids will remain. • Final void in Cheshunt will be larger and deeper than is currently approved. • Final void in Cheshunt will be located further north of Jerrys Plains Road. • Reduced tailings storage area. This option is supported by the proposed mine plan but does not provide for a tailings disposal opportunity in South Lemington Pit 1 final void.
	Two final voids located in Riverview Pit and Cheshunt Pit.	• No change to currently approved mine plans. • Two final voids will be located adjacent to Jerrys Plains Road. • Increased visual impacts on road users. • Safety concerns with final void located in the vicinity of public access. The proposed mine plan does not support this option.
Mining Rate	Project Approval for the existing mining rate of 16 Mtpa ROM coal (under one approval) for all operations within HVO South including extension areas.	• Continue current approved mining rate but under one approval. • Changes to mine plan will result in some additional impacts to social amenity. • Aligns mining production rates with the West Pit consent and increases the throughput capacity of the LCPP to up to 16Mtpa. • Increases flexibility of where and when mining is undertaken across HVO South. • Improvement to rehabilitation planning. • Reduced greenhouse gas emissions from reduced ROM coal transport. **This is the preferred option as it provides flexibility in mining and production rates and will improve the operational efficiency of HVO South by allowing better integration with HVO North.**

Component	Description	Comment
	Maintain existing approvals including: • 8 Mtpa ROM coal from Cheshunt and Riverview Pits (DA 114-12-98); • 4.4 Mtpa from Lemington Pits (DA 405/98 and DA 215/97); • 8 Mt from Cheshunt Extension (DA 181-8-2005); and • Equivalent to a total combined mining rate of up to approximately 16 Mtpa.	• Continue current mining plans (no extensions) would result in no change to social amenity for noise and dust. • Lower production rates and a mismatch between HVO North and HVO South could potentially cause inefficiencies in an integrated operation. • Separate production rates reduce operational flexibility. Separate production rates and approvals are an impediment to creating an integrated and flexible operation. The current processing rate for LCPP does not support current production rates.
Mining Equipment	Ability to use the equivalent of up to three large shovels and two draglines with combinations of two draglines and two large shovels or one dragline and three large shovels. This will include associated shovel/excavator prestrip fleet, and associated mining equipment as required in any pit within HVO South**.**	• Provides operational flexibility to increase production in individual pits to suit market requirements. • Potential to increase the rate of rehabilitation in individual pits. • Amenity impacts have the potential to be concentrated in a single part of HVO South for short periods of time. • Ability to best use appropriate equipment as required across the pits. • Allows use of equipment from HVO North on completion of mining activities. **This option is preferred as it offers greater operational flexibility for equipment usage across HVO South.**

Component	Description	Comment
	Maintain existing approvals including: • Truck and shovel operation within Cheshunt and Riverview Pits (DA 114-12-98); • Dragline operation within Riverview Pit (DA 114-12-98 M2); • Truck and shovel operation within South Lemington Pits (DA 215/97).	• No change to current operational impacts on social amenity. • Limits flexibility for CNA to efficiently utilise existing equipment across HVO South resulting in increased costs, equipment downtime and impacts on mine design. • Will require future modifications to consents to allow change in equipment use across HVO South. While amenity impacts are well understood, the limited flexibility associated with this option reduces the potential to improve overall amenity through better management practices which may be able to be implemented within a flexible operation.
Mining Equipment Transfers	Ability to relocate heavy equipment including draglines, shovels and excavators across Jerrys Plains Road to and from MTW, and within HVO across the Hunter River and Wollombi Brook.	• Reduces the number of approvals required to relocate individual pieces of heavy equipment. • Heavy equipment movements across Jerrys Plains Road will result in disruptions to traffic during temporary road closures. • Improves operational efficiency as the reduced number of approvals required will take less time to obtain. • Local approval will be obtained as required. **This option is preferred as it provides operational flexibility across both HVO and MTW.**
	Approval sought on an as required basis for above detailed heavy equipment movements.	• Numerous approvals required for each heavy equipment movement limits operational efficiencies. • Heavy equipment movements across Jerrys Plains Road will result in disruptions to traffic during temporary road closures. This option provides limited planning flexibility due to timing issues.

Component	Description	Comment
Material and Equipment	Ability to move materials and associated equipment around the HVO mining complex (from HVO North to HVO South) including ROM and product coal, coarse and fine rejects, water, overburden and topsoil as required.	• Provides operational flexibility and full integration for HVO as a whole. • Potential to provide better environmental outcomes as opportunities to use the reserves of the site would not be limited by existing consent conditions developed to manage individual pits. • Greater area available for placement of materials will result in improved final landform outcomes. • Variation to amenity impacts (noise and dust) through modified materials placement. **This option is preferred as it allows HVO South to be fully integrated over all aspects of the operation.**
	Material and equipment movements as defined in existing consents.	• Currently approved for equipment and material movements from HVO South to HVO North (DA 450-10-2003). • Restricts ability for movements from HVO North to HVO South. • Material and equipment movements limited by existing consent conditions developed for individual pits. • Restricted area for material placement reduces ability to improve final landform. • Amenity impacts are well understood and managed. This option provides limited flexibility and impedes the full integration of HVO South with HVO North.
Tailings Disposal	In-pit TSFs.	• Provides backfill of mining voids. • Rehabilitation via standard mining techniques. • Successfully used at HVO South for four previous TSFs. • Potential to reduce flexibility of mine design. **This option is preferred as it utilises established methods and existing voids.**

Component	Description	Comment
	In-pit co-disposal of fine and coarse reject.	• Provides backfill of mining voids. • Additional water requirement. • Reduces flexibility of mine design. • Potential adverse impact to stability of overburden dumps. • Large increase in area required for disposal. This option reduces flexibility within the limited mining footprint.
ROM Coal Transport	Ability to haul ROM coal from all pits to all coal preparation plants within HVO (HVCPP, HCPP, NCPP, LCPP) for processing.	• Provides maximum operational efficiency to meet market demand. • Provides alternatives should any CPP require maintenance or in emergencies. • Provides full integration of HVO South with HVO North which already operates with full internal flexibility for coal handling. • Potential for temporary increase in truck movements at specific locations during maintenance periods for individual plants. **This option is preferred as it provides maximum operational efficiency and integration of operations across HVO. It also provides backup during maintenance periods or emergencies.**
	Haul ROM coal as approved in existing consents.	• No change to current impacts to social amenity for noise and dust. • Reduces operational flexibility and integration within HVO South and HVO as a whole. This option does not improve operational flexibility or integration.

Component	Description	Comment
Coal Processing	Upgrade or reconstruction of LCPP and associated stockpiles to increase processing capacity to up to 16 Mtpa ROM coal and to improve coal processing efficiency.	• Increases processing capacity at LCPP. • Reduces truck movements from HVO South to HVCPP. • Increases truck movements to the LCPP from HVO South and potentially from HVO North. • Upgraded CPP provides increased operational flexibility across HVO. • Staged upgrade will provide throughput flexibility for LCPP. • Increases flexibility of processing throughput at HVCPP, and transport through HVLP and NLP. • Additional load point provides increased logistical flexibility. • Capital expenditure and associated construction required. • Upgrade or reconstruction of LCPP will improve operating efficiency and impacts to social amenity for noise and dust. • Improved yield from latest technology. **This is the preferred option as it provides maximum operational flexibility within HVO South and reduces the distance that ROM coal from HVO South is transported for processing. In turn, a reduction in energy use is expected per tonne of ROM coal processed.**
	LCPP to operate with current processing capacity of 5.5 Mtpa ROM coal.	• Reduces the rate at which coal can be processed per year across HVO and limited coal processing ability within HVO South. • Increases truck movements to the HVCPP and HCPP from HVO South. • Large capital expenditure required to recommission. This option is not preferred as it limits operational flexibility and is not cost effective.
	LCPP to operate as a bypass crusher only.	• Reduces the volume of coal that can be processed per year across HVO and limited coal processing ability within HVO South. • Increases truck movements to the HVCPP and HCPP from HVO South. This option is not preferred as it limits operational flexibility and is not cost effective.

Component	Description	Comment
	LCPP to remain under care and maintenance.	• Reduces the volume of coal that can be processed across HVO and limited coal processing ability within HVO South. • Increases truck movements to the HVCPP and HCPP from HVO South. • No capital expenditure required. • If decommissioned, components will require disposal. This option reduces operational flexibility.
Product Coal Transport	Ability to transport product coal by truck or overland conveyor from all coal preparation plants to all loading points (HVLP, NLP, RCT and the proposed LLP). Construction of a rail spur and loop or OLC from Wambo rail spur to LCPP and the ability to transport product coal via rail or OLC to Wambo rail spur. The northern end of the rail spur is located to the east of the cultural heritage sites (refer to *Chapter 12*).	• Increases efficiency of coal handling and transportation to the Port of Newcastle. • Increases scheduling flexibility and independence from Wambo. • No trucks on Jerrys Plains Road (government and community stakeholders strongly oppose coal haulage on public roads). • Already subject of EIS (Proposed Jerrys Plains Coal Terminal, Rail Spur Line and Associated Infrastructure, HLA, 2000). • Large capital expenditure. • Construction of rail spur or overland conveyor to join the Wambo rail spur on the north side of Jerrys Plains Road. • Provides alternatives should any load point require maintenance or in emergencies. • Provides full integration with HVO North which already operates with full internal flexibility for coal handling. • Minimises impacts to cultural heritage sites. **This is the preferred option as a separate independent spur to HVO South offers the best opportunity for HVO to access the maximum number of trains by avoiding the constraints caused by a shared rail loop.**

Component	Description	Comment
	Ability to transport product coal to all loading points (HVLP, NLP, new LLP). Construction of a rail spur and loop or OLC from Wambo rail spur to LCPP and the ability to transport product coal via rail or OLC to Wambo rail spur. The northern end of the rail spur is located through the cultural heritage sites.	• Increases efficiency of coal handling and transportation to the Port of Newcastle. • Increases scheduling flexibility and independence from Wambo. • No coal trucks from HVO South on Jerrys Plains Road. • Already subject of EIS (Proposed Jerrys Plains Coal Terminal, Rail Spur Line and Associated Infrastructure, HLA, 2000). • Large capital expenditure. • Construction of rail spur or overland conveyor to join the Wambo rail spur on the north side of Jerrys Plains Road. • Impacts on a number significant cultural heritage sites. This option was discounted due to the impact on cultural heritage sites.
	Truck haulage or conveyor transport of product coal from LCPP to Wambo rail loop. or Maintain road transport of product coal to MTCL as approved in existing consents.	• Truck haulage option utilises existing infrastructure. • OLC option requires capital expenditure for new infrastructure. • Negates the need for the construction of rail loop or OLC within HVO South. • An additional loader on the Wambo Loop would not match LCPP processing throughput and would lack reliability and surge capacity. • Trucks would haul coal along a section of Jerrys Plains Road and cross Wollombi Brook. • OLC route would pass around Warkworth Village and cross Jerrys Plains Road and Wollombi Brook. This option is not viable due to restrictions on capacity at the shared rail loop, and logistical and environmental issues involved in product coal transport to the loop.
Comleroi Road	Relocation of Comleroi Road to the east of the proposed relocated HVGC.	• Mining from the Riverview Pit will progress in a south easterly direction using a dragline. • Relocation of the road to the east places the road at a greater distance from mining. • Avoids proposed footprint of HVGC. **This is the preferred option as it maintains the road at a distance from mining operations and optimises mining efficiency of Riverview Pit south east and South Lemington Pit 2.**

Component	Description	Comment
	Relocation of Comleroi Road to the west of the proposed relocated HVGC.	• Mining from the Riverview Pit will progress in a south easterly direction using a dragline. • The location of Comleroi Road to the south west of the Riverview Pit places the road closer to the mining operation. • Avoids proposed footprint of HVGC. This option is too close to active mining.
	No relocation of Comleroi Road	• Reduces mining areas at Riverview Pit south east and South Lemington Pit 2, with some sterilisation of reserves. • Mining of Riverview Pit south east and South Lemington Pit 2 by truck and shovel. • Relocation options for HVGC are limited. This option reduces access for mining and operational efficiency.
HVGC and Airstrip	Reconstruction or reconfiguration of the HVGC Airstrip and facilities (subject to agreement with HVGC).	• Allows the extension of Riverview Pit to the south east to South Lemington Pit 2, with mining by dragline. • Prevents the sterilisation of coal reserve under the HVGC. • Temporary disruption to HVGC operations during relocation/reconfiguration and some dragline operations. • Is dependent upon approval from HVGC. • Nil impact to Class II land. **This is the preferred option as the reconfiguration of the site further to the east will reduce potential impacts to HVGC associated with relocation. In addition, it would increase mining efficiency of Riverview Pit south east and South Lemington Pit 2.**
	Relocation of the HVGC Airstrip and facilities to alternative airstrip locations off HVO site.	• HVGC is relocated a significant distance away from Riverview Pit. • Issues raised have related to proximity to established communities, land ownership and joint use of shared infrastructure. This option is not feasible due to the issues identified.

Component	Description	Comment
	No relocation of the HVGC Airstrip and facilities.	• Reduces mining areas at Riverview Pit south east and South Lemington Pit 2, with some sterilisation of reserves. • Increased mining of Riverview Pit south east and South Lemington Pit 2 by truck and shovel over dragline. This option reduces access for mining and operational efficiency.
In-pit Crushing and Conveying	In-pit crushing and conveying of overburden within Cheshunt Pit. This activity would comprise a mobile hopper and crushing equipment located adjacent to a shovel at Cheshunt Pit. The shovel would load directly into a hopper. The hopper and crusher would move with the shovel. A mobile conveyor would transfer the overburden to the spoil dumps. The tail end of the conveyor would move with the shovel. The head end of the conveyor would feed a spreader.	• Reduces waste truck haulage. • Location proposed (Deep Cheshunt) is poorly suited to in-pit crushing and conveying. The pit is a deep, multi seam, multi shovel operation within a limited footprint. Adoption of this option would result in decreased equipment operating within the pit and, as such, decreased operational flexibility. This option has not been fully assessed for viability at this time.
Ability to Reprocess Tailings	A flotation plant would be constructed at the LCPP or at the adjacent TSF to concentrate the coal fraction within the fine reject. A pump and pipeline would be constructed to transfer the concentrate to the power stations for use as a fuel.	• Maximises reserve recovery. • Three of the TSF at HVO South have been completed, capped and rehabilitated. The fourth remaining facility has been 60% capped. Once capped the potential for the tailings to be significantly compressed and contaminated with spoil is high. • More suitable opportunities exist at HVO North. This option has not been fully assessed for viability at this time.

4.2 CONCLUSIONS

The environmental assessment to support the surrender of existing consents and replacement by one Project Approval has provided CNA with the opportunity to review existing and future operations and key operational components.

Key proposal components relate to the continuation and extension of mining, improvements in operational efficiencies, infrastructure upgrades and modifications and operational integration within HVO South and HVO as a whole. The preferred components listed in *Table 4.1* and described in *Chapter 5* will allow for maximum operational flexibility and reserve recovery whilst ensuring operations are within acceptable environmental parameters.

Key environmental aspects considered when determining preferred options were noise and vibration and dust. Further refinements to proposal components were made as a result of consultation with agencies and the community.

The preferred proposal provides the opportunity to achieve better environmental outcomes through flexibility in the operations which can be adapted to varying climatic conditions. The preferred proposal will also result in improvements in the areas of water management, cultural heritage, energy use and greenhouse gas emissions, rehabilitation, socio-economic outcomes, operational costs and administration.

In addition, operational efficiencies and increased integration across HVO South and HVO as a whole will be realised through the preferred mining and processing rates and preferred options for coal handling, reject disposal and equipment transfer.

5 DESCRIPTION OF THE PROPOSAL

This chapter describes the preferred components of the proposal, summarises key information and compares the consolidated activities to the currently approved HVO South and North.

5.1 OVERVIEW OF THE PROPOSAL

CNA seeks a Project Approval that will replace the 35 existing approvals that currently apply to HVO South. This Project Application also seeks approval for all current operational and environmental activities to continue. In addition, *Annex D* provides details of activities consented under existing approvals to be maintained under the new Project Approval. The proposal will also allow for the following activities:

- ongoing opencut and highwall mining of coal reserves as currently approved;

- extension of opencut and highwall mining in areas described in *Section 5.3* (increasing the currently approved mining surface disturbance footprint by 250 ha) resulting in a single final void located in the Deep Cheshunt Pit;

- mining of all coal seams within HVO South to unlimited depth;

- mining up to 16 Mtpa ROM coal by a combination of draglines, shovels, excavators and associated haul trucks and additional access and haul roads or modifications as required to allow mining to progress;

- modification, upgrades and / or reconstruction of the LCPP to increase processing capacity to 16 Mtpa, provide additional stockpiles and new coal loading infrastructure;

- infrastructure to facilitate transfer of product coal to the Wambo rail spur via either a rail spur and loop, overland conveyor or trucks, or any combination;

- the full integration of operations at HVO South allowing for operational efficiencies and improved economies of scale. These relate to new activities and upgrades and modifications to existing approved operations, mining and processing rates, equipment use and relocation, water, rejects and tailings disposal and coal handling as detailed in *Section 5.4*;

- modification, upgrades, reconstruction or relocation of existing infrastructure as detailed in *Section 5.5* including relocation of Comleroi Road;

- the ability to relocate heavy equipment including draglines, trucks and shovels across Jerrys Plains Rd to and from MTW, and within HVO across the Hunter River and Wollombi Brook;

- relocation or reconfiguration of the Hunter Valley Gliding Club (HVGC) airstrip and facilities (if agreed with the Club), to accommodate the integration of the Riverview Pit with the South Lemington Pit 2; and

- the granting of a Project Approval to replace all existing consents.

5.2 KEY INFORMATION

The following sections describe the elements of this proposal, which can be separated into continuation and extension of mining, operational efficiencies, upgrades and modifications and modifications to non-mine owned facilities. The key proposal information and list of activities for which approval is sought is summarised in *Table 5.1* at the end of the chapter. This table is supported by *Annex D*, which provides a summary of existing consented activities including site infrastructure, for which this application seeks continued approval. It should be noted that HVO North mining components have been listed in *Table 5.1* to provide an indication of the activities to be undertaken at HVO in their entirety. No variation to the West Pit consent under which HVO North is consented is required.

Proposal features presented in *Chapter 5* figures are represented as accurately as possible. However, due to the scale of these figures and the thickness of lines etc minor inaccuracies may occur.

Assessments were undertaken on the mine plans produced at September 2006. The mine plan and mining methods utilised for the purposes of this assessment provide an indicative worst case analysis. In the course of operational implementation, alternative mine plans and mining methods may be utilised, provided that in all cases the environmental impacts remain within the envelope of effects assessed in this report. The overall mining disturbance area is as depicted in *Figure 5.1*. The timing of this disturbance may vary depending on changes to the mine plan.

5.3 CONTINUATION AND EXTENSION OF MINING

The currently approved area of mining in HVO South is approximately 2980 ha. This includes the Cheshunt, Riverview and Lemington Pits. A total area of approximately 250 ha outside of the currently approved limit is required for mining purposes. Each of the current mining areas has been consented to operate for 21 years. As described in *Chapter 2*, all pits are approved for opencut mining operations. Highwall mining is also approved within South Lemington Pits and areas within the Cheshunt and Riverview Pits. Project approval is sought for currently approved operations and extensions to operations as detailed in this section.

CNA has always intended to continue mining in accordance with approved mine plans. However, the legislative process has meant approvals are generally issued for periods of no more than 21 years. The long term mine planning process at CNA has identified reserves available for opencut mining through to 2037. These extension areas are located beneath the base of the currently approved Cheshunt Pit mining limit, to the south east and south west of Riverview Pit, and directly to the west of the South Lemington Pit 1. An indicative overview of the proposed progression of mining is presented in *Figure 5.2*, and indicative mine plans at September 2006 are shown in *Annex E*.

These reserves fall within the currently consented boundaries excluding a small portion of the Riverview Pit south east area. Extending mining into these areas provides access to approximately 84 Mt of additional ROM coal, significantly increasing the value of HVO. Coal will generally be mined in the extension areas in accordance with opencut mining methods described in *Chapter 2* with the addition of the use of excavators to remove coal. *Figure 5.1* depicts approved and proposed opencut mining areas and the proposed location boundary of the conveyor (refer to *Section 5.5*).

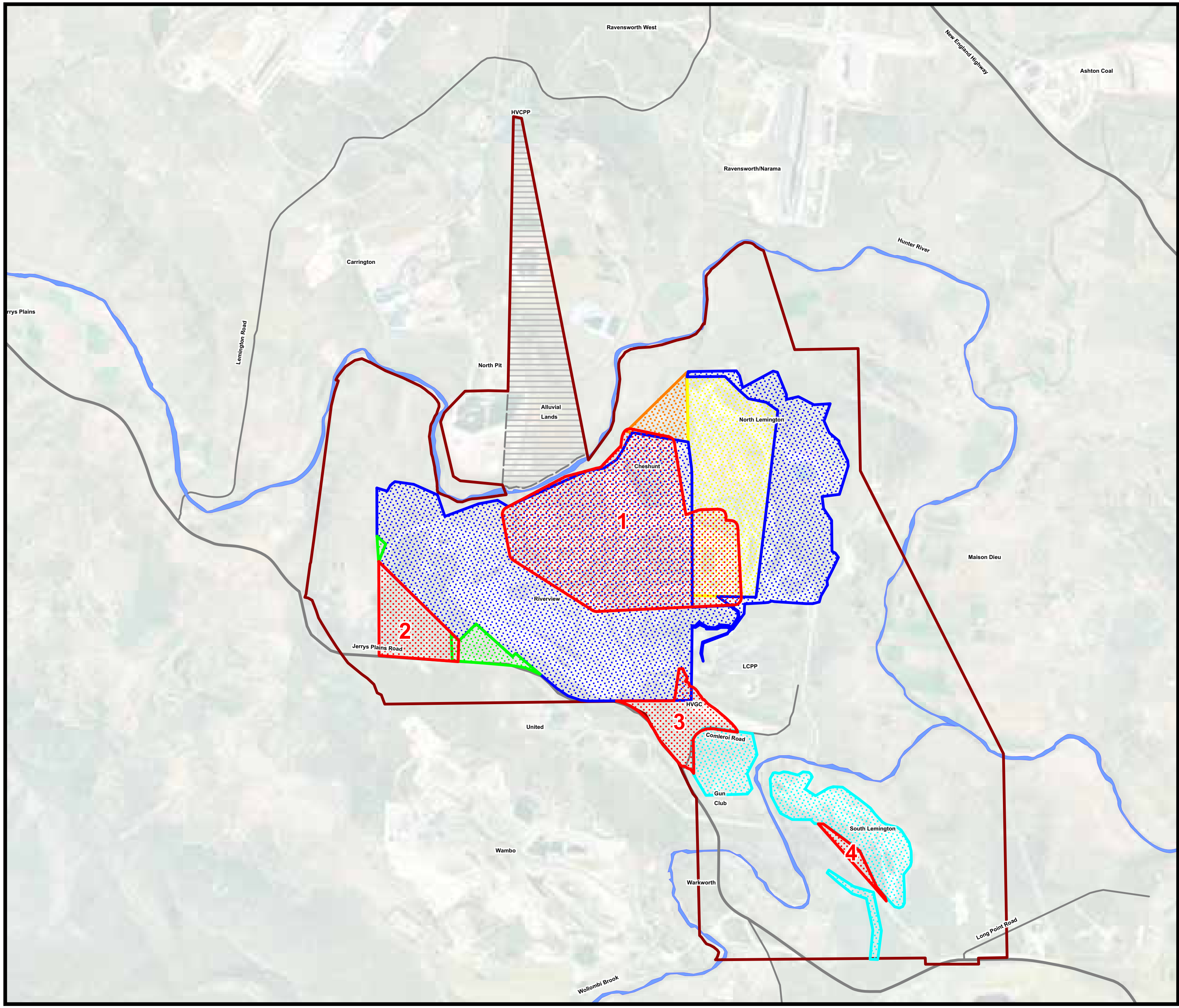
Additional areas potentially available for highwall mining have been identified across the Mine Lease. *Figure 5.3* shows approved and proposed highwall mining areas. Highwall mining would generally be undertaken in accordance with methods described in *Chapter 2* and would provide access to additional ROM coal.

While CNA holds extensive subsurface mining tenements, no underground mining is proposed in this Project Application.

Three sets of mine plan scenarios were produced for the proposal:

- Scenario 1: base case, including combinations of two large shovels and one or two draglines operating across HVO South;
- Scenario 2: three large shovels and one dragline operating across HVO South; and
- Scenario 3: two large shovels and two draglines operating across HVO South.

Equipment types and positions vary across the mine plans. Accordingly, rates of mining within pit areas also vary. A selection of indicative mine plans are presented in *Annex E*. Where relevant, environmental assessments were undertaken selecting the mine plan that resulted in the potentially most significant impact for the relevant assessment area. The mine plans adopted for environmental assessment and a justification for their selection are provided within relevant sections of this report.



Legend

Approved Mining Areas

- DA 114-12-98
- DA 114-12-98 M3
- DA 181-8-2005
- DA 215/97
- DA 84/115

- Project Application Area
- Proposed Extension Areas
- Proposed Location Boundary of Conveyor

1 Deep Cheshunt
2 Riverview Pit South West
3 Riverview Pit South East
4 South Lemington Pit 1

Figure 5.1

Approved and Proposed Opencut Mining Areas and Project Application Area

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_04	Suffix No:	R4
Date:	27.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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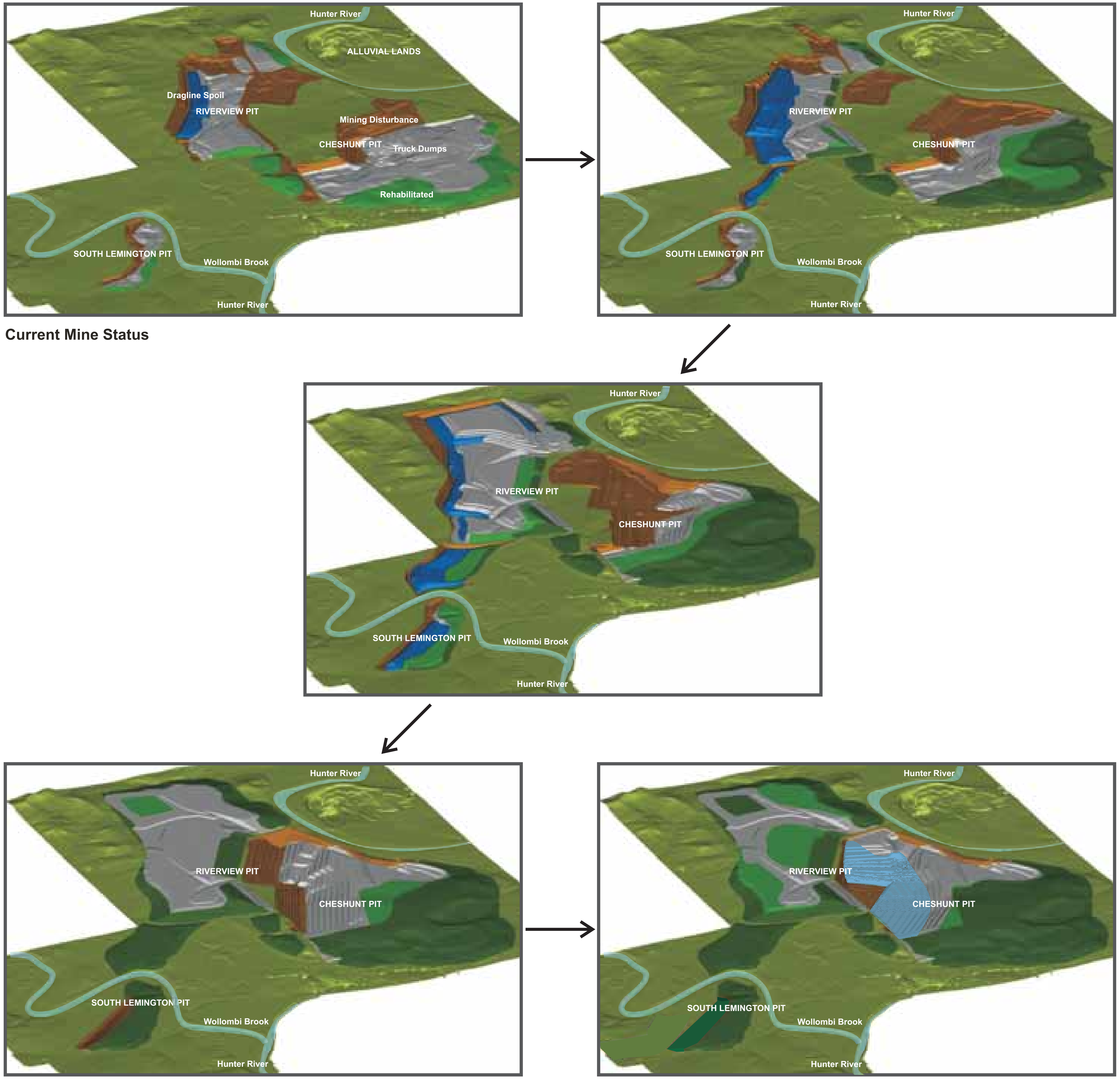

Legend

- Rehabilitation
- Mining Disturbance
- Dragline Spoil
- Truck Dumps
- Established Rehabilitation
- Undisturbed by Mining
- Final Void Lake

Figure 5.2

Indicative Overview of Proposed HVO South Mine Progression

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_IC_09_R5
Date:	03/10/2007 Drawing size: A3
Drawn by:	GC Reviewed by: LS
Source:	RTCA Mine Planning Department
Scale:	N/A

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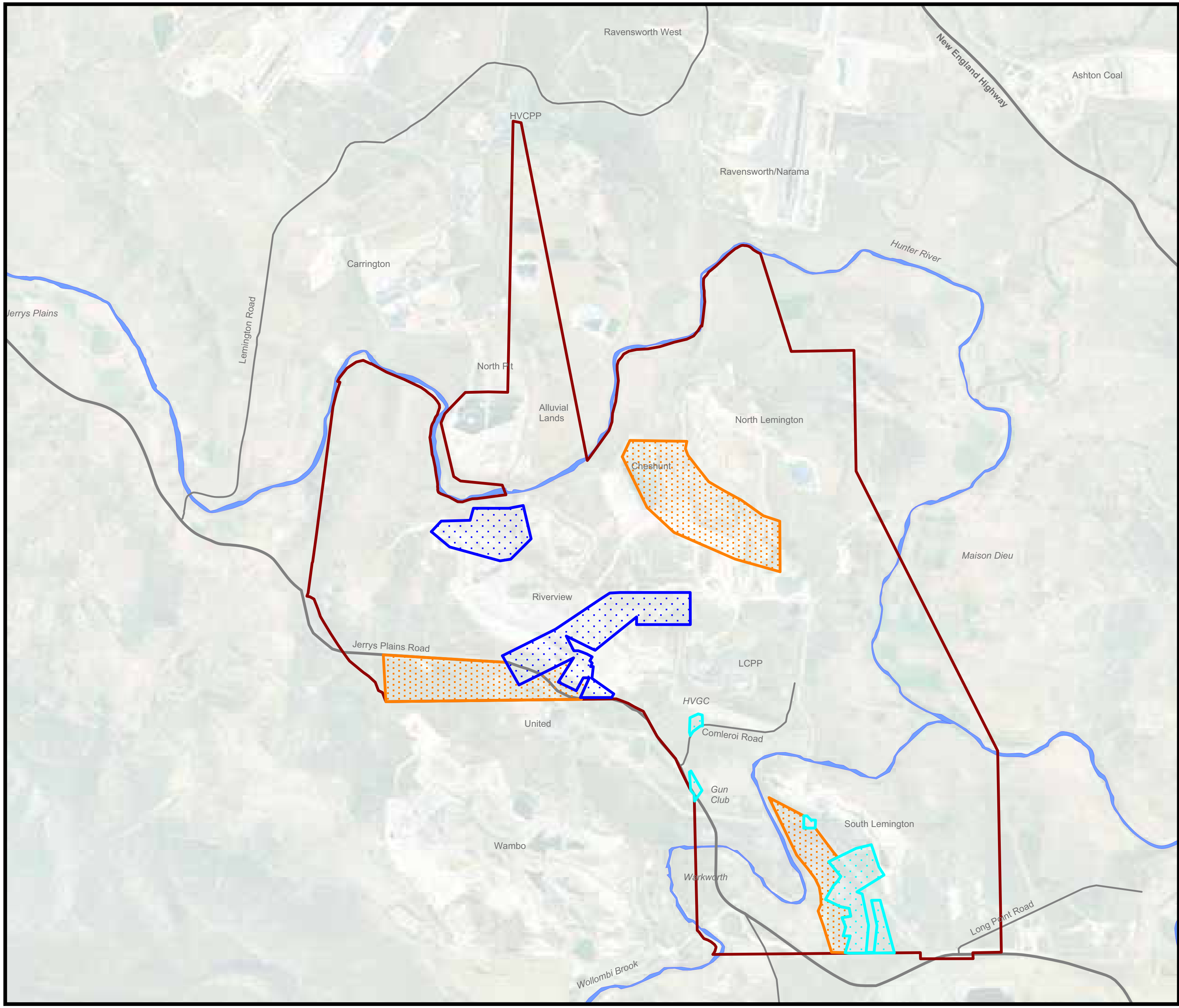

Legend

Proposed Highwall Mining Area
Approved Highwall Mining Area DA 114-12-98
Approved Highwall Mining Area DA 215/97
Project Application Area

Figure 5.3

Approved and Proposed Highwall Mining Areas

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_05	Suffix No:	R3
Date:	29.08.2007	Drawing Size:	A4
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5.3.1 Deep Cheshunt Extension

Mining within the Cheshunt Pit is currently consented from the surface to the base of the Vaux seam. This Project Application seeks consent to mine to unlimited depth and in particular approximately 80 m deeper to the base of the Bayswater seam. Approximately 60 Mt of ROM coal will be mined by opencut mining methods, using up to three large shovel fleets including front end loaders, excavators and other ancillary equipment. The area of surface disturbance will remain largely unchanged from the approved footprint in existing plans. The total surface area of the extension area for the Deep Cheshunt reserves measures approximately 450 ha, which is already consented for surface disturbance.

5.3.2 Riverview Pit South West Extension

The proposed extension of mining in the Riverview Pit to the south west (approximate area 120 ha) will access the remaining coal reserves that were not included in the original South Pit consent (DA 114-12-98) due to the 21 year consent period. Approximately 15 Mt of coal will be removed by opencut mining methods, using a dragline and ancillary equipment with associated truck and shovel or truck and excavator prestrip in advance of mining.

5.3.3 Riverview Pit South East Extension

The proposed extension of mining in the Riverview Pit to the south east by approximately 100 ha will allow the efficient connection to the previously consented South Lemington Pit 2 allowing the dragline to operate in this area (refer to *Figure 5.1*). This will access approximately 4.6 Mt of coal by opencut mining methods, using a dragline and ancillary equipment with associated truck and shovel or truck and excavator prestrip in advance of mining.

5.3.4 South Lemington Pit 1 Extension

South Lemington Pit 1 is currently consented to allow mining of a further two strips followed by highwall mining. Geological investigations have identified a further 4.6 Mt of coal reserves that could be mined by opencut mining methods to the west in an area of approximately 30 ha. Mining is proposed to be undertaken using a dragline and ancillary equipment with associated truck and shovel or truck and excavator prestrip in advance of mining.

5.3.5 Additional Highwall Mining Areas

The proposal seeks approval for additional highwall mining of areas directly to the south of the Riverview Pit, to the north east of the Deep Cheshunt extension area and supplementary areas to the south west of South Lemington Pit 1. Proposed highwall mining methodology is described in *Chapter 2* and is presented in *Figure 2.4*

Potential impacts from highwall mining relate primarily to subsidence and groundwater. Highwall mining areas have been considered in the groundwater assessment (see *Chapter 9*).

Subsidence greater than 20 mm triggers the requirement for the preparation of a Subsidence Management Plan (SMP) in accordance with the *Mining Act 1992*. A SMP would require approval by the DPI-MR prior to this highwall mining commencing.

The assessment completed for the proposed highwall mining was specifically based upon extraction designed to result in subsidence of less than 20 mm. This assessment is included in *Annex F.* The areas north east of the Deep Cheshunt Pit and to the south west of South Lemington Pit 1 are located within the footprint of active mining and will be subject to active management and rehabilitation. The area south of Riverview Pit extends under Jerrys Plains Road. Highwall mining has been designed to result in less than 20 mm subsidence; however, it is acknowledged that highwall mining in this area may require more comprehensive management and therefore an SMP may be developed.

5.4 OPERATIONAL EFFICIENCIES

A review of current activities has identified areas that, if fully integrated, will result in operational efficiencies and improved economies of scale. The management structure and size of the HVO mining complex is such that planning, equipment and facilities can be modified easily to meet changing market needs. To achieve this flexibility this proposal seeks approval for:

- the mining and processing of 16 Mtpa ROM coal for all operations within HVO South to align mining production rates with those approved in HVO North (West Pit Consent DA 450-10-2004) and the maximum proposed throughput of the LCPP;

- the ability to use draglines, trucks and large shovels and excavators at HVO South as suits the operation. This will include the ability to use the equivalent of up to three large shovels and two draglines with combinations of two draglines and two large shovels or one dragline and three large shovels. This will include associated shovel/excavator prestrip fleet, and associated mining equipment as required in any pit within HVO South. Dragline and truck and shovel operations have been described in *Section 2.6*;

- the ability to transport ROM coal from each HVO South pit to each coal preparation plant within HVO for processing (HVCPP, HCPP, NCPP, and LCPP) and product coal to all HVO coal loading points (proposed LLP, HVLP, NLP and RCT). All ROM coal will continue to be transported via existing private haul roads and conveyors. The approved conveyor linking HVO South and HVCPP has not yet been constructed. *Figure 5.4* provides an overview of the proposed operation and *Figure 5.5* depicts the proposed coal movement volumes;

- the ability, additional to that consented under the West Pit consent, to transport rejects and overburden from HVO North to HVO South to assist with final landform construction and capping of TSFs. Existing private haul roads will be used for this purpose;

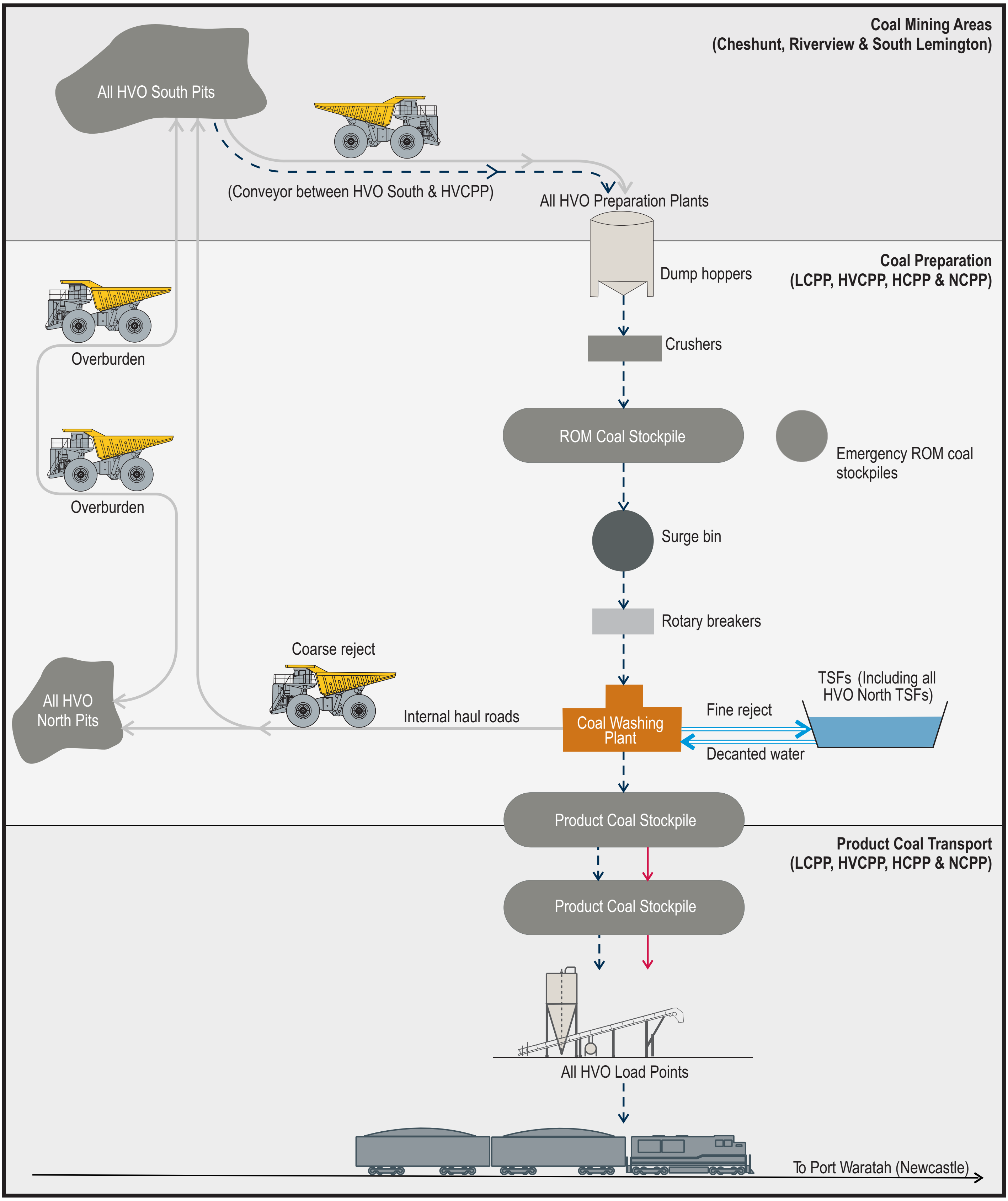
- the ability to move materials and associated equipment around the HVO mining complex (between HVO North and HVO South) including ROM and product coal, fine and coarse rejects, overburden, topsoil and water as required;

- the ability to relocate heavy equipment including draglines, trucks and shovels across Jerrys Plains Rd to and from MTW, and within HVO across the Hunter River and Wollombi Brook. This will allow for rationalisation of existing equipment, improved utilisation of equipment and infrastructure, reduction in equipment hire costs and improved strategic focus on reserve development. Existing and proposed access routes for which approval is sought are depicted in *Figure 5.6*.

  The existing heavy equipment access route originates from the south eastern corner of Cheshunt Pit. From here, the road travels south crossing the existing Wollombi Brook high level bridge before continuing towards the north eastern tip of South Lemington Pit 1. The road borders the eastern edge of South Lemington Pit 1 and continues in a south westerly direction to a point approximately 1 km above the Wambo rail spur. From this point, existing haul roads split to the south and west. Approval is required for two additional short sections of road to provide flexibility in transport options. Both road routes can be seen in *Figure 5.6*. The eastern section allows for an 'at grade' crossing of the Wambo rail spur. The western section would allow for a more direct route to the existing bridge crossing of Wambo rail spur;

- TSFs. There are seven existing TSFs located within HVO South, of which one is open (TSF 5), five are rehabilitated and one is partially rehabilitated. TSF 5 will be reactivated when the LCPP again becomes operational. This Project Application seeks approval for the ongoing use of TSF 5 and the establishment of three additional TSFs. These facilities are proposed within the western section of South Lemington Pit 1, the eastern section of the Riverview Pit and within the south eastern Riverview Pit extension area. All TSFs will be rehabilitated following completion of mining. In addition, this Project Application seeks approval for the ongoing management of the previously rehabilitated TSFs. The locations of the existing proposed and rehabilitated TSFs are depicted in *Figure 5.7;* and

- a single void located in Deep Cheshunt. Current mine plans result in two final voids being formed; one in Riverview Pit and the other in Cheshunt Pit (approved under DA 114-12-98). In accordance with proposed mine plans, these voids will now be backfilled and a single void will result in Deep Cheshunt. The proposed void will be approximately 1700 m in width, 3700 m in length and 200 m deep. The management of the void will be incorporated into the HVO Mine Life Plan for closure. The key requirements are to ensure the ongoing stability of the void and safety of the community. Conceptual final landform is discussed further in *Chapter 19 – Mine Landscape Planning* and depicted in *Figure 19.2*.



Legend

Internal Road Haulage
Conveyor
Intermittent Road Haulage

Figure 5.4

Flowchart of Proposed Operations

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_IC_10_R3		
Date:	24/08/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
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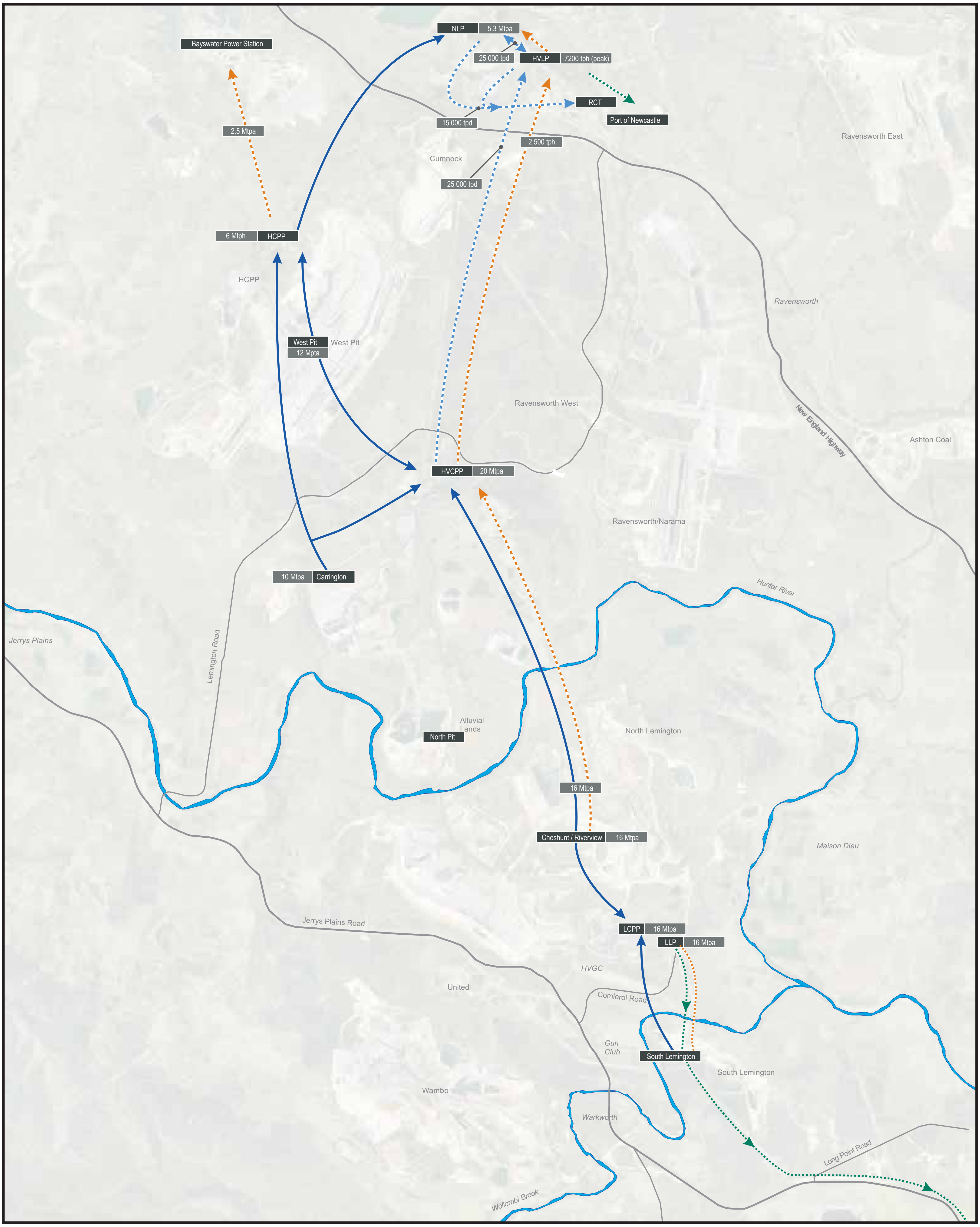

Legend

- Haul road
- Conveyor
- Railway
- Intermittent road haulage

Figure 5.5

Proposed Coal Movement Volumes

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_IC_11_R4		
Date:	21/12/2007	Drawing size:	A3
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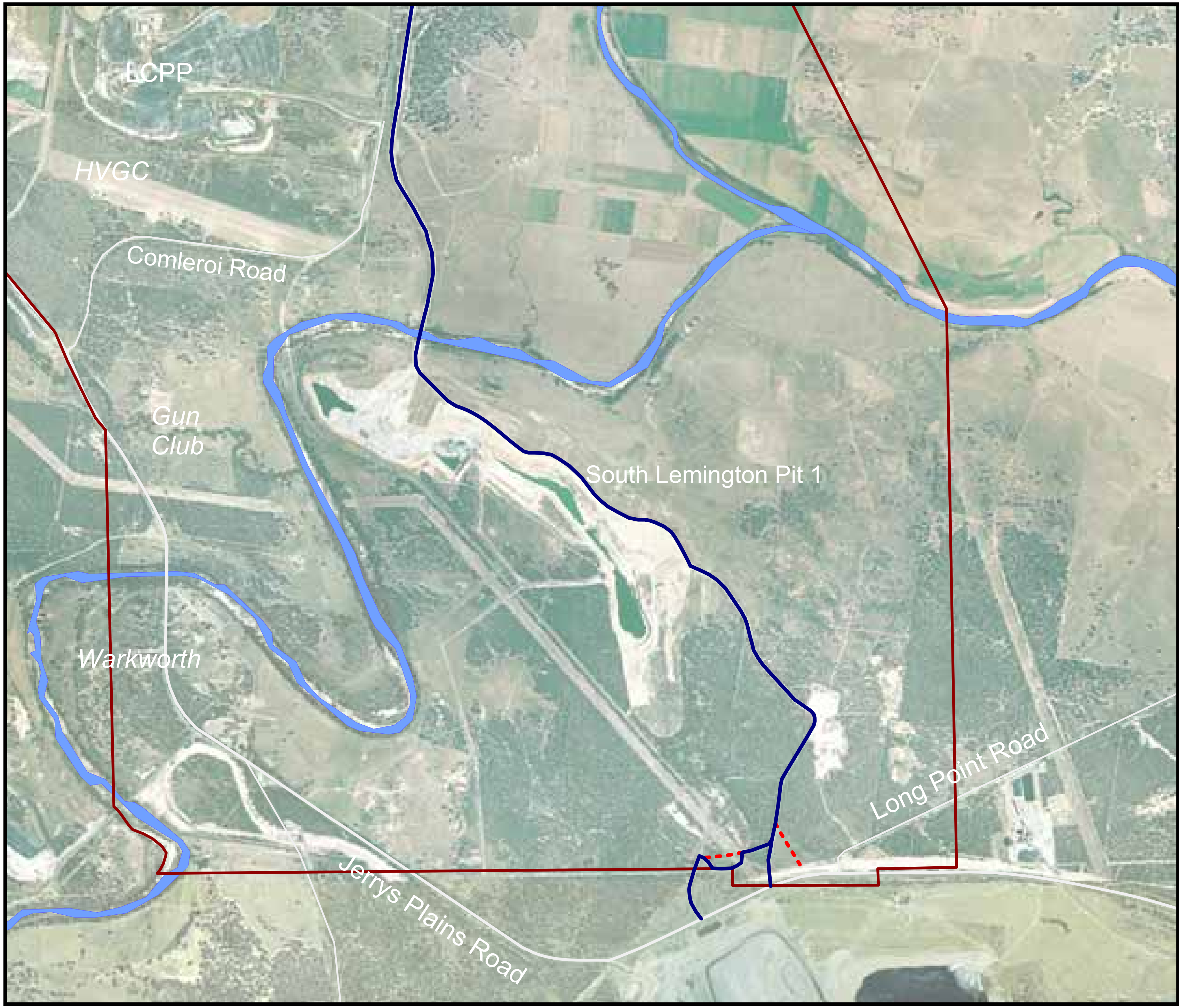

Legend

- Existing Heavy Equipment Access Route
- Proposed Heavy Equipment Access Route
- Project Application Area

Figure 5.6

Existing and Proposed Heavy Equipment Access Routes

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_09	Suffix No:	R2
Date:	14.05.2007	Drawing Size:	A4
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5.5 UPGRADES AND MODIFICATIONS

The review of activities also identified areas that could be readily improved by modifications to existing facilities and infrastructure.

LCPP Infrastructure

- upgrade or reconstruction of the LCPP including associated load point and stockpiles to increase its approved capacity from 5.5 Mtpa (660 tph) to up to 16 Mtpa ROM coal and to improve its coal processing efficiency. The upgrade or reconstruction of the LCPP and associated load point and stockpiles will be constructed within the vicinity of the existing LCPP. LCPP infrastructure components are listed in *Table 5.1*. *Figure 5.7* depicts the LCPP proposed disturbance footprint.

  Two options are being considered for the LCPP.

  Option 1: Comprises the upgrade of the existing LCPP. Modules will be added as required resulting in a staged increase in processing capacity; and

  Option 2: Comprises the demolition of the current LCPP. Demolition work would be undertaken in accordance with Australian Standard *AS 2601-2001: The Demolition of Structures*. A new LCPP would be constructed in generally the same location.

  Environmental aspects with the greatest potential to be impacted by the upgrade or reconstruction are air quality and noise. The associated assessments have assumed that the capacity of the LCPP will be increased to 16 Mtpa.

Transport Infrastructure

- upgrades and modifications to infrastructure enabling the transport of product coal via haul road or OLC to access the Wambo rail spur, or alternatively, via a newly constructed rail spur adjacent to the LCPP. All options will negate the need for continued haulage along Jerrys Plains Road to MTCL and provide more efficient handling and transportation of coal to the Port of Newcastle. All options are presented in *Figure 5.7*.

  Option 1: Comprises the construction of a coal loader and new rail loop adjacent to the LCPP. The loop and associated rail line spur would connect to the Wambo rail spur. In 2001, the Jerrys Plains Coal Terminal, Rail Spur Line and Associated Infrastructure were approved (DA 141-12-00 and DA 412-12-00). Option one is within the previously consented footprint until reaching Wambo rail spur.

  The loop will be designed to accommodate two trains of approximately 1600 m length at any one time. A conveyor would transport stockpiled product coal to the train load out bin. Loop rail length is such that one train will fit between the loop turnout and train loading bin on the arrival side and the second between the bin and turnout on the departure side.

From the loop the spur line would cross the existing South Lemington haul road bridge over Wollombi Brook. The bridge is structurally adequate to support the proposed rail. From this point the rail would travel in a south easterly direction connecting to the Wambo rail spur south of South Lemington Pit 1 adjacent to Long Point Road.

Option 2: Comprises the transport of product coal to a new loop proposed for construction south of the South Lemington Pit 1. Coal would be trucked to the loop via an existing haul road that runs adjacent to South Lemington Pit 1. The proposed loop would be as described for option one.

Option 3: Comprises the construction of a conveyor that would be utilised to transport coal to a new loop as described above. The conveyor would be constructed adjacent to the existing haul road described above.

General Infrastructure

- addition or modification to existing infrastructure and mobile and in-pit facilities as required including new or expanded administration offices and amenities, storage facilities, waste management systems including sewage treatment systems, Lemington workshop, heavy and light vehicle wash pad, fuel storage facilities, explosives magazines and any construction village or project offices within the current mining and infrastructure areas;

- additional access and haul roads or modifications as required to allow mining to progress;

- relocation of water management structures, bunds, powerlines, substations and switchyards, pipelines and communication cables as required in order to allow mining to progress;

- in-pit crusher and conveyor from HVO South to the HVCPP. This is approved under DA 114-12-98. This proposal seeks to gain increased flexibility in the location of the conveyor. This will reduce engineering and terrain constraints to the construction of the conveyor. The proposed location boundary for the conveyor can be seen in *Figure 5.1*;

- relocation of Comleroi Road and South Lemington Pit 2 levee (SLL2) as mining extends in the Riverview Pit to the south east (refer to *Section 5.6.1*); and

- continuing operation of the HVGC including relocation, reconfiguration or upgrade of the HVGC Airstrip and facilities, if agreed with HVGC (refer to *Section 5.6.4*).

Disturbance areas required for construction and installation of infrastructure will be minimised and rehabilitated when possible.

Specific Consented Activities to be Maintained

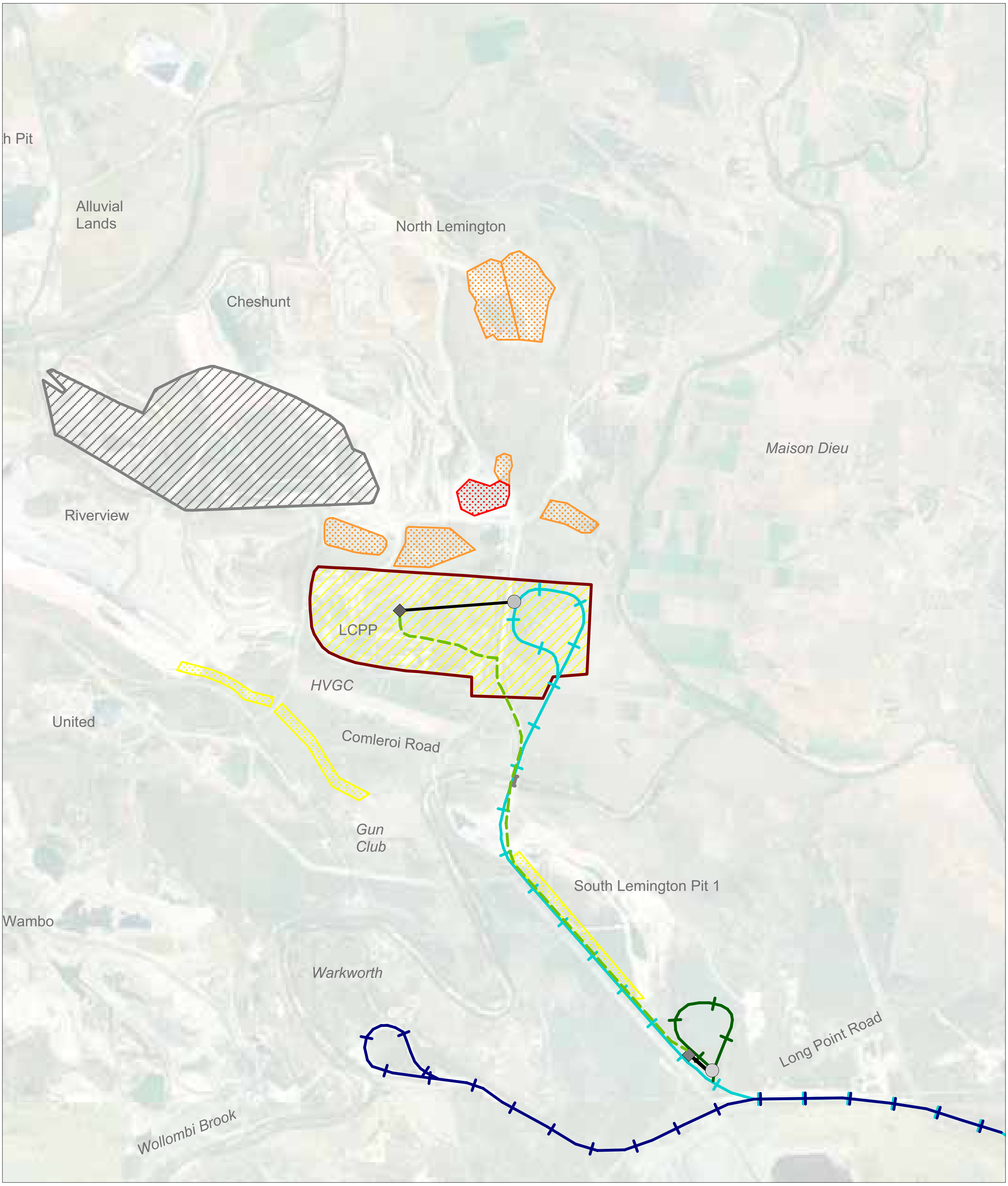
A number of activities are presently approved under existing development consents but not currently undertaken. It is proposed that approval for these activities be maintained unchanged under the single Project Approval being sought for HVO South (refer to *Table 2.1*):

- haulage of coal from HVO South to HVO North using haul trucks with flexibility to use contractor trucks (B double or other);
- expansion of Cheshunt bathhouse and workshop and possible relocation as mining in the Cheshunt Pit progresses. Any new buildings and structures, and any alterations or additions to existing buildings and structures, will be constructed in accordance with relevant requirements of the *Building Code of Australia*; and
- continued use of Lemington offices, bathhouse, workshop and storage facilities and LCPP.

Annex D provides a summary of existing consent conditions for which this application seeks continued approval.

Activities Not Within the Application

- relocation of Singleton Clay Target Shooting Club (Gun Club). The Gun Club, located on CNA owned land, has an agreement with CNA stating that they are to move when requested. CNA have provided an alternative location and the Gun Club are currently relocating. Any approval required by the Gun Club for continued operation does not form part of this Project Application;
- activities approved under the West Pit consent (DA 450-10-2003);
- activities approved under the Warkworth consent (DA 300-9-2002i); and
- activities approved under the Mount Thorley consents (DA 34/95 and 80/53).



Legend

- Lemington Coal Preparation Plant and Associated Infrastructure
- Final Void
- Loading Terminal
- Coal Stockpile
- Proposed Trucking & Conveyor Route
- Proposed Short Loop
- Coal Conveyor
- Proposed Rail Line
- Wambo Rail Loop and Spur
- Existing Bridge
- Existing Tailings Facility
- Proposed Tailings Facility
- Rehabilitated Tailings Faclity

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_10	Suffix No:	R4
Date:	27.08.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
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Figure 5.7

Proposed LCPP Footprint, Transport Options from LCPP to Wambo Rail Spur, Tailings Storage Facilities and Final Void

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5.6 MODIFICATIONS TO NON MINE OWNED FACILITIES

5.6.1 Comleroi Road

The relocation of Comleroi Road is critical to allow the continued mining of Riverview Pit to the south east.

Potential alternative locations have been identified to the east and west of the current location. The preferred option is to shift the southern portion of Comleroi Road to the east, around the eastern edge of the proposed HVGC footprint. The proposed modifications will occur to the east of the intersection of Comleroi Road and Jerrys Plains Road, therefore no changes to the current intersection will be required. The portion of the road to be relocated will be constructed above the nominated flood level and join Jerrys Plains Road at the existing intersection. The preferred option will be discussed with the SSC and the users of the road. The preferred realignment is presented in *Figure 5.8*.

5.6.2 Stock Reserve

Two areas of stock reserve are located within the Project Application area.

Management and or/potential relocation of these areas will be discussed with the HRLPB as required and as the project develops further.

5.6.3 CFMEU Land

The proposed extension of the Riverview Pit to the south east will impact on land currently owned by the CFMEU. Discussions will progress with the land owners over a possible land purchase. These discussions have not concluded.

5.6.4 The Hunter Valley Gliding Club

The proposed extension of the Riverview Pit to the south east will impact on land currently owned and used by the HVGC which includes a grassed airstrip, hangars, clubhouse and amenities. Discussions are in progress with the HVGC over a possible configuration change or relocation of the HVGC from its current location. These discussions have not concluded.

The HVGC is a non-profit co-operative with approximately 100 members, who live in the Hunter Valley and surrounding areas. The club generally operates on weekends and public holidays between 11.00 am to last light, however, operations can occur from first light to last light on any day of the year. An average of 50 launches take place every week and during the peak summer period, 25 to 30 launches may be expected during each day, most of these during the weekend.

Approximately four to six times per year, the HVGC hosts special events such as training camps or cross-country and aerobatics regattas. The number of people attending these events vary but can be up to 100 persons if the regatta is a state or national competition.

If a reconfiguration is agreed with the Club members, this would result in a shift of the airstrip to the east of approximately 400 m. Possible relocation options are within close proximity to the current HVGC footprint and all within the Project Application area.

Correspondence dated 4 September 2007 was received in relation to the ashes of a deceased HVGC member. CNA have been requested to relocate the ashes if relocation of the HVGC is agreed. These ashes were previously spread next to the HVGC airstrip. If the ashes are confirmed as being located in an area to be disturbed, CNA will coordinate the removal the section of grass and immediate layer of topsoil and re-spread the ashes beside the airstrip at the relocated site.

Approval for in-principle relocation or reconfiguration of the HVGC is included in this Part 3A as ancillary workings. The scenario ultimately selected will be determined in consultation with the HVGC.

A separate Development Application for the HVGC operations including relocation and construction of infrastructure and the airstrip will be submitted to SSC if agreed with the HVGC.

Figure 5.8 presents the option currently under discussion with the HVGC.

Legend

- Proposed Relocated Comleroi Road
- Existing Comleroi Road
- Proposed Relocated Airstrip
- Existing Airstrip
- South Lemington Pit 2 Levee
- Proposed HVGC Facilities
- Existing HVGC Facilities

Figure 5.8

Preferred Realignment of Comleroi Road and Reconfiguration of HVGC (yet to be agreed)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
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ERM

5.7 CURRENT APPROVALS

5.7.1 Existing Development Consents

The activities undertaken at HVO South are currently required to be managed under multiple approvals, some of which were granted by the SSC and others by the Minister for Planning.

Many of the approvals have different or potentially conflicting conditions and approval periods. The existence of 35 separate approvals from different consent authorities with varying conditions and different approval periods does not allow flexibility in mining and makes compliance with and administration of the consents more difficult for all parties concerned.

With the new Part 3A legislation there is a distinct operational and environmental benefit in applying for a new Project Approval. A new Project Approval will provide one set of conditions, one approval authority and a single approval period, which will streamline administration for DoP and CNA. This application seeks approval for the development already approved in the numerous development consents as modified (*Annex D*).

5.7.2 Existing Mine Leases

To further streamline administration of HVO South activities, the option to replace the tenements that are applicable to HVO South with one Mining Lease is being examined. *Table 5.1* lists the current tenements. An application to replace the tenements may be made to the DPI-MR and if granted this will assist with the management of tenure and compliance with Mining Lease conditions.

Further, it is proposed to align, where appropriate, the proposed HVO South Project Approval boundary with the Mining Lease tenement. This will assist operational personnel with planning processes.

Table 5.1 Key Information and list of Activities for Approval

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
General Information			
Land Area and Land Capability (areas are approximate)	Total DA area – 5227 ha Final land capability: • Grazing land (60-70%) • Native vegetation (30-40%) • Two final voids (325 ha) • Infrastructure	Total Project Application area – 6534 ha Proposed land capability for the 250 ha extension areas ranges from Class IV to Class VII	Total HVO North approval area – 5429 ha Total HVO South approval area – 6534 ha Post Mining Land Capability HVO North: • Cultivation • Grazing land • Native vegetation • Up to four final voids HVO South: • Grazing • Cultivation • Native vegetation • One final void (275 ha)
Tenement Status	• CL 327, CL 398, CL 390, ML 1489 and EL 5606 cover Riverview Pit; • CL 327, CCL 714, ML 1396, ML 1465, EL 5606 and EL5292 cover Cheshunt Pit; • ML 1582 covers the Cheshunt Pit extension area; and • CCL 714, ML 1465 and EL 5292 cover South Lemington Pit.	• Possible replacement of tenements with one single lease. • If a replacement Mining Lease is not obtained, additional Mining Leases will be required in certain areas.	HVO North: • CL 359, CL 360, CL 755, CL 584, CL 709, CML 4, ML 1474, ML 1482, ML 1500, ML 1324, ML 1359, ML 1406, ML 1428, ML 1337, ML 1560, ML 1589, EL 5417, EL 5418, EL 5606, Authorisation 72, Authorisation 435 and PLL 481 HVO South: • Possible replacement of tenements with one single Mining Lease

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
Approval Period	• 21 years concluding 2021 (Cheshunt and Riverview Pits); and • 21 years concluding 2019 (South Lemington Pits).	21 years from 2007 concluding 2028.	21 years concluding 2028 (HVO South) and 2025 (HVO North).
Hours of Operation	Mining Operations and Transport • 24 hours per day, seven days per week. Construction • Daylight hours, seven days per week.	Mining Operations and Transport • 24 hours per day, seven days per week. Construction • Daylight hours, seven days per week.	Mining Operations and Transport • 24 hours per day, seven days per week. Construction • Daylight hours, seven days per week.
Employment Numbers	679 at HVO North and South.	Up to 50 additional employees and up to 100 additional contractors during construction.	829 at HVO North and South.
Approach to Mining			
Mining Methodology	• Opencut mining and areas of highwall mining within the Cheshunt and Riverview Pits (DA 114-12-98); and • Opencut mining and highwall mining within South Lemington (DA 215/97). *(*Refer to *Figures 5.1 and 5.3)*	• Continuation of mining within approved opencut and highwall mining areas located within HVO South; • Extension of opencut mining into Deep Cheshunt, to the south east and south west of Riverview Pit, and to South Lemington Pit 1 (refer to *Figure 5.1*); and • Highwall mining of areas directly to the south west of the Riverview Pit, to the north east of the Cheshunt Pit and supplementary areas to the south west of South Lemington Pit 1 (refer to *Figure 5.3*).	HVO North: • Continued mining in West, Carrington and North Pits. HVO South: • Ongoing opencut and highwall mining of coal reserves as currently approved and the extension of opencut and highwall mining within the Cheshunt, Riverview and South Lemington Pits.

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
Mining Rate	• 8 Mtpa ROM coal from Cheshunt and Riverview Pits (DA 114-12-98); • 4.4 Mtpa from Lemington Pits (DA 405/98 and DA 215/97); • 8 Mt from Cheshunt Extension (DA 181-8-2005); and • Equating to a total combined mining rate of approximately 16 Mtpa.	• Consolidation of the existing mining rate to 16 Mtpa ROM coal (under one Approval) for all operations within HVO South.	HVO North: • West Pit 12 Mtpa, Carrington 10 Mtpa and North Pit / Alluvial Lands 4 Mtpa. HVO South: • HVO South 16 Mtpa.
Mining Equipment	• Truck and shovel operation within Cheshunt and Riverview Pits (DA 114-12-98); • Dragline operation within Riverview Pit (DA 114-12-98 M2); and • Truck and shovel operation within South Lemington Pits (DA 215/97).	Ability to use the equivalent of up to three large shovels and two draglines with combinations of two draglines and two large shovels or one dragline and three large shovels. This will include associated shovel/excavator prestrip fleet, and associated mining equipment as required in any pit within HVO South.	HVO North: • Truck and shovel operations within the West Pit, North Pit and Carrington Pits; and • Dragline operation within the West Pit. HVO South: • Ability to use up to three large shovels and two draglines in any pit with associated mining equipment as required, with combinations of two draglines and two large shovels or one dragline and three large shovels. Additional small shovels and ancillary equipment will be used for prestrip activities

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
	Maximum equipment modelled in previous assessments totals 133[1]: Cheshunt and Riverview Pits • 80 - Extension to Cheshunt Pit SEE (2005)[2] • 85 - Hunter Valley No. 1 South Pit EIS (1998) South Lemington Pits 1 and 2 • 53 - South Lemington Pit EIS (1997) 1. Current equipment numbers in use across HVO South (2006) – 50. 2. This included equipment that was also in use in the active Cheshunt and Riverview Pits.	Equipment numbers as modelled - 104. Note: • Equipment numbers and locations modelled represent scenarios only; • This number does not include coal, overburden and rejects trucks travelling from HVO North to HVO South, and does not include trucking of product coal from the LCPP to load points; and • Ability to use total modelled numbers of equipment in various permutations in either HVO North or South.	Proposed equipment numbers: • HVO North – 134; • HVO South – 104; • Ability to use numbers of equipment in various permutations as modelled in either HVO North or South.
Mining Disturbance Area	2980 ha • Including 82 ha of Warkworth Sands Woodland consented to be removed under DA 215/97.	An additional approximate 250 ha for a total of 3230 ha (as defined in *Figures 5.1and 5.3*).	Mining disturbance area: • HVO North – 5200 ha; • HVO South – 3230 ha.
Coal Seams	All coal seams from surface to the bottom of the Vaux coal seam.	All coal seams from surface to unlimited depth.	HVO North • All coal seams from surface to unlimited depth. HVO South • All coal seams from surface to unlimited depth.

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
Out of pit overburden emplacement RL	• Lemington RL 150 m • Western RL 160 m • Eastern RL 125 m • Central Riverview RL 120 m • Riverview East and West not defined • South Lemington Pit 2 RL 86 m • South Lemington Pit 1 RL 80 m • Redbank Area RL 140 m	• Lemington RL 155 m • Western RL 160 m • Eastern RL 125 m • Central Riverview RL 140 m • Riverview East and West RL 150 m • South Lemington Pit 2 RL 120 m • South Lemington Pit 1 RL 91 m • Redbank Area RL 140 m	Proposed maximum RL: • HVO North – RL 210 m; • HVO South – RL 160 m (WOOP dump).
Associated Activities			
Overall Material and Equipment Movements	• 16 Mtpa ROM coal from all HVO South Pits can be hauled within HVO South and to HVO North, and ROM coal from Cheshunt and Riverview can be conveyed to HVCPP; • ROM coal from all HVO South Pits can be processed at HVCPP or HCPP, and ROM coal from South Lemington Pits can also be processed at LCPP; • Product coal can be transported via road to MTCL; • Fine rejects from all HVO South Pits can be disposed in North Pit or North Pit TSF in HVO North, or in Lemington TSF in HVO South;	• Ability to move material and associated equipment movements around the HVO mining complex (from HVO North to HVO South) including ROM coal and product coal, rejects, overburden and water as required - additional to what is currently consented in West Pit DA; and • Ability to relocate heavy equipment including draglines, truck and shovels across Jerrys Plains Road to and from MTW, and within HVO across the Hunter River and Wollombi Brook.	HVO North: • Ability for ROM coal, overburden and reject to be hauled between any pit, CPP and reject emplacement area within HVO as required on existing private haul roads (*Section 4.3.4, West Pit Extension and Minor Modifications EIS 2003*); HVO South: • Ability to move material and associated equipment movements around the HVO mining complex (from HVO North to HVO South and HVO South to HVO North) including ROM coal and product coal, coarse and fine rejects, overburden and water as required;

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
	• Coarse rejects from all HVO South Pits can be transported within HVO South and to North Pit for disposal in TSFs or overburden emplacements in HVO North and HVO South; • Overburden from all HVO South Pits can be transported within HVO South and to HVO North for placement; and • Water can be transported via existing pipelines from South Lemington Pit to HVCPP or MTW CPP.		• Ability to relocate heavy equipment including draglines, truck and shovels across Jerrys Plains Road to and from MTW, and within HVO across the Hunter River and Wollombi Brook.
Rejects Disposal	Fine Rejects: • Fine rejects from LCPP can be disposed of into Lemington TSFs in opencut backfill or adjacent to LCPP (*South Lemington EIS 1997)*; • Fine rejects from HVCPP can be pumped as a slurry to a new or existing fine rejects emplacement in the North Pit, or to the North Mine void for disposal (*Hunter Valley No. 1 South Pit EIS 1998*); • Fine and coarse rejects from HVCPP are permitted to be disposed in North Pit and in the North Pit TSF *(Section 4.3.4, West Pit Extension and Minor Modifications EIS 2003);* • In summary, fine rejects from all HVO South Pits can be disposed in North Pit TSF or mine void, or in Lemington TSFs in HVO South.	Fine Rejects: • Construction and operation of additional TSFs located in South Lemington Pit and the south eastern and eastern sections of the Riverview Pit and ongoing management of existing TSFs. Coarse Rejects: • Ability additional to that consented under the West Pit DA to dispose of coarse rejects across locations from HVO North to HVO South consent areas to assist with final landform construction, and capping of TSFs.	HVO North: • Construction and operation of TSFs located in North Pit and West Pit; • Ability for … reject to be hauled between any pit, CPP and reject emplacement area within HVO as required on existing private haul roads *(Section 4.3.4, West Pit Extension and Minor Modifications EIS 2003).* HVO South: • Construction and operation of additional TSFs located in South Lemington Pit 1 and the south eastern and eastern sections of the Riverview Pit and ongoing management of existing TSFs.

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
	Coarse Rejects: • Coarse rejects from LCPP can be disposed in Lemington backfill operations (*South Lemington EIS 1997*); • Coarse rejects from HVCPP can be disposed in backfill operations in HVO North, Cheshunt or Riverview Pits (*Hunter Valley No. 1 South Pit EIS 1998*); • Fine and coarse rejects from HVCPP are permitted to be disposed in North Pit and in the North Pit TSF *(Section 4.3.4, West Pit Extension and Minor Modifications EIS 2003);* • In summary, coarse rejects from all HVO South Pits can be transported within HVO South and to HVO North, and can be disposed in TSFs located in HVO South and HVO North, in North Pit mine void, or in opencut backfill operations.		• Ability additional to that consented under the West Pit DA to dispose of coarse rejects across locations from HVO North to HVO South consent areas to assist with final landform construction, and capping of TSFs.

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
Overburden Management	• Disposal of overburden during backfilling operations into pit or to out of pit emplacements; and • Ability for… overburden … to be hauled between any pit, CPP and reject emplacement area within HVO as required on existing private haul roads (*Section 4.3.4, West Pit Extension and Minor Modifications EIS 2003*).	• Ability to dispose of overburden within all pits and out of pit emplacement areas within HVO.	• Ability to dispose overburden within all pits and out of pit emplacement areas within HVO.
ROM Coal Transport	• Truck haulage of 5.5 Mtpa ROM coal from South Lemington Pits to LCPP (*South Lemington EIS 1997*); • Transport of 8 Mtpa ROM coal via haul road and conveyor from HVO South (Cheshunt and Riverview Pits) to HVCPP and HCPP (*Hunter Valley No. 1 South Pit EIS 1998*); • Transport of coal to… the HVCPP and LCPP (*Hunter Valley Operations Section 96(2) Modification of Development Consent SEE 2001*); • ROM coal… able to be hauled between any pit, CPP and reject emplacement area within HVO as required on existing private haul roads; …haulage of coal between mining areas south of the Hunter River and the HVCPP (of) 16 Mtpa (*Section 4.3.4, West Pit Extension and Minor Modifications EIS 2003*);	• Ability to haul ROM coal from all pits to all coal preparation plants within HVO (HVCPP, HCPP, NCPP, and LCPP) for processing; and • Conveying of ROM coal (approved DA 114-12-98) from HVO South to HVCPP.	• Transport of ROM coal from all HVO pits via internal haul roads to all coal preparation plants within HVO mining complex (HVCPP, HCPP, NCPP and LCPP) for processing; • Ability for ROM coal … to be hauled between any pit, CPP and reject emplacement area within HVO as required on existing private haul roads *(Section 4.3.4, West Pit Extension and Minor Modifications EIS 2003);* • Transport of ROM coal from HVO South via overland conveyor to HVCPP.

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
	• In summary, 16 Mtpa ROM coal from all HVO South Pits can be hauled within HVO South and to HVO North, and ROM coal from Cheshunt and Riverview can be conveyed to HVCPP. ROM coal from all HVO South Pits can be processed at HVCPP or HCPP, and ROM coal from South Lemington Pits can also be processed at LCPP. Note: OLC from HVO South to HVO North is approved but not yet constructed.		
Product Coal Transport	• Road haulage from LCPP along Jerrys Plains Road to MTCL.	• Transport product coal by truck or OLC from all coal preparation plants to all loading points (HVLP, NLP, RCT and proposed LLP); • Construction of a rail spur or OLC from Wambo rail spur to the LLP at LCPP and the ability to transport product coal to Wambo rail spur by rail or OLC; and • Construction of new LLP at LCPP or adjacent to Wambo rail spur and the ability to transport product coal to LLP from LCPP by truck or conveyor.	• Transport product coal by truck or OLC from all coal preparation plants to all loading points (HVLP, NLP, new LLP); • Construction of a rail spur or OLC from Wambo rail spur to LCPP and the ability to transport product coal to Wambo rail spur; • Construction of new load point at LCPP or adjacent to Wambo rail spur and the ability to transport product coal to LLP from LCPP by truck or conveyor.

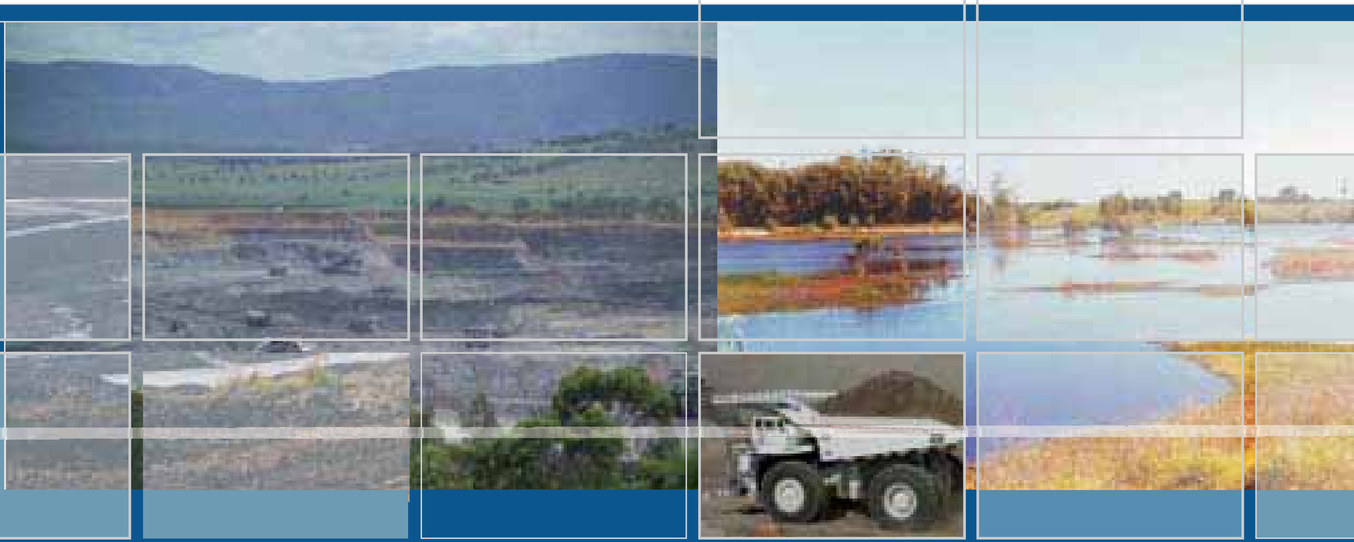
Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
Processing			
Processing Locations and Methodology	ROM coal is washed at LCPP or HVCPP using standard methodology.	Upgrade or reconstruction of LCPP and associated stockpiles to increase capacity to up to 16 Mtpa of ROM coal and to improve coal processing efficiency. Washing of coal using standard methodology.	HVO North: • Existing HVCPP, HCPP and NCPP. HVO South: • Upgraded or replaced LCPP. Washing of coal using standard methodology.
CPP Infrastructure	LCPP: • ROM coal pad; • One ROM dump station; • CPP – including washery building, thickener, reagent farm, coarse reject bin; • Product coal skyline conveyor; • Product coal truck loading bin; • Product coal hardstand areas; and • Fuel farm.	Associated LCPP infrastructure including but not restricted to: • ROM coal pad; • Two new ROM dump stations; • Raw coal stockpiles – including stacking and reclaiming equipment; • CPP – including combination of existing and new washery buildings, thickeners, reagent farms, coarse reject bins; • Product coal skyline conveyor; • Product coal truck loading bin; • Product coal stockpiles – including stacking and reclaiming equipment; • Product coal conveyor linking stockpiles to surge bin; • Product coal surge bin; • Product coal conveyor linking surge bin to train loadout bin; • Train loadout bin; and • Fuel farm.	HVO North: • Coal preparation plants, load points and associated infrastructure. HVO South: • As listed in preceding column.

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
Processing Capacity	• LCPP - 5.5 Mtpa ROM coal. Note: • All ROM coal currently produced within HVO South is transported to HVO North; • HVCPP is approved to accept 16 Mtpa of ROM coal from HVO South (West Pit consent).	LCPP - 16 Mtpa ROM coal.	HVO North: • Total processing capacity at HVCPP – 20 Mtpa • Total processing capacity at HCPP – 6 Mtpa • Total processing capacity at NCPP – 4.5 Mtpa; HVO South: • Total processing capacity at LCPP - 16 Mtpa.
CPP Associated Infrastructure	• River pump station; and • CPP offices, bathhouse, workshop and stores facilities.	• River pump station – upgraded installation; and • CPP offices, bathhouse, workshop and stores facilities – combination of new and existing facilities.	HVO North: • HVCPP, HCPP, NCPP existing infrastructure HVO South: • As proposed.

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
Mining Associated Infrastructure	• Upgrade and eventual relocation of existing Cheshunt bathhouse and associated infrastructure; • Existing bulk fuel storage and workshop at South Lemington; and • Existing mobile and fixed in-pit facilities.	• Upgrade and possible relocation of existing Cheshunt bathhouse and associated infrastructure; • Modification to existing infrastructure as required including new or expanded administration offices, storage facilities and onsite waste management systems, water management structures, heavy and light vehicle wash pad, fuel storage facilities, explosives magazines, mobile and fixed in-pit facilities and construction village or project offices; and • Additional access and haul roads or modifications as required to allow mining to progress.	HVO North: • Existing workshops, vehicle washing facilities, bulk oil and fuel storage, general stores, bathhouse, administration and technical offices and internal roads. Other infrastructure has been detailed previously. HVO South: • Upgrade and possible relocation of existing Cheshunt bathhouse and associated infrastructure; • Modification to existing infrastructure as required including new or expanded administration offices storage facilities and onsite waste management systems, water management structures, heavy and light vehicle wash pad, fuel storage facilities and explosives magazines; and • Additional access and haul roads or modifications as required to allow mining to progress.

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
Services and Related Infrastructure			
Services	Existing locations of amenities, buildings, transmission lines, powerlines, switchyards, substations, water lines, phone lines, haul roads, mine access roads, stockpiles and bridges.	Relocation or alteration of amenities, buildings, transmission lines, water management structures, powerlines, substations and switchyards, pipelines, communications cables, fuel and explosives storage facilities, haul roads, mine access roads, stockpiles and bridges.	HVO North: Not applicable HVO South: Relocation or alteration of amenities, buildings, transmission lines, water management structures, powerlines, substations and switchyards, pipelines, communications cables, fuel and explosives storage facilities, haul roads, mine access roads, stockpiles and bridges.
Temporary River Crossing	Construction of temporary crossings over the Hunter River for equipment too heavy for the existing bridge, such as draglines and shovels (*Section 4.6, West Pit Extension and Minor Modifications EIS 2003*).	No change to existing	HVO North: Not applicable HVO South: Construction of temporary crossings over the Hunter River for heavy equipment as required.
External Roads	Existing Comleroi Road alignment.	Relocation of Comleroi Road as mining extends in the Riverview Pit to the south east including the construction of South Lemington Pit 2 levee (SLL2).	HVO North: Not applicable HVO South: Relocation of Comleroi Road as mining extends in the Riverview Pit to the south east.

Component	HVO South – Currently Approved	HVO South – Project Application Activities	HVO Complex - Proposed
Water Supply	Existing water supply, including • 4 licences providing 4165 ML per annum • Recycled water Mine water from HVO South	No change to existing.	HVO North: Existing water supply licences and sources. HVO South: Existing water supply licences and sources.
Water Management Infrastructure	Existing sediment and mine water dams. Existing and previously approved but unconstructed levees (including South Lemington Pit 1 and South Lemington Pit 2 levees). Removal of all levees.	Relocation, augmentation or creation of sediment or mine water dams. Construction of previously approved levees at South Lemington Pit 1 and South Lemington Pit 2. Permanent retention of South Lemington Levee 2.	HVO North: Existing water management infrastructure. HVO South: Relocation, augmentation or creation of sediment or mine water dams. Construction of previously approved levees at South Lemington Pit 1 and South Lemington Pit 2. Permanent retention of South Lemington Levee 2.
HVGC	Existing location and operation of the HVGC	Ongoing operation of the HVGC including relocation, reconfiguration or upgrade of the airstrip and facilities.	HVO North: Not applicable HVO South: Ongoing operation of the HVGC including relocation or reconfiguration of the airstrip and facilities.



Coal & Allied Operations Pty Ltd

Hunter Valley Operations South Coal Project

Environmental Assessment Report Part C - Social and Environmental Interactions

6 STAKEHOLDER ENGAGEMENT

This chapter details the government and community consultation strategies implemented during the preparation of the Environmental Assessment Report. Key issues raised during consultation are identified.

6.1 INTRODUCTION

CNA endeavours to develop positive relationships with communities which are characterised by mutual respect, active partnership and long term commitment. A stakeholder engagement strategy is in place to assist in achieving this and, as outlined in this chapter, additional consultation activities have been carried out during this environmental assessment process.

6.2 METHODOLOGY

A consultation strategy was developed as part of the environmental assessment to provide a process through which stakeholders could gain information about the proposal and raise potential concerns with members of the project team. This provided a mechanism through which stakeholder concerns could be identified early and addressed as part of the environmental assessment process.

6.2.1 Stakeholder Identification

Stakeholder groups identified in the existing CNA stakeholder engagement strategy were reviewed to capture any additional stakeholders related to this proposal. The stakeholder groups identified are:

- State government agencies;
- local government;
- neighbours, local and regional communities, including downstream water users;
- Aboriginal groups;
- mining and industrial community and unions;
- local organisations, associations and non-government organisations;
- landowners including HVCG, CFMEU, United, Xstrata, Wambo, SSC, Department of Lands and RLPB;
- service providers, including TransGrid, Energy Australia, Telecom and the Australian Rail Track Corporation (ARTC); and
- media.

6.3 *EXISTING STAKEHOLDER ENGAGEMENT STRATEGY*

CNA has an existing NSW Communities Plan 2006 which is consistent with the Rio Tinto Coal Australia External Affairs/Community Relations 2006 Plan.

CNA's stakeholder engagement objectives are to:

- ensure CNA consistently builds upon its credibility within the region through a process of engagement and transparency within the communities neighbouring CNA mining operations;
- be proactive and focus on an honest and open approach rather than complaint management;
- build awareness and provide information on current and future plans;
- ensure all stakeholders are kept well informed and a working relationship is established;
- address any concerns held by residents and other stakeholders; and
- minimise any disruption and inconvenience to residents and operations.

The CNA EMS Communications procedure has been developed to provide guidelines for external communication and complaints handling and an outline of communication roles and responsibilities. *Table 6.1* details consultation and communication techniques utilised in CNA's existing engagement strategy, and the potential changes to these techniques resulting from this proposal.

Table 6.1 Consultation and Communication Techniques

Item	Current Communication Programme	Potential Changes Resulting from Approval of the Proposal
CCC	Community Consultative Committee meetings as specified by the CCC on site to discuss operations.	No change
Near Neighbours	Face to face meetings.	No change
24 h complaints hotline	Active hotline to receive complaints. Advertised in the local telephone directory and local paper.	No change
Near Neighbour Newsletter	As required to inform of significant activities taking place at HVO.	A newsletter to be distributed after approval of the project to advise the community of progress.
Road Closure	Notifications to community and neighbours.	Modification of Road Closure Plan to include extension areas.
Local Schools	Little Links Programme.	No change
Community Trust	Annual report/television advertisements.	No change

Item	Current Communication Programme	Potential Changes Resulting from Approval of the Proposal
CNA Performance	CNA Social and Environmental Reports.	No change
SSC/MSC	Project Newsletters.	No change
Aboriginal Groups	Aboriginal Development Consultative Committee (ADCC) meetings as specified by the Committee. Ongoing advertising of ADCC funding opportunities in all Upper Hunter Valley newspapers. Programmes and initiatives are communicated via whole community mail-outs and advertisements as required. Dedicated CNA representative for Aboriginal Relations.	No change
Government Departments	Meetings as required.	No change
Non-Government Organisations	Project Newsletters and face to face meetings if requested.	No change
Neighbouring Mines / Industry	Project Newsletters. Hunter Coal Environment Group involvement.	No change

6.4 GOVERNMENT CONSULTATION

6.4.1 Overview

Consultation was undertaken with relevant government departments and agencies throughout the environmental assessment process. Consultations included formal briefings, presentations and ongoing information sharing to ensure that the environmental assessment met key agency requirements. Meetings were held with the DoP, DWE, DPI-MR, Department of Environment and Climate Change (DECC), SSC and the Roads and Traffic Authority (RTA).

6.4.2 State Government Agency Consultation

Project briefings were undertaken with government agencies from February to May 2006 to provide an overview of the project prior to the Planning Focus Meeting (PFM) which was held on the 11 July 2006. These project briefings allowed discussion about the project, provided opportunity to identify the existing approvals that would need to be incorporated, and gain an understanding of key agency issues early in the environmental assessment process.

All agencies were supportive of the proposal particularly on the concept of replacement of all development consents with a single approval. Meetings and presentations additional to the above and key discussion points are presented in *Table 6.2.*

Table 6.2 Meetings Undertaken with Regulatory Authorities

Regulatory Authority	Date	Representatives	Discussion Topics
DoP	13 April 2006	DoP RTCA ERM	• Project overview, background and timing; • Confirmation of assessment pathway; • Key assessment issues and assessment approach; and • DoP Part 3A assessment expectations.
	11 October 2006	DoP RTCA ERM	• Review aspects of the environmental assessment; • Communication of noise modelling results and discussion of management approach; and • Review of project time frames.
	28 February 2007	DoP RTCA ERM	• Approach to Environmental Management Plans, greenhouse gas assessment, final landform, highwall mining assessment and summary of commitments; • Noise criteria; and • HVCG approval.
	22 March 2007	DoP DECC DWE DPI-MR RTCA	• Project update; • Consultation summary; • Proposed management plans; • Project timing; and • Groundwater modelling approach.
DECC (Newcastle)	11 April 2006	DECC RTCA ERM	• Project overview, background, timing and assessment approach; • Key DECC considerations; and • Structure and form of the Environmental Assessment Report.

Regulatory Authority	Date	Representatives	Discussion Topics
DECC (Air quality – Sydney)	30 May 2006	DECC DoP RTCA ERM	• Project overview, background and assessment approach; • Appropriate modelling scenarios; • DECC / DoP assessment expectations; • Cumulative assessment and interactions with surrounding mines; and • Model assumptions, criteria and limits.
DECC (Noise – Sydney)	30 May 2006	DECC DoP RTCA ERM	• Project overview, background and assessment approach; • Appropriate modelling scenarios; • Monitoring requirements and need for contingency if exceedances occur; • Noise validation work; • Adoption of appropriate criteria; • Cumulative assessment and interactions with surrounding mines; and • Model assumptions, criteria and limits.
DWE	11 April 2006	DWE RTCA ERM	• Project overview, background and assessment approach; • Opportunities for consolidated approach to water management and licencing; • Key DWE considerations; • Collation of groundwater data and information sharing; and • Post closure monitoring.
	5 September 2006	DWE RTCA ERM	• ERM groundwater modelling methodology and Stage 1 Report; • Peer review of modelling comments; and • Interactions with surrounding mines.
	28 March 2007	DWE RTCA ERM	• General overview and background to project; • Explanation of modelling approach; and • Approach to reporting.
DPI-MR	25 May 2006	DPI-MR RTCA	• Project overview and discussion about 150 m buffer zone.
	12 September 2007	DPI-MR RTCA	• Project overview; • Assessment results; • Groundwater modelling approach; and • Discussion about 150 m buffer zone.
	18 September 2007	DPI-MR RTCA	• Project overview; • Assessment results; • Groundwater modelling approach; and • Discussion about 150 m buffer zone.

Regulatory Authority	Date	Representatives	Discussion Topics
RTA	8 June 2006	RTA RTCA	• Project overview, background and assessment approach; and • Clarification of previous conditions.

6.4.3 *Local Government*

A Council representative attended the PFM and the March 28 project update presentation. In addition, CNA representatives met with SSC on 8 June 2006. The objective of the meeting was to brief Council on all aspects of the proposal and to obtain feedback at an early stage of the environmental assessment process.

The Council was supportive of the proposal particularly on the concept of replacement of all development consents with a single approval. Council's main areas of concern included impacts on the community resulting from lighting and changes to the road network.

6.4.4 *Planning Focus Meeting*

The PFM for the project was held at the HVO Corporate Centre on 11 July 2006 and was attended by representatives from DoP, DWE, DPI-MR, DECC and SSC with RTCA and CNA representatives and members of the ERM project team. The PFM is an essential component of the environmental assessment process, facilitating information exchange between relevant state and local government agencies and the proponent.

A detailed briefing paper was prepared and distributed to all participants prior to the meeting. The paper provided a background and overview of the proposal, a summary of the planning framework, consultation strategy and likely environmental issues associated with the proposal.

The PFM included a series of presentations describing the project followed by a period of open discussion and a tour of the site to assist agencies in developing their requirements for the environmental assessment.

Following the PFM, DoP requested that all agencies prepare a list of issues and matters that they want to see addressed in the Environmental Assessment Report. This list formed the basis of the Director-General's Requirements developed by the DoP (DGRs). A summary of the issues presented in the DGRs and where each issue is addressed is provided in *Table 6.3*. A copy of the DGRs is presented in *Annex B*.

In addition, a pre-submission meeting was scheduled for 3 October 2007 to provide an updated overview of the proposal to relevant government departments.

Table 6.3 Summary of Director-General's Requirements

Issue	Description	Relevant Section in Environmental Assessment Report
General Requirements	The Environmental Assessment Report must include: • An executive summary; • A detailed description of the project including the: ▪ Need for the project; ▪ Various components and stages of the project; and ▪ The likely inter-relationship between the proposed operations and the existing or approved mining operation at HVO South and HVO North. • Consideration of any relevant statutory provisions • A general overview of the environmental impacts of the project, identifying the key issues for further assessment, and taking into consideration the issues raised during consultation; • A detailed assessment of the key issues specified below, and any other significant issues identified in the general overview of environmental impacts of the project (see above), which includes: ▪ A description of the existing environment; ▪ An assessment of the potential impacts of the project including potential cumulative impacts (particularly on noise, air quality, surface water and groundwater) that may arise from the combined operation of the project, together with the other approved and existing mines in the region; • A description of the measures that would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the impacts of the project, and how the existing environmental monitoring and management programs/plans at HVO South and HVO North would be revised to accommodate the proposed changes; • A draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures; and • A conclusion justifying the project, taking into consideration the environmental impacts of the project, the suitability of the site, and the benefits of the project.	*Executive Summary* *Chapter 1* *Chapter 5* *Chapter 5* *Chapter 3 – Annex C* *Executive Summary, Chapters 6 and 22* *Chapters 7 – 20* *Chapters 7 – 20* *Chapters 7 -20 and 22* *Chapter 22* *Chapter 1, 4 and 23*
Surface and Groundwater	Including detailed modelling of potential surface and groundwater impacts; a site water balance, a salinity balance; and a detailed description of final void management.	*Chapters 9, 10 and 19 and Annex J and K*
Flora and Fauna	Including impacts on critical habitats (including riparian habitat), threatened species, populations or ecological communities; and native vegetation.	*Chapter 11 and Annex L*

Issue	Description	Relevant Section in Environmental Assessment Report
Rehabilitation and Final Landform	Including a detailed Rehabilitation and Landscape Management Strategy that describes how the site would be progressively rehabilitated and integrated into the landscape, taking into consideration the rehabilitation plans of existing and approved mines in the area, the Department of Primary Industry's Synoptic Plan, and any other relevant strategic land use objectives for the area. The strategic land use objectives for the area. The strategy must also describe what measures would be put in place for the long term protection and management of the site following cessation of mining.	*Chapters 18 and 19*
Noise, Blasting and Vibration	Including operational and offsite road and rail noise impacts.	*Chapter 7 – Annex H*
Air Quality	Including spontaneous combustion.	*Chapter 8 – Annex I*
Greenhouse Gases	A greenhouse gas assessment (including a quantitative analysis of the greenhouse gas emissions associated with the combustion of product coal, and a qualitative assessment of the impacts of these emissions on the environment).	*Chapter 17 and Annex O*
Subsidence	An assessment of subsidence impacts associated with any highwall mining.	*Chapter 5 and Annex F*
Heritage	Both Aboriginal and non-Aboriginal.	*Chapters 12 and 13 and Annex M and N*
Traffic and Transport	No reference in DGRs	*Chapter 15*
Visual	No reference in DGRs	*Chapter 14*
Social and Economic	No reference in DGRs	*Chapter 20*
Consultation	During the preparation of the Environmental Assessment Report, you must consult with the relevant local, State or Commonwealth government authorities, service providers, community groups or affected landowners. In particular you must consult with: • Department of Environment and Conservation; • Department of Natural Resources; • Department of Primary Industries; • Australian Rail Track Corporation; • NSW Roads and Traffic Authority; and • Singleton Council. The consultation process and the issues raised must be described in the Environmental Assessment Report.	*Chapter 6*

6.5 COMMUNITY AND NON-GOVERNMENT STAKEHOLDER CONSULTATION

6.5.1 Overview of Strategy

HVO has an existing stakeholder consultation strategy which ensures that CNA staff liaise with near neighbours, the local community and government authorities. This includes a number of techniques to provide information to near neighbours and the broader community on the current operations and any modifications to those operations.

The community consultation strategy for the proposal was structured to provide open and transparent communication with the local community and key stakeholders throughout the environmental assessment process. The consultation strategy aimed to ensure that:

- the community was fully aware of all aspects of the proposal and the environmental assessment process;
- there were multiple mechanisms for community participation and for ongoing communication and feedback;
- opportunities were provided for any queries to be addressed directly by the project team to minimise the effects of incorrect information being passed through the community;
- community issues and concerns in relation to the proposal were identified at an early stage of the environmental assessment;
- issues raised by the community were actively assessed and managed throughout the project; and
- appropriate solutions and mitigation strategies were developed to minimise potential negative impacts associated with the proposal.

In order to meet the information needs of different community groups, a range of consultation strategies were adopted. The community consultation approach for this proposal is provided in *Table 6.4*. An overview of the community consultation strategy is provided in *Figure 6.1*.

Table 6.4 Community Consultation Approach

Activity	Description
Phone calls to immediate neighbours and personalised letters to nearby villages (within 5 km) with the offer of face to face information sessions.	*Figure 6.2* depicts closest receptors and consultation zones. The three consultation zones identified are noted below: • Neighbours in the current HVO zone of affectation; • Nearby residents (those within a 5km radius of the centre of HVO South); and • The outer ellipse which includes nearby residents/local communities of Maison Dieu and Warkworth and part of Jerrys Plains. The ellipse shape was applied to identify the latter consultation zone to ensure that residents potentially impacted by HVO South were captured. Those residents further to the north and south have more potential to be impacted by surrounding mines (including Wambo, HVO North and MTW) and were therefore excluded from this zone. Newsletters were sent to all community members within the outer ellipse. Residents living in close proximity to the site were considered likely to be the most affected by the proposal and to be most concerned about associated potential impacts. Neighbours in the current HVO zone of affectation and nearby residents within 5 km of HVO South were contacted by phone and offered the opportunity to meet with representatives of CNA. This provided a mechanism to discuss the project in detail. Contact was made with 19 property owners located around HVO South. Of these, 10 accepted the offer of a face to face information session. The sessions involved providing residents with details of the proposal and providing a forum for issues of concern to be raised directly with project team members for incorporation into the Environmental Assessment Report. These sessions were completed in July 2006; a summary of key issues raised is presented in *Table 6.6*.
Three newsletters distributed to the local community.	One newsletter was prepared and distributed to the wider community during the preliminary stages of the environmental assessment process. The newsletter was designed to provide the wider community with an overview of the proposal and the environmental assessment process and ensure the community was kept up to date with the progress of the environmental assessment and project development. The newsletter also included a Q&A sheet and advertised the date, time and location for the project information sessions held at Maison Dieu and Warkworth. The newsletter was distributed in July 2006 to near neighbour property owners either during face to face information sessions or via mail. Properties located in the outer ellipse were provided with a copy of the newsletter via mail. Following receipt of newsletter one, two property owners contacted CNA to enquire about the project and requested a face to face information session. A second newsletter will be produced prior to the public exhibition of the Environmental Assessment Report. This newsletter will provide information regarding the outcome of the environmental assessment and locations where reports can be viewed. It will also include a guide to making a submission. A third newsletter will be produced after the project is approved. A copy of newsletter one is provided in *Annex G*.

<table>
<tr><th>Activity</th><th>Description</th></tr>
<tr><td>Two advertisements placed in the Singleton Argus on 11 and 14 July 2006.</td><td>Advertisements provided the dates, times and locations of the project information sessions (an example of the advertisement is provided in Annex G). In addition, the second information session was advertised in the CNA near neighbour Environmental Newsletter, distributed to Maison Dieu, Warkworth, Jerrys Plains and Long Point residents, and the Mount Thorley Industrial Estate.</td></tr>
<tr><td>Project information sessions (Maison Dieu and Warkworth).</td><td>Two project information sessions were held locally on Saturday 29th July 2006 and Saturday 16th June 2007 at Maison Dieu and Warkworth. Advertisements were placed as detailed above. Notices were placed at the Jerrys Plains petrol station information board and SSC to advise the public about the information sessions. In addition, the local radio (KOFM) station advertised the sessions on the day.

The aim of the project information sessions was to provide an opportunity for the wider community to obtain information regarding the proposal. Representatives from CNA were present to respond to questions and to provide information to community members. ERM representatives were also present for the first round of information sessions.

Material that was on display included:
project overview;
the approvals and environmental process;
Key Assessment Areas;
Air quality;
Noise and vibration (including a Sound Chart comparison);
Rehabilitation and land management; and
Surface and groundwater.
a large map depicting HVO South Coal Project in its local setting with inserts of particular aspects of the operation;
flowchart of currently approved operations;
outline of mining methodology; and
guide to making a submission.
The first project information day was held early in the planning process, prior to the commencement of technical studies, to allow input and feedback from the community to be used to identify and assist with prioritising issues for assessment. A total of 37 residents attended the information sessions (15 at Maison Dieu and 22 at Warkworth).

The second project information day provided similar information to the first. In addition, fact sheets summarising preliminary results for air quality, noise, surface water and groundwater were displayed. Four people attended the Maison Dieu session and eight people the Warkworth session. Letters were sent to near-by resident non-attendees. These letters included information sheets provided at information sessions, and the offer of individual meetings to discuss the proposal with CNA representatives. An indicative timing of submission and public exhibition were also provided. At this time, no additional meetings have been requested.</td></tr>
</table>

The community consultation strategy recognised that residents in the Hunter Valley area are likely to be familiar with mining operations and may previously had been involved in stakeholder consultation on mining activities.

The main community concerns related to air quality (primarily dust) as well as noise and vibration. There were various requests from the residents to receive notification when the Environmental Assessment Report is on exhibition. A summary of community issues identified through the consultation process is presented in *Table 6.6*.

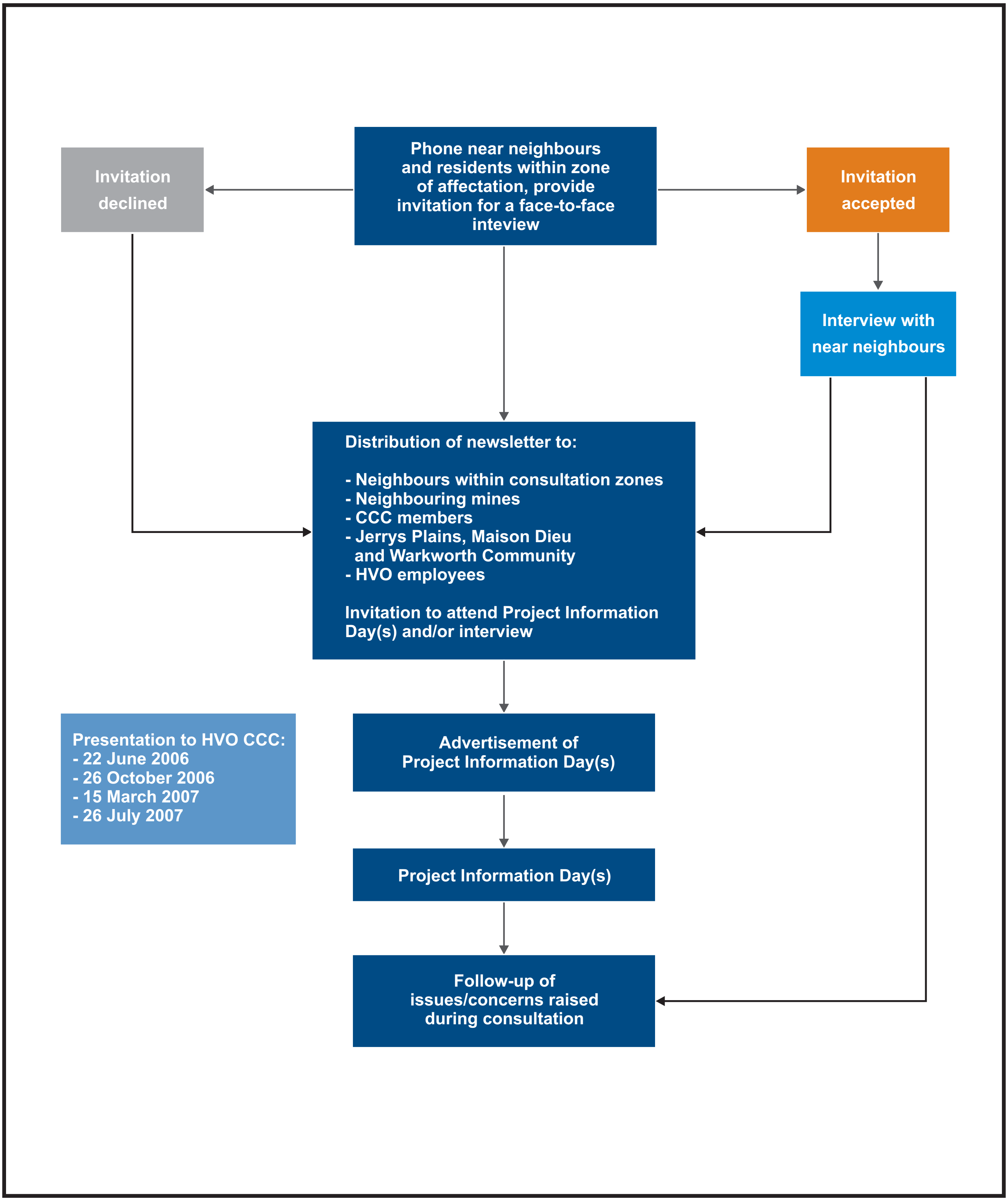


Figure 6.1

Community Consultation Activities

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_EAR_G_01_R0		
Date:	26/09/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	N/A		

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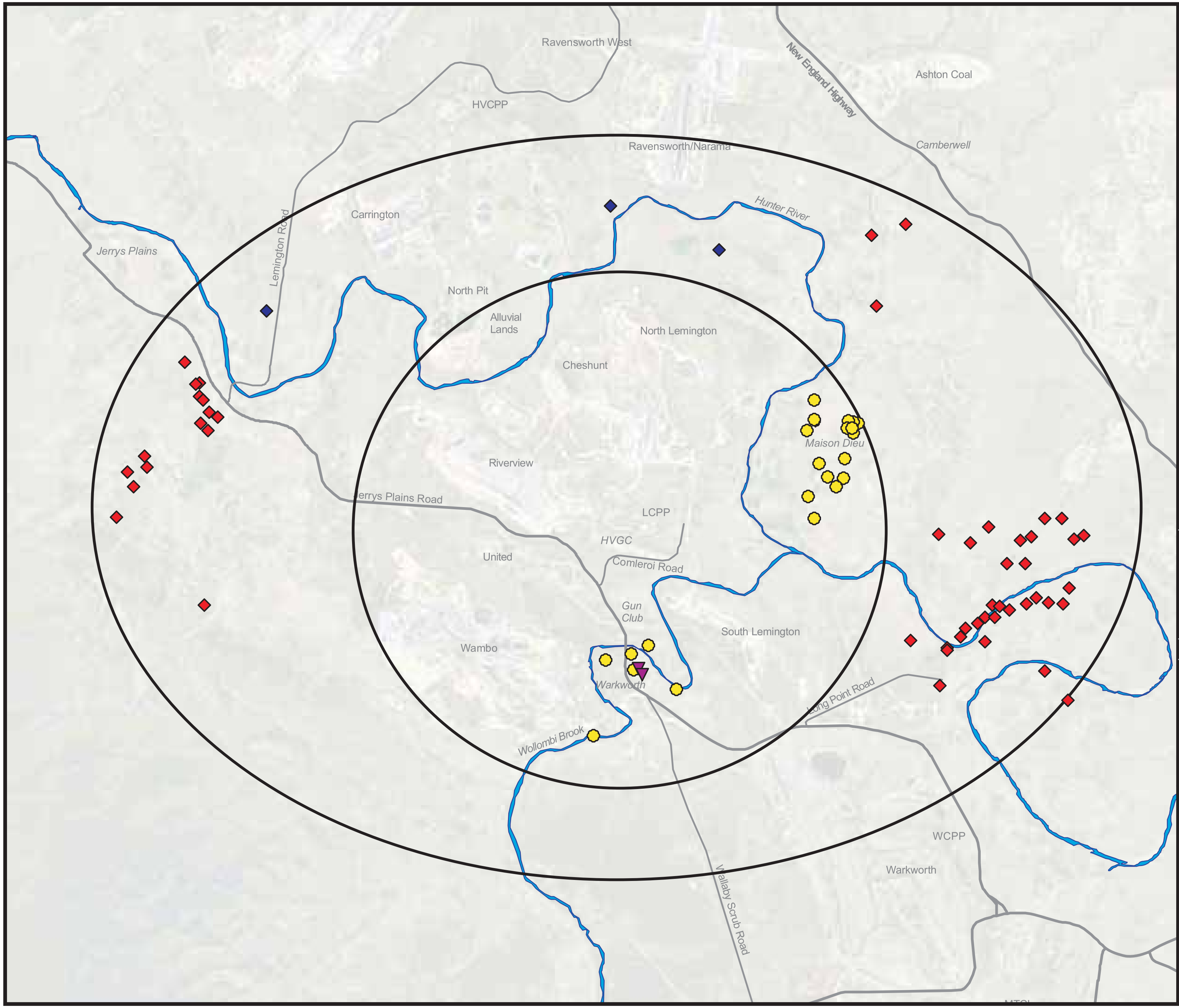
ERM



Legend

- Non Mine Owned Residences within HVO zone of affectation
- Non Mine Owned Residences within 5km Consultation Zone
- Non Mine Owned Residences within 10km Consultation Zone
- Community Infrastructure
- Consultation Zones

Figure 6.2

Residence Locations and Consultation Zones

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_EAR_G_02_R0		
Date:	27/09/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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0 1 2 3km

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6.5.2 Community Consultative Committee

The HVO Community Consultative Committee (CCC) was formed in 2003. Meetings are held three times per year and provide a forum in which information is exchanged and issues raised. The committee comprises members from the community and representatives from CNA, SSC, MSC, DPI-MR and the DoP.

The project has been flagged with the CCC since June 2005 and progress communicated at the regular meetings. A detailed presentation was provided to the CCC during the 22 June 2006, 26 October 2006, 15 March 2007 and 26 July 2007 meetings.

A follow-up face to face information session was held with four of the six community members in July 2006. CCC members were provided with copies of newsletters and will be updated throughout the life cycle of the project.

6.5.3 HVO Mine Employees

CNA employees were informed of the proposed development via a presentation and the newsletter. For those employees who wanted more information, feedback was provided through discussions with project team members.

6.5.4 Neighbouring Mines and Power Stations

Neighbouring mining companies and power stations were provided with a copy of the newsletter and invited to contact CNA for further information. These included:

- Wambo Mining Corporation (Peabody);
- Cumnock Opencut (Xstrata);
- United Collieries (Xstrata);
- Liddell Coal Operations Pty Ltd (Xstrata);
- Macquarie Generation, Bayswater Power Station;
- Ravensworth Operations Pty Ltd, Narama Mine (Xstrata); and
- Redbank Power Station.

In addition, CNA met with Wambo Mining Corporation, United Collieries, Xstrata Corporate and Bulga on 14 March and 12 September 2007 to provide these companies with a general project update.

6.5.5 *Non-Government Organisations*

Non-government organisations that operate within the Hunter Valley area were provided with a copy of the newsletter and invited to contact CNA for further information. These organisations included:

- Hunter Catchment Management Trust;
- Hunter Environment Lobby;
- Minewatch;
- Hunter Valley Water User's Association; and
- Green Alliance Network/North East Forest Alliance.

At this time, CNA has not received any enquiries from these groups.

6.5.6 *Aboriginal Stakeholders*

CNA has undertaken regular consultation with the Aboriginal community for all previous proposals requiring cultural heritage assessments and associated works.

This consultation process for previous proposals included the development of the proposal, the survey process and the salvage activities. Although the level of consultation with the Aboriginal community was comprehensive, the Aboriginal community believed they did not have sufficient input into the design and conduct of the Aboriginal heritage assessments and salvage programmes.

In 2004, the DEC produced Interim Guidelines for Consultation (Protecting Aboriginal Objects and Places) (DEC, 2004). These guidelines were developed to improve consultation with the Aboriginal community. The requirements of these guidelines have been considered and further expanded for this proposal.

To further improve Aboriginal stakeholder consultation and in accordance with the Rio Tinto Cultural Heritage Management Guidelines, CNA established the Upper Hunter Valley Cultural Heritage Working Group (the 'Working Group'). The Working Group is comprised of RTCA and CNA representatives and representatives from most of the Upper Hunter Valley Aboriginal Community (UHVAC) groups and corporations.

The Aboriginal groups participating in the Working Group include:

- Upper Hunter Wonnarua Council;
- Wonnarua Nation Aboriginal Corporation;
- Aboriginal Native Title Elders Consultants (formerly the Combined Council);
- Hunter Valley Aboriginal Corporation;
- Wanaruah Local Aboriginal Lands Council;
- Ungooroo Aboriginal Corporation;
- Wanaruah Aboriginal Custodians Corporation;

- Lower Wonnarua Tribal Consultancy Pty Ltd;
- Wattaka Wonnarua CC Service;
- Yarrawalk Aboriginal Corporation;
- Valley Culture;
- Upper Hunter Heritage Consultants;
- Hunter Valley Cultural Consult;
- Wonnarua Culture Heritage;
- Giwiir Consultants;
- Mingga Consultants;
- Muswellbrook Cultural Consultants; and
- Wonnarua Elders Council.

The Working Group was established in September 2005 in order to jointly develop and implement a new cultural heritage consultation and management process in the Upper Hunter Valley. A Cultural Heritage Advisory Committee (CHAC) was nominated from the larger Working Group, who worked with RTCA to develop a draft cultural heritage process including community consultation procedures, project work Terms of Reference (ToR), cultural heritage investigation methodologies, and the selection and engagement of personnel to conduct the cultural heritage investigations.

Issues raised in relation to the selection of personnel including the technical advisors, administrative coordinator, data management officers and field officers were resolved throughout the development of the process.

Through the Working Group/CHAC, CNA has an ongoing consultation process with the Aboriginal community on all matters pertaining to cultural heritage associated with CNA owned lands, projects and operations in the Upper Hunter Valley.

CNA initially consulted with the Aboriginal community with respect to the proposal through the Working Group and CHAC. CNA subsequently formally notified the Aboriginal community via mail, published public notices and community meetings were held in July and August 2006. The cultural heritage assessment process and management plan are being developed in accordance with the requirements of Part 3A of the *EP&A Act*.

CNA has also met with representatives of DECC throughout 2006 and 2007 to describe this process and ensure DECC requirements are incorporated.

Further details on the Aboriginal consultation undertaken for the cultural heritage assessment and the results of the assessment are provided in *Chapter 12.*

6.5.7 Service Providers

Representatives from CNA had discussions with ARTC (see *Table 6.5* below) to understand current and planned rail networks and usages, and to communicate options being investigated as part of this proposal that relate to rail infrastructure and use.

No other official meetings with specific reference to this proposal have been held with service providers at this time.

Table 6.5 Meetings undertaken with Service Providers

Service Provider	Date	Representatives	Discussion Topics
ARTC	26 June 2006	ARTC CNA	• Project overview, background and timing, including investigations into CPP capacity and transport of product coal from CPP; and • ARTC's current strategy for upgrade of main line at root of Whittingham branch.
	16 October 2006	ARTC CNA	• Project options related to CPP and rail, including new rail loop and load point and expected timing; and • CNA undertook to advise ARTC of future potential capacity requirements by the end of 2006.
	24 November 2006	ARTC CNA	• Explanation of HVO South Coal Project Application; and • Discussion on rail capacity.
	4 May 2007	ARTC CNA Parsons Brinkerhoff	• Update of HVO South Coal Project Application; and • Technical discussion in relation to rail spur.

6.5.8 Key Issues

Key issues identified during the community consultation process are summarised below, together with the corresponding Environmental Assessment Report chapter where the issues are addressed.

Table 6.6 Combined Summary of Key Issues

Issue Category	Specific Issues	Relevant section in the Environmental Assessment Report
Noise	The key issue relating to noise was the impact to amenity. Specific issues raised included: increased operational noise levels produced from the proposed LCPP Rail load out; upgrade of the coal preparation plant; mining activities resulting from the south east extension to Riverview Pit to South Lemington Pit 2; and recommencement of mining in the South Lemington Pit 1.	*Chapter 7*
Vibration	The key issue of concern relating to vibration was the potential for structural damage to property. Additional concerns related to blast monitoring data availability and blast monitoring locations.	*Chapter 7*
Air Quality	Impacts to air quality were the issue most commonly raised during both during face to face meetings and public information sessions. Specific concerns related to: potential contamination of drinking water: dams and swimming pools; atmospheric dust during seasonal westerly winds; dust impacts from Cheshunt overburden dumps and from dumping, activities; potential impacts from the expansion of the LCPP; and mining activities resulting from the south east extension to Riverview Pit to South Lemington Pit 2; and recommencement of mining in the South Lemington Pit 1.	*Chapter 8*
Water Management	The scarcity of water in the Hunter region was acknowledged to be an issue for the community as was HVO water usage. The groundwater interaction between the Hunter River and the pits, and potential flood impacts related to the timing of the removal of Hunter Valley No.1 Levee were also raised.	*Chapters 9 and 10*
Rehabilitation	Issues raised relating to rehabilitation included green offsets, subsidence, lack of rehabilitation and final landform.	*Chapter 18 and 19*
Property Values and Acquisition	Potential impacts to property values in relation to depreciation and acquisition rates were a concern for a number of residents.	*Chapter 20*
Ecological Values	Some residents expressed concerns regarding the impacts of the proposal on the local flora and fauna communities and disturbances to the ecological values of the site. Specific concerns related to habitat potential for the Green and Golden Bell Frog, increased kangaroo numbers (due to the development) and unproductive land.	*Chapter 11*
Aboriginal Cultural Heritage	The local Aboriginal community had previously raised concerns about not having sufficient input into the design and conduct of Aboriginal heritage assessments and salvage.	*Chapter 12*
Recreation	Representatives from the HVGC expressed concern	*Chapter 20*

Issue Category	Specific Issues	Relevant section in the Environmental Assessment Report
	about the impacts of the proposal on their activities.	
Coal Transport/ Traffic	Concerns related to the haulage of coal on Jerrys Plains Road and traffic delays due to blasting.	*Chapter 15*

6.6 *ENVIRONMENTAL ASSESSMENT REPORT EXHIBITION*

The exhibition of the Environmental Assessment Report and invitation for submissions is the final component of the consultation process.

The Environmental Assessment Report will be lodged with DoP and assessed for adequacy. The Environmental Assessment Report will be placed on public exhibition for a period of at least 28 days. Discussions with the DoP prior to the production of this Environmental Assessment Report indicate that it will be available for viewing at the following locations:

- DoP's offices in Sydney and Newcastle;
- SSC offices;
- CNA website; and
- DoP's website.

Any other exhibition locations will be advertised prior to the exhibition of the Environmental Assessment Report. During the exhibition period all members of the community, interest groups and government authorities are invited to view the Environmental Assessment Report and accompanying documents and make a written submission on any aspect of the project.

6.7 *ONGOING COMMUNITY CONSULTATION*

The existing consultation programmes will continue to be undertaken to ensure any specific outcomes from the environmental assessment are included into the relevant programmes as required. As summarised above, this includes:

- CNA NSW Communities Plan 2006;
- CNA EMS Communications Procedure;
- CCC meetings;
- 24 hour complaints hotline (advertised);
- near neighbour interactions;
- Near Neighbour Community Relations Strategy;
- near neighbour and project newsletters;
- CNA public reporting; and
- CNA website.

The community consultation specific to the proposal will continue throughout the project, from submission through to government decision and implementation of commitments. Ongoing communication techniques utilised by CNA (*Table 6.1*) will be implemented as appropriate.

6.8 CONCLUSIONS

CNA has an existing comprehensive stakeholder consultation strategy that is implemented for all operations. An additional consultation strategy was developed during the planning phase of the environmental assessment process to allow issues raised by government, non-government and community stakeholders to be incorporated and addressed in the Environmental Assessment Report.

HVO has developed and maintained open communication channels with the near neighbours and local communities. The issues raised can be managed by current operational procedures and management strategies as detailed in the respective chapters.

Consultation is planned to continue throughout the project to allow for ongoing communication and feedback with government authorities and the community.

Ongoing consultation will also continue throughout the ongoing life of the mine.

7 NOISE AND VIBRATION

This chapter outlines the methodology adopted for the noise and vibration assessment, describes the existing acoustic environment and presents potential impacts resulting from the proposal. It includes management and monitoring measures that will be implemented to mitigate potential impacts. Further details are provided in the full HVO South Noise and Vibration Assessment Report prepared by ERM and presented as Annex H.

7.1 INTRODUCTION

This study assesses the noise and vibration effects from all of the proposed operations at HVO South as presented in *Chapter 5*. The proposal includes the replacement of existing consents with one Project Approval for HVO South. This will provide the opportunity for improved operational management and improved environmental control over a large source of industrial noise. It will be a significant and positive step toward noise management, which also provides operational flexibility.

This noise assessment conservatively assumed four worst case mining stages for noise generation which are representative of 21 years of future operations based on mine plans provided by CNA. Worst case mining stages were selected based on the concentration and proximity of mining equipment to the various assessment locations.

This assessment has been prepared in accordance with the NSW DECC's Industrial Noise Policy (INP), which was published in January 2000. A glossary of noise related terms used in this assessment are provided in *Table 1.1* of *Annex H*.

7.2 METHODOLOGY

7.2.1 Assessment Location Selection

The nominated noise assessment locations were selected to represent the impacts at the potentially most affected areas. These locations are shown in *Figure 7.1*. *Table 7.1* provides resident names, and where available, the property name and coordinates. For ease of identifying the assessment locations, these have been grouped into localities. The general direction of these areas from HVO South is also included in the table.

The assessment locations adopted for modelling were selected for the following broad reasons:

- they are generally those closest to the mine to ensure that potential worst case impacts are captured. Additional specific properties were not included as these are located further away, or otherwise are equally or less impacted, from the active mining areas (than the nominated locations). It can therefore be assumed, that noise at nominated assessment locations will be equal to or higher than noise at other private properties. To that end, noise contours also demonstrate this and provide a graphic of expected noise levels on a broader scale;

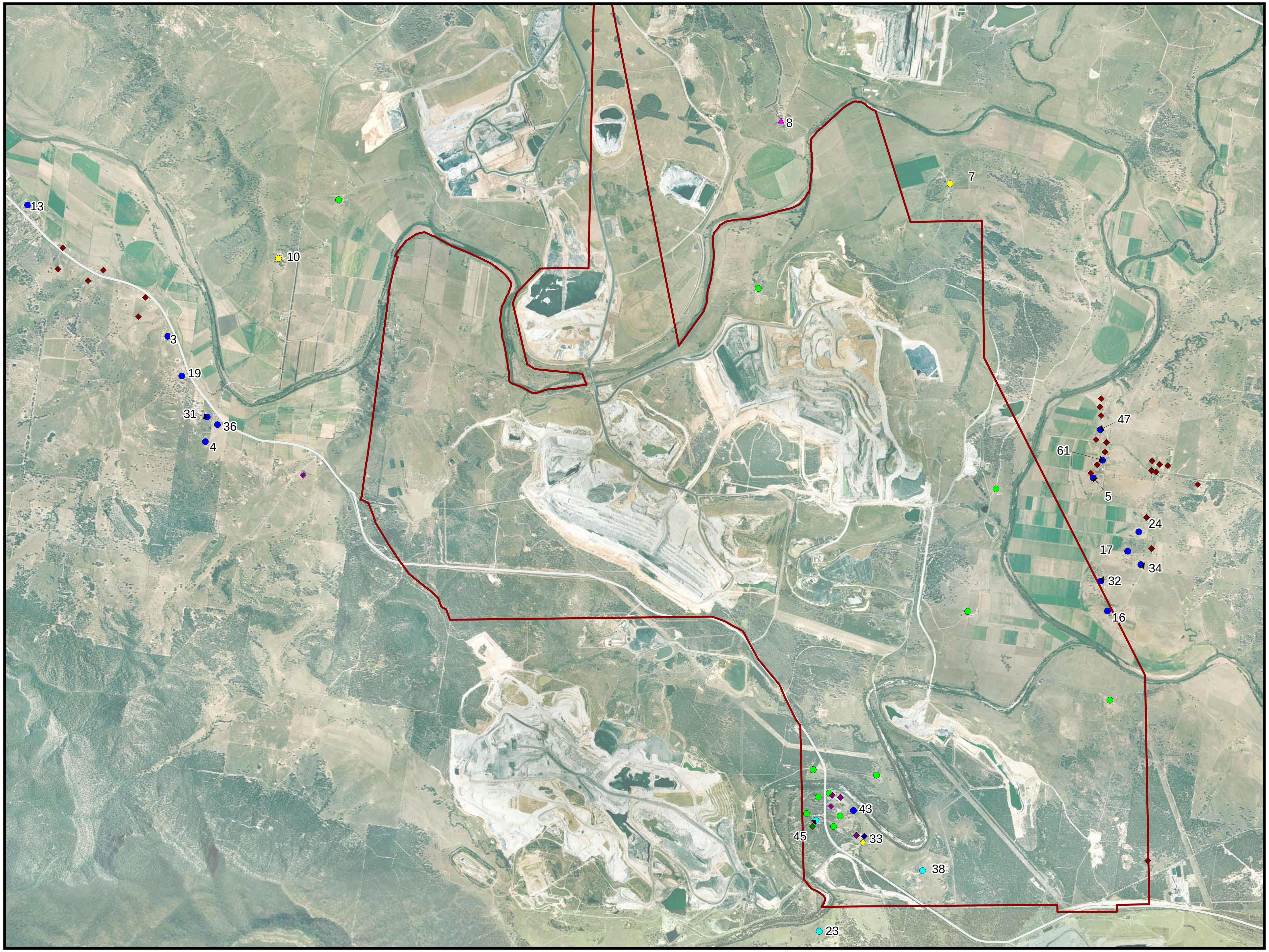
- modelling all individual properties in the locality would not provide any additional information than shown by the noise contours;

- the numbering systems adopted for past HVO South and HVO North assessment locations and resulting consents have not been consistent. This Project Application presented an opportunity to adopt a single numbering system for both areas and therefore improve administration and management of potential acoustic impacts. As listed in the *West Pit Extension and Minor Modifications EIS 2003*, residential properties around HVO have been identified and numbered from 1 to 61. Of these, a total of 22 locations were considered to be representative of the most exposed surrounding HVO South and have therefore been selected for this assessment.

Table 7.1 Surrounding Assessment Locations used for Modelling Purposes

Location No.	Location and Name	MGA56 Coordinates	
		Easting	**Northing**
Locations at Maison Dieu (East)			
5	Bowman	317887	6399172
16	Algie	318128	6397347
17	Algie	318352	6398192
24	Clifton and Edwards	318153	6398497
32	Algie (Curlewis)	317982	6397802
34	Ernst	318530	6397994
47	Moxey	317979	6399821
61	Shearer	318014	6399408
Locations at Warkworth (South)			
23	Hawkes (Springwood)	313989	6392994
33	Edward and Haynes	314699	6394353
38	Henderson	315584	6393898
43	Kannar	314648	6394680
45	Kelly	314149	6394563
Locations west along Jerrys Plains Road (West)			
3	Elisnore	305416	6401053
4	Muller	305950	6399615
13	Jerrys Plains Centre	303535	6402851
19	Birralee Feeds Pty Ltd	305655	6400600
31	Cooper (Kilburnie)	305953	6399990
36	Garland	306139	6399895
Isolated Locations			
7	Stapleton (Cheshunt) – North East	315919	6403004
8	Holz (Oaklands) - North	313711	6403979
10	Moses (Wandewoi) – North West	306970	6402069

- Location No. is consistent with the HVO West Pit consent (DA 450-10-2003).
- Location No's 33 and 43 have been purchased by Wambo Mine.
- Location No. 8 has been purchased by Xstrata.



Legend

Model Status

- CNA Owned, Not Modelled
- Private, Modelled
- Private, Modelled, CNA ZOA
- Private, Modelled, Wambo ZOA
- Private, Not Modelled
- Private, Not Modelled, Wambo ZOA
- Private, Not Residential, Not Modelled
- Wambo Owned, Modelled
- Wambo Owned, Not Modelled
- Xstrata Owned, Modelled

Notes:

ZOA = Zone of Affectation

Figure 7.1

Property Ownership and Assessment Locations

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_GIS04_R0
Date:	21/01/2008 Drawing Size: A3
Drawn By:	JS Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

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metres

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Environmental Resources Management Australia Pty Ltd
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7.2.2 Mining Scenarios

To assess potential noise impacts, the expected life and progression of the mine were examined to identify critical scenarios. Representative mine operating scenarios are provided in *Appendix C* of *Annex H*. The proposed mining method includes a combination of dragline, truck and shovel and possible highwall operations.

The following scenarios were chosen as representative of potentially the worst in terms of noise at nominated locations:

- Scenario A – is indicative of mining operations in 2010 with mining activities concentrated in the Cheshunt Pit and in the north western and south eastern sections of the Riverview Pit. For this scenario, two draglines and two large shovels with associated trucks are in operation;

- Scenario B2 - is indicative of mining operations in 2014 with mining activities concentrated in the Cheshunt and South Lemington Pits. For this scenario, one dragline and three large shovels with associated trucks are in operation;

- Scenario C2 - is indicative of mining operations in 2019 with mining activities concentrated in the Cheshunt and South Lemington Pits. For this scenario, one dragline and three large shovels with associated trucks are in operation; and

- Scenario D - is indicative of mining operations in 2024 with mining activities concentrated in the Cheshunt Pit only.

Worst case scenarios were selected in terms of potential impacts to surrounding areas. This was done by studying the mine plans provided by CNA with respect to equipment locations (geographically and in terms of elevation) and weather conditions. Selected mine plans generally included grouping of equipment on the periphery of the Project Application area. This environmental noise 'envelope' approach was adopted to provide maximum flexibility for mining operations within acceptable noise parameters.

Mining equipment schedule and plant noise levels are detailed in *Section 4.3* of *Annex H*.

Lemington Coal Preparation Plant

Options for the transportation of product coal from the LCPP to the Wambo rail spur have been presented in *Chapter 5*. For Scenarios B2 and C2, the LCPP is expected to be operational. Three options were considered to transport product coal from the plant to the main railway line. All three options involve the construction of a rail loop which will link to the main railway line. Noise modelling for these two scenarios has incorporated all three options. Further detail on LCPP transport options, including the potential noise contribution of additional trains on the main rail line and associated modelling assumptions are presented in *Sections 3.4* and *4.5* of *Annex H*.

7.2.3 Noise Limits

The operation currently has multiple consents which include noise limits. The existing noise limits for all the assessment locations were derived from:

- baseline studies;
- existing industrial noise (comprising predominately surrounding mining operations); and
- predicted noise with all reasonable and feasible mitigation adopted.

Operational noise limits relate to 'day to day' activities within HVO South. Acquisition limits are a condition of consent that if exceeded require the mining company to negotiate the purchase of the property if requested by the property owner. These are properties that generally have the greatest potential to be impacted.

As discussed in *Chapter 2*, prior to CNA purchasing South Lemington in 2000, Cheshunt and Riverview Pits, and South Lemington were separate operations. Each operation has its own consent which details noise limits at surrounding properties. These properties may be impacted by both mining areas simultaneously with a limit for operations in Cheshunt and Riverview Pits and a separate limit for operations in South Lemington. For example, Location No.5 (Bowman) located in Maison Dieu, has an operational day time noise limit of 36 dB(A) for the Cheshunt and Riverview Pit areas. As currently approved, Location No.5 also has an operational day time noise limit of 37 dB(A) for operations within the South Lemington area. If the mines operated at these limits, they would not exceed approved limits, although collectively they would produce 40 dB(A) at this location.

The consolidation of both the South Pit (DA 114-12-98) and South Lemington Mine (DA 215/97) noise limits would result in two noise limits applying to the same property. Rather than adding the two consent limits, a more conservative approach was used. This was to adopt the stricter INP based limits in the South Pit consent for the two operations separately. Hence, South Pit's more conservative noise limits of 35 dB(A) and 36 dB(A) are converted to 38 dB(A) and 39 dB(A) respectively by doubling them logarithmically. For the locations where a noise limit of 39 dB(A) exists in the South Pit consent, the noise limit is left unchanged. In addition, the $Night_{LA1(1\ min)}$ sleep disturbance criteria stated in the South Pit consent remains unaltered.

Where applicable the noise acquisition limits will be determined by the appropriate authority through the approval process. However, one approach is presented here for consideration. The basis for this includes adopting the existing South Pit (DA 114-12-98) acquisition limits of 43 dB(A) $L_{\mathbf{Aeq(15\ min)}}$ for the daytime and 40 dB(A) $L_{\mathbf{Aeq(15\ min)}}$ for the evening and night. However, where comparable noise levels can be expected from both South Pit and South Lemington at the same receiver, then a consolidated acquisition value could apply such as 46 dB(A) $L_{\mathbf{Aeq(15\ min)}}$ for the daytime and 43 dB(A) $L_{\mathbf{Aeq(15\ min)}}$ for the evening and night. The relative location of the two pits to assessment locations suggests that the latter acquisition limits could reasonably apply to properties in Warkworth Village and Maison Dieu. This considers prevailing wind effects and is supported by noise modelling results, where a comparable contribution of noise is calculated from each pit to the one assessment location.

These currently approved noise limits applicable to the proposal have been modified based on consultation with the DECC and DoP following a meeting on 30 May 2006 and correspondence dated 29 November 2006 (*Section 6.4.2* and *Annex H*).

This assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. Therefore the existing and potential environmental impacts are already approved and management measures have been developed and implemented. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. The assessment results are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been approved.

Table 7.2 summarises the consolidated criteria that will be adopted for HVO South.

Table 7.2 Noise Limits Applicable to Proposal, dB(A)

Location No.	Name	Day Limits	Evening Limits	Night Limits		Likely Acquisition Limits $L_{Aeq(15\ min)}$	
		$L_{Aeq(15\ min)}$	$L_{Aeq(15\ min)}$	$L_{Aeq(15\ min)}$	$L_{1(1\ min)}$	Day	Evening & Night
3	Elisnore	38	38	38	45	*43*	*40*
4	Muller	38	38	38	45	*43*	*40*
5	Bowman	39	39	39	46	46	*43*
7	Stapleton (Cheshunt)[1]	38	38	38	45	*N/A*	*N/A*
8	Holz (Oaklands)[2]	38	38	38	45	*N/A*	*N/A*
10	Moses (Wandewoi)[1]	38	38	38	45	*N/A*	*N/A*
13	Jerrys Plains Centre	38	38	38	45	*43*	*40*
16	Algie	39	39	39	46	46	*43*
17	Algie	39	39	39	46	46	*43*
19	Birralee Feeds Pty Ltd	38	38	38	45	43	*40*
23	Hawkes (Springwood)[1]	39	39	39	46	*N/A*	*N/A*
24	Clifton and Edwards	39	39	39	46	46	*43*
31	Cooper (Kilburnie)	39	39	39	49	43	*40*
32	Algie (Curlewis)	39	39	39	46	46	*43*
33	Edward and Haynes[2]	39	39	39	46	*N/A*	*N/A*
34	Ernst	39	39	39	46	46	*43*
36	Garland	38	38	38	45	43	*40*
38	Henderson[1]	39	39	39	46	*N/A*	*N/A*
43	Kannar[2]	39	39	39	46	*N/A*	*N/A*
45	Kelly[1]	39	39	39	46	*N/A*	*N/A*
47	Moxey	39	39	39	46	46	*43*
61	Shearer	39	39	39	46	46	*43*

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General notes:

- Daytime (between 7am and 6pm); evening (between 6pm and 10pm); and night time (between 10pm and 7am).
- The noise emission limits above apply for winds up to 3 m/s (at a height of 10 m) and temperature gradients up to 4 degrees Celsius per 100 m.
- If there is a valid private amenity agreement with any property owners these criteria may be exceeded.
- Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8, 10.
- Location No. is consistent with the HVO North consent (DA 450-10-2003).

Cumulative Noise

The cumulative impact of more than one development can be compared against the DECC's amenity criteria which has a holistic approach to industrial noise. The more critical night period was used as an assessment period for cumulative noise. The INP stipulates an amenity criteria of 40 dB(A) $L_{eq,9hour}$ for a rural area for the night period. The results of the cumulative assessment are discussed in *Section 7.4*.

7.2.4 Calculation Procedure

The Environmental Noise Model (ENM) noise prediction software was used for modelling purposes. ENM takes into account distance, ground effect, atmospheric absorption and topographic detail. ENM is a DECC accepted noise prediction model as it gives consistently reliable predictions of environmental noise. Initial calculations were performed with no wind or temperature gradients, which are termed calm weather conditions. Assumed night air temperature and relative humidity were 10 °C and 90% respectively. Noise levels during other conditions are discussed in *Section 2.4 of Annex H*.

The model incorporates three-dimensional digitised ground contours for the surrounding land and mine plans. Contours of the mine for each mining stage were superimposed on the base topography. Equipment was placed at various locations and heights, representing potential operating conditions that could result in the greatest noise impacts for the life of the mine.

The model predicts noise levels, based on equipment sound power levels determined from measurements conducted at the existing operations as detailed in *Appendix B of Annex H.* The results assume that all plant and equipment operate simultaneously. In practice, such an operating scenario would be unlikely to occur. The results are therefore considered conservative.

7.2.5 Blasting

Blasting limits for HVO South have been set in DA 114-12-98 and DA 215-97. They are applicable to two main effects of blasting:

- airblast overpressure; and
- ground vibration.

The consent limits for blasting are the same for both consents and are described below. This assessment re-evaluates all HVO South activities including those already consented and consolidates all potential impacts.

Airblast Overpressure

The consents specify that airblast overpressure should not exceed 115 $dB_{(Lpeak)}$ for more than 5% of the total number of blasts over a period of 12 months. However, the maximum level should not exceed 120 $dB_{(Lpeak)}$ at any time. The $dB_{(Lpeak)}$ unit of sound measurement considers the low frequency sounds which are not audible to the human ear but can be 'felt'. Such limits will also ensure damage from blast noise overpressure is avoided.

Ground Vibration

The consents specify that the peak particle velocity (ppv) from ground vibration should not exceed 5 millimetres per second (mm/s) for more than 5% of the total number of blasts over a period of 12 months. However, the maximum level should not exceed 10 mm/s at any time. These criteria apply to minimise human annoyance and discomfort and were not developed to control possible structural damage. However, if ground vibration ppv comply with criteria for minimising human annoyance and discomfort, they would also be below levels that may cause structural damage to buildings.

Time and Frequency of Blasting

The consents state that blasting should generally be limited to the hours from 7.00 am to 6.00 pm Monday to Saturday and should not take place on Sundays or public holidays without the written approval of DECC.

CNA's ongoing consultation with the rural communities surrounding their operations has found that generally the community supports some flexibility in blast times in response to environmental conditions. These communities are more reactive to dust from blasting and would prefer blasting to be undertaken earlier or later in the day where wind conditions are more suitable and less likely to carry dust.

In addition, existing management measures for noise and vibration were reviewed to identify additional measures required as a result of this proposal.

7.3 EXISTING ENVIRONMENT

7.3.1 Background and Ambient Noise

INP based noise limits have been stipulated in previous HVO South consents and these are used for the current assessment. These limits are still applicable as INP is the current DECC noise policy.

Attended noise monitoring is conducted on a quarterly basis for CNA as part of the HVO monitoring programme. This data was required to allow assessment of the current noise environment. This included quantification of the noise levels from HVO on typical days of operation. Measurements were conducted at 15 minute time periods at nine locations during each quarter. The range of noise levels measured over the five quarters reviewed (2005 and quarter 1 2006) are presented in *Table 7.3*.

Table 7.3 Summary of Existing Noise Levels

Location		Total Measured Noise Levels, dB(A)				HVO South Pit Contribution[1], $L_{Aeq,}$ dB(A)		HVO West Pit Contribution[1], $L_{Aeq,}$ dB(A)		Total HVO Contribution, $L_{Aeq,}$ dB(A)	
Location No.	Location Name	Day		Night		Day	Night	Day	Night	Day	Night
		L_{eq}	L_{90}	L_{eq}	L_{90}						
7	Stapleton[2]	35-54	23-34	30-45	28-41	IA	IA-38	IA	IA	IA	IA-38
8	Holz (Oaklands)[3]	35-48	27-41	38-48	34-38	IA	IA-39	IA	IA	IA	IA-39
10	Moses (Wandewoi)[2]	38-49	31-39	38-45	30-41	IA	IA	37-38	35-43	37-38	35-43
11	Fisher	45-52	30-39	35-48	32-39	IA	32-40	IA-31	32-36	IA-31	32-41
13	Jerrys Plains Centre	57-66	35-45	36-42	27-38	IA	IA-28	IA	28-35	IA	28-35
31	Cooper (Kilburnie)	50-55	35-46	30-50	27-45	IA	22-38	IA	IA	IA	22-38
32	Algie (Curlewis)	38-55	29-35	31-78	27-41	26-37	IA-36	IA	IA	26-37	IA-36
43	Kannar[3]	52-59	36-50	40-45	37-41	IA	IA	IA	IA	IA	IA
47	Moxey	36-41	30-33	29-51	27-47	IA-38	IA-36	IA-25	IA-36	25-38	IA-36

1. Data sourced from HVO 2005 and Quarter 1, 2006 Environmental Noise Monitoring Report by Global Acoustics prepared for Ecowise Environmental Pty Ltd.
2. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
3. These residences are owned by mining companies other than CNA.

General:

- Location No. 43, Kannar was selected as the property representing Warkworth Village in the above mentioned report.
- Day is defined to be from 7am to 6pm and night is defined to be from 10pm to 7am according to the INP.
- 'IA' – Inaudible.
- Location No. 11 (Fisher) is located west of the mine towards Jerrys Plains (E 307019 N 6399079). It was modelled for validation purposes only.

The measured noise levels may have been influenced by the HVO pits, Wambo Mine, Warkworth Mine, road traffic, animals, insects and the weather conditions present during the measurement period. These levels provide an indication of the existing total noise levels in the area surrounding the mines. From these measurements, Global Acoustics evaluated the individual contribution of HVO South and HVO West Pit (the northern most pit with the HVO North Mine Lease area) in the absence of all other noise sources.

HVO South's current noise contribution was used for validating noise modelling results in this report as described in the following section.

7.3.2 Modelled Existing Noise

Existing noise levels were modelled based on the meteorological conditions at the time of the quarterly attended noise monitoring conducted in December 2005 and January 2006. The meteorological condition was identified along with the equipment present at HVO South, as provided by CNA based mostly on plant GPS records. The modelling results represent the noise level contribution solely due to the operations at HVO South. The noise modelling procedure has been described in *Section 7.2* and the Sound Power Levels attributed to each type of equipment is provided in *Section 4.3 of Annex H*. The modelled results are presented in *Table 7.4*.

From the modelling results, it can be seen that the different meteorological conditions influenced the noise levels modelled at each location. The measured HVO South contribution evaluated during quarterly monitoring included corresponding meteorological conditions for each measurement. However, the meteorological station where wind speed and wind direction were obtained may not always be representative of the parameters at the source or assessment location position. Notwithstanding, it can be seen that results at Location No's 13 and 32 show good correlation between measured and modelled noise levels. The highest modelled noise level for the five prevailing meteorological conditions correlated well with that of the INP weather condition (last column). The highest modelled levels (for either the five prevailing winds or INP wind) are above the measured levels at all the assessment locations except Location No. 31. Hence, the ENM noise model and the adopted modelling approach can be deemed to be conservative under adverse wind conditions most of the time.

Prevailing weather conditions are detailed in *Section 2.4* of *Annex H*.

Table 7.4 Summary of Modelled Existing Noise Levels

Location No.	Location Name	Modelled (Measured) Noise Levels, dB(A) and Wind Speed and Direction						Highest Existing Noise Level Modelled/ INP Weather
		02/12/05 0:04 5.2m/s, 298 deg	**02/12/05 1:27 4.4m/s, 308 deg**	**02/12/05 3:08 4.9m/s, 326 deg**	**10/01/06 10:57 1.5m/s, 106 deg**	**10/01/06 0:52 2.4m/s, 133 deg**	**10/01/06 1:42 1.8m/s, 137 deg**	
3	Elisnore	5	6	7	32	31	30	32
4	Muller	4	6	7	33	32	26	33
5	Bowman	49	47	46	21	12	14	48
7	Stapleton[1]	43	40	27**(38)**	25	20	33	47
8	Holz (Oaklands)[3]	26**(39)**	24	21	39	40	41	48
10	Moses (Wandewoi)[1]	15	14	14	36	34	34	36
11	Fisher[2]	8	8	10	33	31	27**(33)**	37
13	Jerrys Plains Centre	0	0	0	28	26**(28)**	26	28
16	Algie	45	43	44	20	12	13	44
17	Algie	46	44	44	23	12	13	45
19	Birralee Feeds Pty Ltd	3	4	5	33	31	30	33
23	Hawkes (Springwood)[1]	37	36	40	21	12	12	39
24	Clifton and Edwards	47	46	45	20	12	13	46
31	Cooper (Kilburnie)	3	4**(38)**	5	33	32	27	33
32	Algie (Curlewis)	47	44	44	25**(26)**	13	14	46
33	Edward and Haynes[3]	42	40	44	22	15	14	43
34	Ernst	45	43	43	23	11	13	45
36	Garland	2	3	5	33	33	27	34
38	Henderson[1]	33	33	31	15	8	9	32
43	Kannar[3]	43	41	45	23	18	18	45

Location No.	Location Name	Modelled (Measured) Noise Levels, dB(A) and Wind Speed and Direction						Highest Existing Noise Level Modelled/ INP Weather
		02/12/05 0:04 5.2m/s, 298 deg	02/12/05 1:27 4.4m/s, 308 deg	02/12/05 3:08 4.9m/s, 326 deg	10/01/06 10:57 1.5m/s, 106 deg	10/01/06 0:52 2.4m/s, 133 deg	10/01/06 1:42 1.8m/s, 137 deg	
45	Kelly[1]	42	41	45	24	16	15	44
47	Moxey	50	48	46	18	11	13	49
61	Shearer	49	47	46	18	11	14	48

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. Location No. 11 was modelled for validation purposes only.
3. These residences are owned by mining companies other than CNA.

General:

- Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8, 10.
- Values in brackets are actual measured HVO South noise contribution levels provided in the HVO Monitoring reports for the corresponding meteorological condition listed.

7.4 IMPACT ASSESSMENT

The following section provides results of noise modelling for the project.

7.4.1 Calm Weather Conditions

Table 7.5 summarises noise modelling results for calm weather conditions. Under calm weather conditions, a noise impact is not likely at most residences. Calm weather noise contours are presented graphically in *Figure 5.1 of Annex H*. The noise contours are the combination of the calm weather contours for all four scenarios described in *Section 4*. These levels typify the noise levels at the assessment locations during the day in the absence of adverse INP assessable weather conditions.

All private residences not within the currently recognised zone of affectation are below the likely acquisition criteria. The operational noise limits are exceeded at Location No's 33, 38, 43 and 45 during particular operating scenarios. However, it should be noted that these locations are situated in Warkworth Village and recognised as being within a zone of affectation or owned by mines other than HVO.

It is clear that daytime and night time mine operations will satisfy DECC noise goals during calm weather conditions at all private residences not already within a zone of affectation.

Table 7.5 ***$L_{eq,15minute}$ Noise Under Calm Weather Conditions, dB (A)***

Location No.	Location Name	A	B2 Op1	B2 Op2	B2 Op3	C2 Op1	C2 Op2	C2 Op3	D	Day Limits	Evening Limits	Night Limits	Likely Acquisition Limits
3	Elisnore	18	16	16	16	15	15	15	15	38	38	38	*43*
4	Muller	21	19	19	19	18	18	18	15	38	38	38	*43*
5	Bowman	36	29	29	30	25	25	27	31	39	39	39	*43*
7	Stapleton[1]	33	25	25	25	22	22	22	28	38	38	38	*43*
8	Holz (Oaklands)[2]	29	26	26	26	23	23	24	28	*N/A*	*N/A*	*N/A*	*N/A*
10	Moses (Wandewoi)[1]	29	26	26	26	25	25	25	25	*N/A*	*N/A*	*N/A*	*N/A*
13	Jerrys Plains Centre	15	14	14	14	14	14	14	12	38	38	38	*43*
16	Algie	35	36	36	37	30	31	33	27	39	39	39	*43*
17	Algie	34	31	31	31	26	26	28	29	39	39	39	*43*
19	Birralee Feeds Pty Ltd	19	17	17	17	15	16	16	14	38	38	38	*43*
23	Hawkes (Springwood)[1]	25	31	28	29	29	26	27	21	39	39	39	*N/A*
24	Clifton and Edwards	33	28	28	28	23	23	25	29	39	39	39	*43*
31	Cooper (Kilburnie)	20	18	18	18	17	17	17	14	39	39	39	*43*
32	Algie (Curlewis)	37	37	37	38	31	32	33	30	39	39	39	*43*
33	Edward and Haynes[2]	32	37	38	39	36	37	39	24	*N/A*	*N/A*	*N/A*	*N/A*
34	Ernst	33	30	30	31	25	26	28	28	39	39	39	*43*
36	Garland	19	17	17	17	16	16	16	14	38	38	38	*43*
38	Henderson[1]	34	40	40	40	43	43	43	23	39	39	39	*N/A*
43	Kannar[2]	33	39	40	41	40	41	42	24	*N/A*	*N/A*	*N/A*	*N/A*
45	Kelly[1]	33	37	38	38	36	36	37	25	39	39	39	*N/A*
47	Moxey	33	26	26	27	22	22	24	29	39	39	39	*43*
61	Shearer	36	29	29	30	24	25	27	30	39	39	39	*43*

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- Refer to *Table 4.3* of *Annex H* for a definition of Options 1 to 3.
- Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8 and 10.

7.4.2 *Predicted Noise Levels – Adverse Weather Conditions*

INP weather conditions and ENM model validation outcomes are described in *Section 5.2* of *Annex H.*

The predicted levels under INP weather conditions are provided in *Table 7.6 and Table 7.7*. Noise contours for these scenarios are given in *Figures 5.2* to *5.6* of *Annex H*. Temperature inversions and INP based adverse wind conditions are only present during the night as discussed in *Section 2.4 of Annex H*.

Under temperature inversions, the likely acquisition criterion of 43 dB(A) is met at all the residences that are not currently under a zone of affection (as defined in the existing consents). *Table 7.6* shows Location No's 5, 16, 17, 24, 32, 47 and 61 (private residences that are not currently under any zone of affectation) are predicted to potentially exceed night limits.

The predictions in *Table 7.7* show that the night time operational limits are exceeded at several instances at various locations in Warkworth Village and Maison Dieu during adverse wind conditions. Location No's 5, 16, 24, 32, 34, 47 and 61 experience marginal exceedances over the likely acquisition criterion. At all these locations, predicted future HVO South mining noise levels are marginally below or marginally above existing noise levels, depending on the operating scenario. Location No's 3, 4, 13, 19, 31 and 36 comply with the limits under all scenarios.

As a result, further management measures were considered necessary to reduce noise levels as far as reasonably possible.

Figure 7.2 depicts noise contours for all modelled scenarios combined under INP weather conditions.

Table 7.6 Night $L_{eq,15minute}$ Noise Under Temperature Inversion Conditions, dB (A)

Location No.	Location Name	Mining Scenario								*Night Limits*	*Likely Acquisition Limits*
		A	B2 Op1	B2 Op2	B2 Op3	C2 Op1	C2 Op2	C2 Op3	D		
3	Elisnore	32	28	28	28	29	29	29	27	*38*	*43*
4	Muller	35	30	30	30	29	29	29	25	*38*	*43*
5	Bowman	41	38	38	39	35	35	37	38	*39*	*43*
7	Stapleton[1]	39	36	36	36	34	34	34	36	*38*	*N/A*
8	Holz (Oaklands)[2]	38	37	37	37	36	36	36	36	*NA*	*N/A*
10	Moses (Wandewoi)[1]	36	33	33	33	34	34	34	34	*NA*	*N/A*
13	Jerrys Plains Centre	28	26	26	26	27	27	28	25	*38*	*43*
16	Algie	41	41	42	42	36	38	39	34	*39*	*43*
17	Algie	40	38	38	39	36	36	37	35	*39*	*43*
19	Birralee Feeds Pty Ltd	33	28	28	29	29	29	29	26	*38*	*43*
23	Hawkes (Springwood)[1]	33	38	36	37	38	36	37	29	*39*	*N/A*
24	Clifton and Edwards	40	37	37	38	35	35	36	36	*39*	*43*
31	Cooper (Kilburnie)	34	30	30	30	29	29	29	25	*39*	*43*
32	Algie (Curlewis)	42	41	42	42	37	38	39	36	*39*	*43*
33	Edward and Haynes[2]	40	44	44	45	43	44	44	32	*N/A*	*N/A*
34	Ernst	39	38	39	39	36	36	37	34	*39*	*43*
36	Garland	35	31	31	31	29	29	29	25	*38*	*43*
38	Henderson[1]	38	45	44	44	46	46	46	31	*39*	*N/A*
43	Kannar[2]	42	47	47	47	44	45	46	33	*N/A*	*N/A*
45	Kelly[1]	41	43	43	44	41	41	42	32	*39*	*N/A*
47	Moxey	40	37	37	38	35	35	36	37	*39*	*43*
61	Shearer	41	38	38	39	35	35	37	37	*39*	*43*

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8 and 10.

Table 7.7 Night $L_{eq,15minute}$ Noise Under Adverse INP Wind Conditions, dB (A)

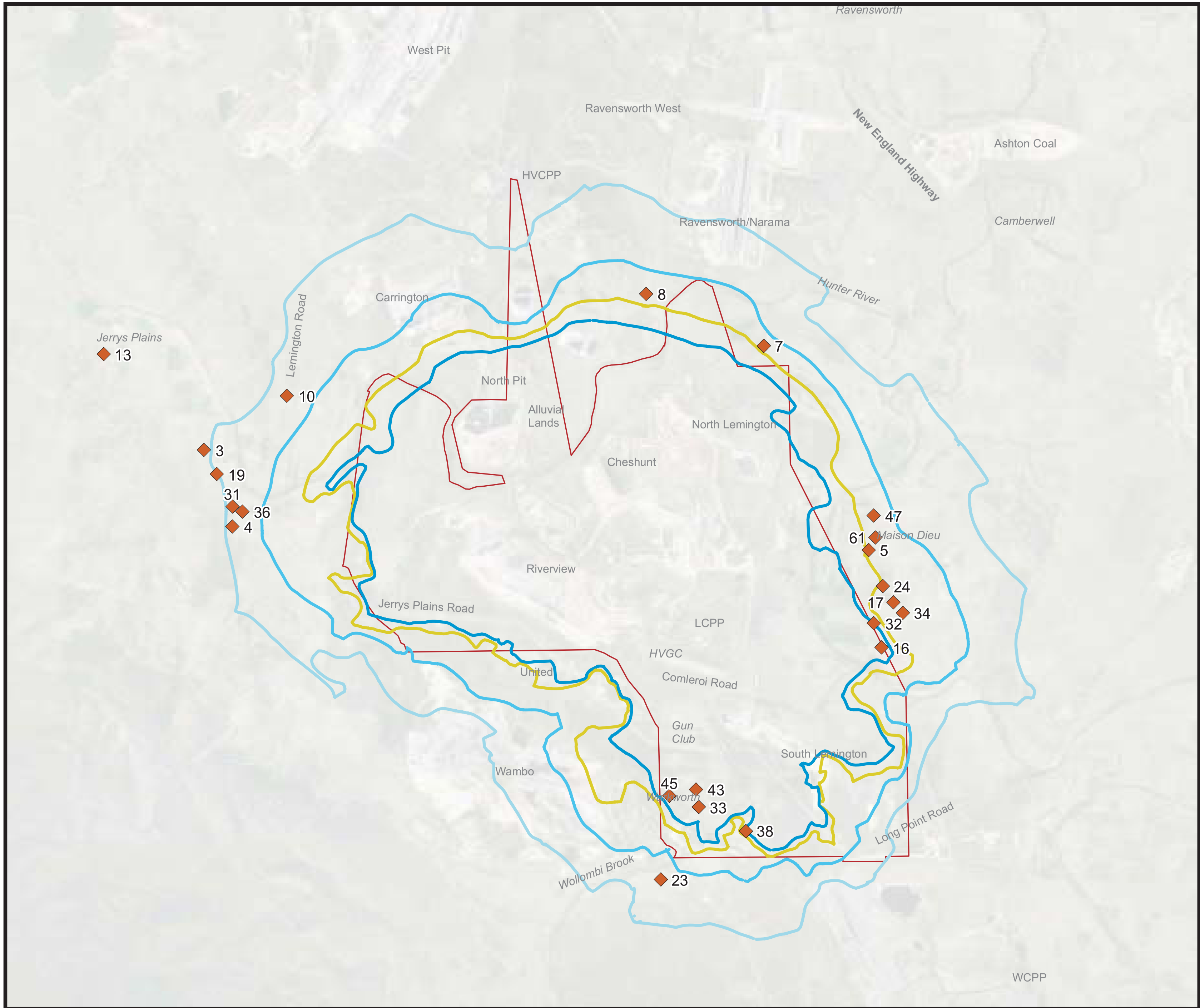
Location No.	Location Name	Mining Scenario									Night Limits	Likely Acquisition Limits
		2006	**A**	**B2 Op1**	**B2 Op2**	**B2 Op3**	**C2 Op1**	**C2 Op2**	**C2 Op3**	**D**		
3	Elisnore	32	35	35	35	36	35	35	35	31	*38*	*43*
4	Muller	33	38	37	37	37	36	36	36	29	*38*	*43*
5	Bowman	48	43	**44**	**44**	**45**	41	41	42	38	*39*	*43*
7	Stapleton[1]	47	42	**44**	**44**	**44**	43	43	43	41	*38*	*43*
8	Holz (Oaklands)[2]	48	42	45	45	45	45	45	45	42	*N/A*	*N/A*
10	Moses (Wandewoi)[1]	36	39	39	39	39	40	40	40	36	*N/A*	*N/A*
13	Jerrys Plains Centre	28	29	31	31	31	31	31	31	26	*38*	*43*
16	Algie	44	41	**48**	**48**	**48**	42	**44**	**45**	31	*39*	*43*
17	Algie	45	41	42	43	43	39	40	41	34	*39*	*43*
19	Birralee Feeds Pty Ltd	33	36	36	36	36	36	36	36	31	*38*	*43*
23	Hawkes (Springwood)[1]	39	26	44	39	40	44	40	40	22	*39*	*N/A*
24	Clifton and Edwards	46	41	43	**44**	**44**	40	41	41	36	*39*	*43*
31	Cooper (Kilburnie)	33	38	37	37	37	36	36	36	30	*39*	*43*
32	Algie (Curlewis)	46	43	**48**	**48**	**48**	42	**44**	**44**	33	*39*	*43*
33	Edward and Haynes[2]	43	33	48	48	49	48	48	49	22	*N/A*	*N/A*
34	Ernst	45	40	43	43	**44**	39	41	41	33	*39*	*43*
36	Garland	34	39	38	38	38	36	36	36	30	*38*	*43*
38	Henderson[1]	32	31	49	47	48	50	49	49	19	*39*	*N/A*
43	Kannar[2]	45	33	51	51	52	49	50	50	23	*N/A*	*N/A*
45	Kelly[1]	44	36	48	48	49	46	46	46	26	*39*	*N/A*
47	Moxey	49	42	43	43	**44**	41	41	42	39	*39*	*43*

Location No.	Location Name	Mining Scenario									*Night Limits*	*Likely Acquisition Limits*
		2006	A	B2 Op1	B2 Op2	B2 Op3	C2 Op1	C2 Op2	C2 Op3	D		
61	Shearer	48	42	**44**	**44**	**45**	41	41	42	38	*39*	*43*

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8, 10.
- Bold numbers indicate exceedance of likely acquisition limits where applicable for private residences not currently within a zone of affectation.
- 2006 noise levels are the highest modelled existing noise levels as discussed in *Section 7.3.2*.



Legend

Assessment Locations

Project Application Area

Noise Contours

35 dB(A)

40 dB(A)

43 dB(A)

45 dB(A)

Figure 7.2

All Scenarios Combined
Leq 15 Minute Operation Noise Levels -
INP Weather, dB(A)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_15	Suffix No:	R1
Date:	27.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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0 1 2 3km

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7.4.3 *Management Measures and Modelling*

Following analysis of the individual contribution of the noise sources at the various assessment locations, the equipment at South Lemington Pit 1 and the truck haulage associated with it, were determined to be the main causes behind the night time criteria exceedances at the locations in Maison Dieu. The high noise levels at these locations are due to the presence of south westerly winds, which exceed the INP 30% threshold during the night.

Scenario B2 and Scenario C2 have equipment operating in South Lemington Pit 1. For these scenarios, modelling indicates a potential exceedance for south westerlies at or above 2.1 m/s. Equipment operation in South Lemington Pit 1 will be reviewed if it is determined that mine operations during nights with south westerly winds at or above 2.1 m/s may result in exceedance of noise criteria at Maison Dieu locations. At lower wind speeds, real-time noise and weather monitoring will be used to guide modifications to operations as required. The results for this mitigation method are presented below in *Table 7.8*. *Figure 7.3* displays the noise contours with this mitigation measure in place.

The results show that noise levels are significantly reduced for the locations in Maison Dieu for Scenarios B2 and C2. The likely acquisition criterion of 43 dB(A) is met at all the Maison Dieu locations during all weather conditions as a result of the mitigation measure.

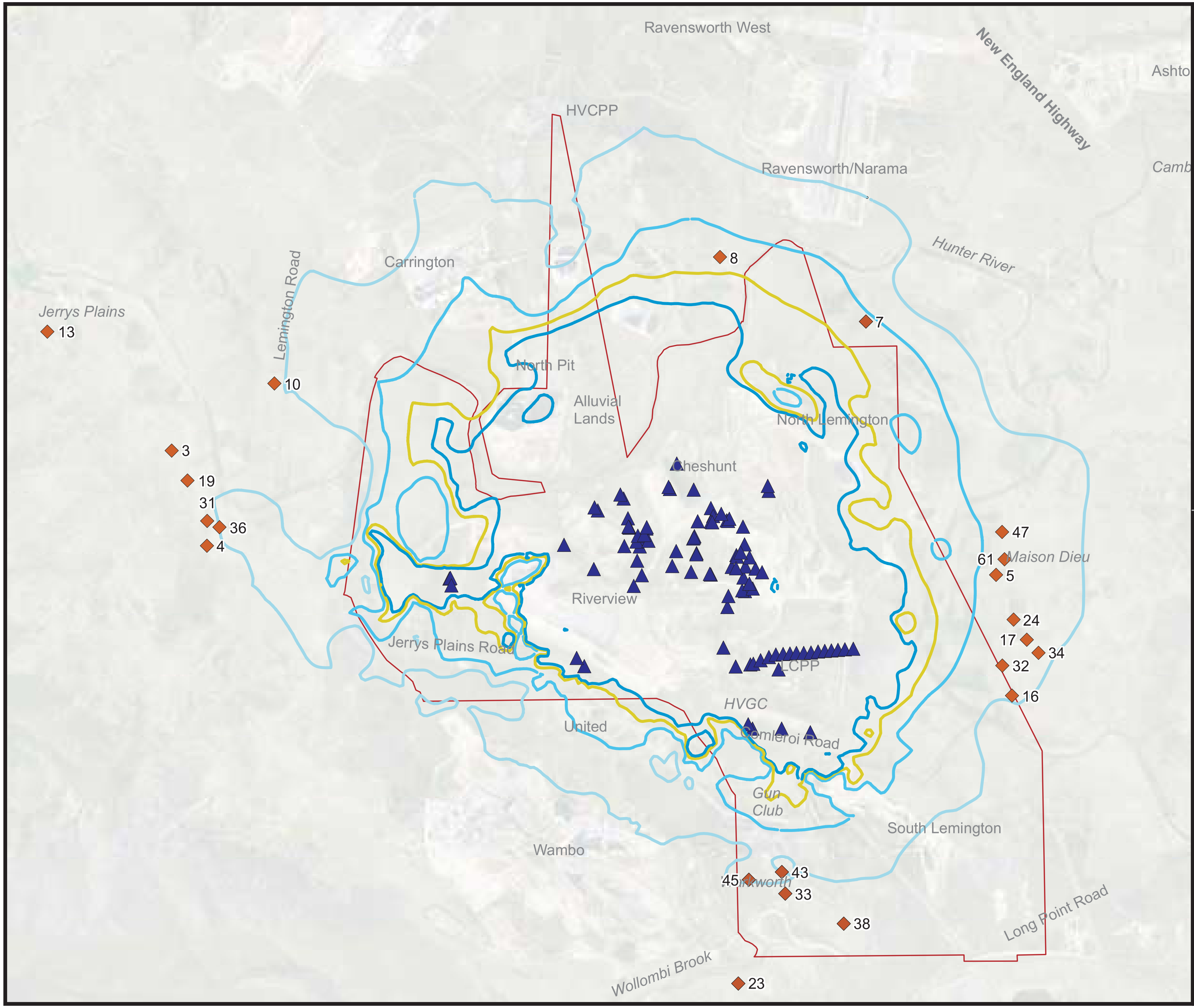
Table 7.8 Mitigated Night $L_{eq,15minute}$ Noise Under Adverse Wind Conditions, dB (A)

Location No.	**Location Name**	**Mining Scenario**						***Night Limits***	***Likely Acquisition Limits***
		B2 Op1	**B2 Op2**	**B2 Op3**	**C2 Op1**	**C2 Op2**	**C2 Op3**		
3	Elisnore	33	33	33	32	32	33	*38*	*43*
4	Muller	35	35	35	33	33	33	*38*	*43*
5	Bowman	39	40	41	38	38	40	*39*	*43*
7	Stapleton[1]	41	41	41	40	40	40	*38*	*N/A*
8	Holz (Oaklands)[2]	42	42	42	42	42	42	*NA*	*N/A*
10	Moses (Wandewoi)[1]	36	36	36	37	37	37	*NA*	*N/A*
13	Jerrys Plains Centre	28	28	28	28	28	28	*38*	*43*
16	Algie	37	42	42	35	41	42	*39*	*43*
17	Algie	37	38	40	36	37	39	*39*	*43*
19	Birralee Feeds Pty Ltd	34	34	34	33	33	33	*38*	*43*
23	Hawkes (Springwood)[1]	43	36	37	43	36	37	*39*	*N/A*
24	Clifton and Edwards	37	38	39	36	37	39	*39*	*43*
31	Cooper (Kilburnie)	35	35	35	33	33	33	*39*	*43*
32	Algie (Curlewis)	38	41	42	36	40	41	*39*	*43*
33	Edward and Haynes[2]	44	44	45	44	44	45	*N/A*	*N/A*
34	Ernst	37	39	40	35	38	39	*39*	*43*
36	Garland	35	35	36	33	33	34	*38*	*43*
38	Henderson[1]	48	45	46	48	45	46	*39*	*N/A*
43	Kannar[2]	42	45	46	41	44	46	*N/A*	*N/A*
45	Kelly[1]	42	42	43	41	41	43	*39*	*N/A*
47	Moxey	39	39	41	38	38	40	*39*	*43*
61	Shearer	39	39	41	38	38	40	*39*	*43*

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8 and 10.



Legend

- Equipment Location
- Assessment Locations
- Project Application Area

Noise Contours

- 35 dB(A)
- 40 dB(A)
- 43 dB(A)
- 45 dB(A)

Figure 7.3

Mitigated B2
Leq 15 Minute Operation Noise Levels - INP Weather, dB(A)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_16	Suffix No:	R1
Date:	27.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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0 1 2 3km

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7.4.4 *Percentage Occurrence of Noise Levels*

The mine operation contribution to noise levels at any residence varies and is dependent upon many factors including prevailing weather conditions. It is therefore useful to gain an understanding of this variation rather than relying on a single predicted noise level for a worst case meteorological condition as presented earlier.

The ENM model calculates noise levels under various combinations of wind speed and direction and vertical temperature gradient. Hence, the proportion of time during which certain noise levels will be experienced can be calculated from the probabilities of various combinations of wind speed, wind direction and stability class.

The effects of a representative set of meteorological conditions on noise are presented for the mine operating Scenario B2 (Op 1), without South Lemington Pit 1 operating, for Location No's 16, 36 and 43. Location No's 16 and 36 are private residences and No. 43 is owned by a mining company other than CNA. These three locations provide a representation of others in the surrounding areas of Maison Dieu, Jerrys Plains Road and Warkworth Village respectively.

For each assessment location, this involved calculating noise for each of 198 meteorological conditions based on a combination of wind speed, wind direction and temperature gradient, and combining these in proportion to the probability of their occurrence. These conditions are derived by adopting sixteen wind directions, six temperature gradients and two 10 m elevation wind speed ranges (ie 16 x 6 x 2 = 192). In addition, six calm weather conditions (defined by winds less than 0.5 m/s) and six stability classes were included in calculations. This was used to develop a noise probability distribution for each location.

The results of these calculations are presented in *Figure 7.4.*

Typically, the noise distribution has a larger range for locations further away from the operations (eg Location No. 36). This is due to the consideration of all prevailing weather effects, adverse or favourable, and the corresponding influence on noise propagation over large distances. In ERM's experience, a reasonable indicator of noise impact is associated with an industrial noise level present for at least 10% of the time. This is consistent with the intent of the INP. The 10% exceedance noise level is 48 dB(A), 36 dB(A), and 48 dB(A) for Location No's 16, 36 and 43 respectively.

These compare to an INP based prediction (see *Table 7.8*) of 42 dB(A), 35 dB(A) and 45 dB(A) for Location No's 16, 36 and 43 respectively. This demonstrates a reasonable level of correlation between the two methods, with the 10% approach being more conservative.

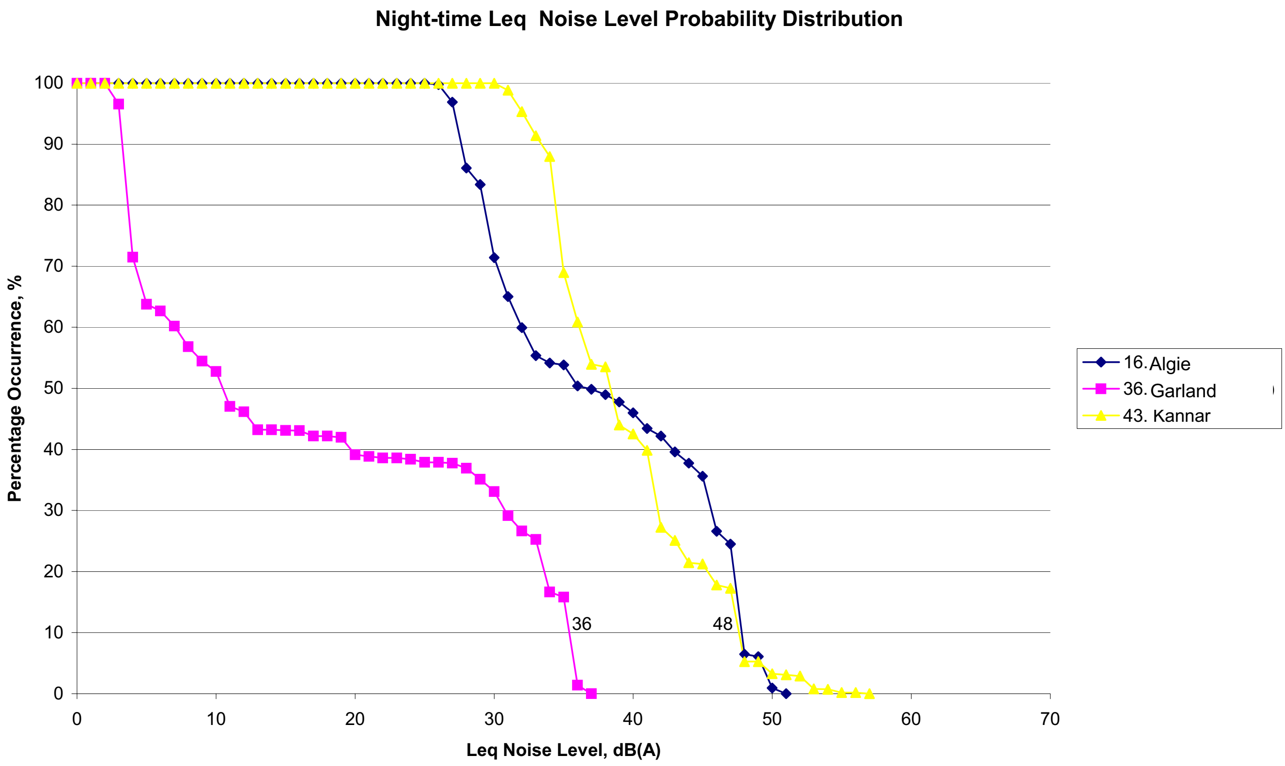


Figure 7.4 ***Night Time $L_{eq,15\ Minute}$ Noise Level Probability Distribution***

The above calculations apply to stable meteorological conditions with constant wind speed and linear temperature gradients. Atmospheric turbulence results in fluctuations of the sounds received by the listener. Therefore, on occasions when there is a particular combination of non-linear wind and temperature gradients, noise from a particular source can focus on a particular location. Under these conditions, higher enhancements can be expected. The frequency and intensity of such events are not predictable, but would be relatively rare.

7.4.5 Sleep Disturbance

There is a potential for sleep of residents to be disturbed by transient noise such as shovel gates banging, bulldozer track plates, truck engine at fast revving and vehicle reversing alarms.

Table 7.9 shows calculated maximum noise levels from the highest ranked source for a given location. This is based on the typical equipment locations used for mining operations and corresponds to the maximum sound power level for the particular item of plant (generally that for a truck or 125 dB(A)). The criteria used to assess sleep disturbance are based on the DECC's background plus 15 dB for the $L_{1,1min}$ noise level (which in this case is conservatively approximated by the maximum noise level (Lmax)). Sleep disturbance is presented in more detail in *Section 5.5* of *Annex H*.

Table 7.9 Sleep Disturbance Impact – INP Weather (Mitigated)

Location No.	Location Name	External L_{max} Noise Level From Onsite Plant, dB(A)				$L_{1,1min}$ Criteria, dB(A)
		Mining Scenario				
		A	**B2**	**C2**	**D**	
3	Elisnore	38	31	34	35	45
4	Muller	42	34	37	31	45
5	Bowman	44	38	30	40	46
7	Stapleton	**49**	40	39	**47**	45
8	Holz (Oaklands)[2]	45	44	39	42	45
10	Moses (Wandewoi)[1]	43	35	39	37	45
13	Jerrys Plains Centre	31	26	33	25	45
16	Algie	42	42	39	33	46
17	Algie	40	40	37	36	46
19	Birralee Feeds Pty Ltd	39	32	35	31	45
23	Hawkes (Springwood)[1]	25	35	41	25	46
24	Clifton and Edwards	42	37	28	38	46
31	Cooper (Kilburnie)	41	33	36	31	49
32	Algie (Curlewis)	44	45	40	35	46
33	Edward and Haynes[2]	38	46	**48**	24	46
34	Ernst	40	41	37	33	46
36	Garland	42	34	37	32	45
38	Henderson[1]	34	38	**54**	22	46
43	Kannar[2]	35	**49**	**48**	25	46
45	Kelly[1]	39	46	39	29	46
47	Moxey	43	36	31	41	46
61	Shearer	43	37	31	39	46

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8 and 10.
- Bold numbers indicate exceedance of likely acquisition limits where applicable for private residences not currently within a zone of affectation.

Table 7.9 demonstrates that calculated noise levels under prevailing weather conditions are within the stipulated criteria at most locations. There are criteria exceedances at Location No's 33, 38 and 43 which are residences owned or already under the zone of affectation of other mines. Location No. 7 experiences a marginal criteria exceedance of 2 dB(A) for Scenario D and an exceedance of 4 dB(A) for Scenario A. Location No. 7 is in a zone of affectation of another mine. Furthermore, maximum internal levels are likely to be below 50-55 dB(A) which recent literature studies (reference *Environmental Criteria for Road Traffic Noise* (DEC 1999)) state are generally perceived to be the minimum noise level to cause an awakening reaction of a resident.

7.4.6 *Cumulative Noise Assessment*

Adjoining industrial activity also influences the noise climate at locations potentially exposed to the proposal. Other industrial operations of significance are HVO North, Wambo (including rail spur), MTW, Ravensworth-Narama and Ashton Coal Mine.

Noise contribution from these surrounding mines was sourced from documents listed in *Section 5.6* of *Annex H*.

The documents provided predicted L_{eq} noise levels for adverse weather.

Since not all of the locations used for this proposal were assessed in studies for other mines, some locations were assigned noise levels based on a representative location in the same vicinity.

Generally, cumulative noise from these operations was added to the results for worst case INP weather from the proposal. However, a special case is Warkworth Village where this would be unrealistic as, for example, a westerly wind that may enhance noise from Wambo will not enhance noise from the proposal. Hence, the locations in Warkworth Village were assessed separately.

Cumulative Noise Impact

Table 7.10 summarises the cumulative noise effects of surrounding mines and related infrastructure. The percentage values in the parentheses indicate the proposal's contribution (in noise terms) at that location. The results are for prevailing weather conditions as described earlier and are therefore conservative. The critical night period was used as the period of assessment for cumulative noise impact.

It should be noted that based on the information provided in other EISs, Wambo and Ravensworth-Narama mines will cease operations in 2016 and 2007 respectively. However, the Ravensworth-Narama mine was presumed to operate until 2012 for assessment purposes. MTW is expected to operate throughout the length of the subject proposal. The predicted noise from these operations was therefore cumulatively assessed accordingly.

Table 7.10 Cumulative Night-Time L_{eq} Noise Levels at Assessment Locations

Location No	Location Name	Cumulative Noise Level (Proposal contribution), dB(A)							
		Mining Scenario							
		A	B2 Op1	B2 Op2	B2 Op3	C2 Op1	C2 Op2	C2 Op3	D
3	Elisnore	37 (32%)	37 (20%)	37 (21%)	37 (21%)	36 (20%)	37 (18%)	37 (19%)	35 (19%)
4	Muller	39 (41%)	39 (20%)	39 (20%)	39 (20%)	39 (13%)	39 (14%)	39 (15%)	33 (22%)
5	Bowman	**41 (78%)**	38 (63%)	**41 (74%)**	**42 (71%)**	38 (50%)	39 (58%)	40 (66%)	37 (69%)
7	Stapleton[1]	41 (69%)	39 (79%)	39 (80%)	39 (85%)	38 (79%)	38 (74%)	39 (64%)	39 (74%)
8	Holz (Oaklands)[2]	44 (32%)	42 (50%)	42 (54%)	42 (56%)	42 (50%)	42 (49%)	42 (50%)	42 (47%)
10	Moses (Wandewoi)[1]	40 (40%)	39 (25%)	39 (25%)	39 (26%)	39 (32%)	39 (32%)	39 (33%)	40 (22%)
13	Jerrys Plains Centre	33 (21%)	35 (10%)	35 (10%)	35 (11%)	35 (10%)	35 (11%)	35 (12%)	38 (3%)
16	Algie	40 (69%)	38 (40%)	**45 (93%)**	**45 (96%)**	38 (25%)	**42 (79%)**	**43 (68%)**	36 (17%)
17	Algie	40 (56%)	38 (40%)	40 (66%)	**41 (63%)**	38 (32%)	39 (50%)	40 (53%)	36 (33%)
19	Birralee Feeds Pty Ltd	36 (52%)	35 (40%)	35 (39%)	35 (41%)	34 (40%)	34 (39%)	34 (41%)	28 (100%)
24	Clifton &Edwards	39 (74%)	37 (50%)	**41 (75%)**	**41 (83%)**	36 (50%)	38 (68%)	39 (67%)	35 (65%)
31	Cooper	39 (40%)	39 (20%)	39 (20%)	39 (20%)	39 (13%)	39 (13%)	39 (14%)	33 (26%)
32	Algie (Curlewis)	**41 (72%)**	38 (50%)	**45 (88%)**	**45 (92%)**	38 (32%)	**42 (67%)**	**42 (77%)**	36 (28%)
34	Ernst	40 (48%)	38 (40%)	41 (64%)	41 (70%)	38 (25%)	39 (58%)	40 (54%)	36 (26%)
36	Garland	40 (39%)	39 (20%)	39 (23%)	39 (24%)	39 (13%)	39 (15%)	39 (15%)	33 (24%)
47	Moxey	**41 (59%)**	39 (50%)	40 (66%)	**41 (66%)**	39 (40%)	39 (49%)	40 (56%)	39 (54%)
61	Shearer	**41 (68%)**	39 (50%)	**41 (68%)**	**42 (66%)**	39 (40%)	39 (55%)	40 (63%)	38 (55%)

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. This residence is owned by a mining company other than CNA.

General:

- Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8 and 10.
- Bold numbers indicate exceedance of the DECC night time amenity goal of 40 dB(A) at private residences.

Applying a night time cumulative noise criterion equivalent to the DECC's night time amenity goal of 40 dB(A) $L_{eq,9hour}$ (applicable for a rural residence according to the INP), shows that all private residences not currently within a zone of affectation will be no more than 5 dB(A) above the DECC's amenity goal. The private residences which are currently in a zone of affectation are well above the amenity goal. As discussed earlier, the predictions above are based on a worst case $L_{eq,15minute}$ noise level from each operation. The data in *Table 7.10* includes a conservative 3 dB correction for the predicted worst case $L_{eq,15minute}$ and $L_{eq,9hour}$ noise level. This correction is due to the inherent downtime of plant over the 9 hour night-time period as compared with a worst case 15-minute noise emission level.

Private residences predicted to experience cumulative noise above the DECC criterion are Location No's 5, 16, 17, 24, 32, 47 and 61.

Residences in Warkworth Village are discussed in the following section.

Cumulative Noise Impact at Warkworth Village

For the assessment locations at Warkworth Village, the two main noise contributors are the proposal and Wambo Mine. All assessed locations are either within a zone of affectation or owned by other mines. The adverse winds affecting the proposal and the adverse winds affecting Wambo Mine will not be the same for these locations and hence three separate scenarios are assessed where the wind situations affecting both the proposal and Wambo Mine are similar. *Table 7.11* below shows all three wind scenarios.

Table 7.11 Wind Scenarios for Locations at Warkworth Village

Wind Scenario	Proposal	Wambo Mine
1	0 m/s	0 m/s
2	2.1 m/s at 225 degrees	2m/s at 270 degrees with a temperature inversion of 3 degrees C/m
3	2.7 m/s at 135 degrees	3m/s at 135 degrees

Table 7.12 provides the results for these three modelling scenarios. From the results, it can be seen that the proposal will be the sole contributor of noise to these locations only for Scenario D when the Wambo Mine is expected to have ceased operation.

Wind scenario 1 shows that in the absence of wind, Wambo Mine is the main contributor of noise at Location No's 23, 33 and 45.

For wind scenario 2, the proposal's contribution is diminished at Warkworth Village as expected due to westerly winds. Wambo remains the main noise contributor in all scenarios prior to Scenario D.

For wind scenario 3, the proposal is predicted to be a significant noise contributor at Location No. 38 only. It is worth noting again that the residences which are in Warkworth Village are within the Wambo Mine affectation zone as documented in Wambo's consent or owned by Wambo.

Table 7.12 Cumulative Night-time L_{eq} Noise Levels at Warkworth Village, dB(A)

	Location				
	23[1]	33[2]	38[1]	43[2]	45[1]
Scenario	**Hawkes (Springwood)**	**Haynes**	**Henderson**	**Kannar**	**Kelly**
			Wind Scenario 1 (Calm)		
A	46 (0%)	49 (1%)	37 (11%)	46 (2%)	50 (2%)
B2 Op1	47 (23%)	50 (30%)	47 (79%)	50 (56%)	51 (26%)
B2 Op2	46 (10%)	50 (30%)	45 (78%)	50 (63%)	51 (27%)
B2 Op3	46 (11%)	51 (27%)	45 (92%)	50 (69%)	51 (29%)
C2 Op1	47 (25%)	50 (32%)	48 (85%)	49 (51%)	51 (15%)
C2 Op2	46 (12%)	50 (33%)	46 (96%)	49 (60%)	51 (15%)
C2 Op3	47 (11%)	51 (30%)	47 (85%)	50 (54%)	51 (17%)
D	19 (100%)	19 (100%)	16 (100%)	20 (100%)	23 (100%)
			Wind Scenario 2 (Westerly)		
A	53 (0%)	54 (0%)	48 (1%)	50 (0%)	54 (0%)
B2 Op1	53 (0%)	54 (0%)	47 (4%)	50 (1%)	53 (0%)
B2 Op2	53 (0%)	54 (1%)	47 (4%)	50 (2%)	53 (1%)
B2 Op3	53 (0%)	54 (1%)	47 (4%)	50 (4%)	53 (1%)
C2 Op1	53 (0%)	54 (0%)	47 (7%)	50 (2%)	53 (0%)
C2 Op2	53 (0%)	54 (1%)	47 (7%)	50 (3%)	53 (1%)
C2 Op3	53 (0%)	54 (1%)	47 (7%)	50 (4%)	53 (1%)
D	10 (100%)	13 (100%)	13 (100%)	14 (100%)	14 (100%)
			Wind Scenario 3 (South Easterly)		
A	42 (0%)	50 (0%)	35 (7%)	50 (0%)	54 (0%)
B2 Op1	42 (2%)	50 (1%)	38 (56%)	50 (2%)	54 (0%)
B2 Op2	42 (1%)	50 (1%)	38 (57%)	50 (3%)	54 (0%)
B2 Op3	42 (1%)	50 (2%)	38 (59%)	50 (4%)	54 (1%)
C2 Op1	42 (11%)	50 (10%)	41 (74%)	51 (16%)	54 (3%)
C2 Op2	42 (3%)	50 (11%)	41 (69%)	51 (18%)	54 (3%)
C2 Op3	42 (5%)	51 (11%)	41 (72%)	51 (20%)	54 (4%)
D	10 (100%)	12 (100%)	11 (100%)	13 (100%)	14 (100%)

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- The proposal's contribution to total received noise levels is shown in brackets as a percentage %.
- The results for the proposal scenario include the mitigation described earlier.

7.4.7 Other Noise Emissions

Other noise emissions include:

- construction activities relating to the proposal;
- road traffic noise resulting from additional personnel; and
- main rail line noise.

These emissions are detailed in *Sections 5.7.1, 5.8.4* and *5.8.5* of *Annex H* respectively. It was concluded that significant noise impacts will not arise from the above activities.

7.4.8 Relocation / Reconfiguration of the Hunter Valley Gliding Club

A description of the HVCG and its proposed relocation/ reconfiguration has been provided in *Chapter 5*. The potential noise impact associated with the proposed relocation is presented in the following section, based on a maximum of 30 daily flights. It should be noted that on average, less than 20 launches take place and the L_{max} level of 80 dB(A) would be applicable. The more stringent criteria of 75 dB(A) is used for assessment purposes here.

Criteria

Noise criteria applicable to aircraft noise associated with the HVGC are obtained from the Australian Standard AS2021 – 2000 Appendix D *Method for Determining Building Site Acceptability for Light General Aviation Aerodromes Without ANEF Charts*. The criteria are stated in *Table 7.13* below.

Table 7.13 Recommended Aircraft Noise Levels from AS2021

Building Site	Aircraft noise level expected at building site, dB(A) L_{max}					
	20 or less flights per day			Greater than 20 flights per day		
	Acceptable	Conditional	Unacceptable	Acceptable	Conditional	Unacceptable
Houses, home units, flat, caravan parks	<80	80 to 90	>90	<75	75 to 85	>85
Hotels, motels, hostel	<85	85 to 95	>95	<80	80 to 90	>90
Schools, University	<80	80 to 90	>90	<75	75 to 85	>85
Hospitals, nursing homes	<80	80 t0 90	>90	<75	75 to 85	>85
Public building	<85	85 to 95	>95	<80	80 to 90	>90
Commercial building	<90	90 to 100	>100	<80	80 to 90	>90
Light industrial	<95	95 to 105	>105	<90	90 to 100	>100
Heavy Industrial	No limit	No limit	No Limit	No Limit	No Limit	No Limit

- The number of aircraft operations is the estimated average number of flights per day over the site. Each night time flight between the hours of 1900 and 0700 is to count as four operations.

From the above table, a L_{max} level of up to 75 dB(A) is acceptable for houses during the worst case scenario of there being 30 launches during the summer period.

Results

The results from recorded measurements are presented in *Table 7.14*.

Table 7.14 Noise Measurements under Flight Path of Tug Aircraft on 17 June, 2006

Time	Location			Noise Level,
	GPS_x	GPS_y	Description	$L_{ASmax\ dB(A)}$
13.09	0315170	6396843	End of eastern end of runway; Aircraft 150 m away.	71.1
13.12	0315170	6396843	End of eastern end of runway; Aircraft 20 m away.	74.5
13:15	0315170	6396843	End of eastern end of runway; Aircraft directly above.	61.6
13.28	0315194	6396831	30 m east of eastern end of runway; Aircraft directly above.	75.5
13.28	0315356	6396803	150 m east of eastern end of runway; Aircraft 50 m away.	76.0
13.32	0315194	6396831	30 m east of eastern end of runway; Aircraft directly above.	59.7
13.33	0315356	6396803	150 m east of eastern end of runway.	55.7
13.50	0315318	6395741	100 m east of eastern end of runway; Aircraft 50 m away.	68.9
13.51	0315309	6396750	100 m east of eastern end of runway; Aircraft 150 m away.	71.1
13.53	0315309	6396750	100 m east of eastern end of runway; Aircraft 300 m away.	63.4

- GPS co-ordinates used the MGA56 datum.

The measured levels comply with the criterion of 75 dB(A) in all but two cases and marginally exceed this criterion at those two instances. It should be noted that the closest residences are beyond the flight path of the Tug aircraft and noise levels at these residences are unlikely to exceed the levels measured above.

In addition to evaluating noise levels under the flight path, measurements were undertaken at the HVGC strip to evaluate take off and landing noise associated with the Tug aircraft. The location of these measurements was at 50 m from the centre of the runway which is the main take-off and landing point and hence they represent the maximum noise levels experienced at the HVGC. The results are presented in *Table 7.15*.

Table 7.15 Noise Measurements at Hunter Valley Gliding Club Airstrip on 17 June, 2006

Time	Event	Noise Level, $L_{ASmax\ dB(A)}$
12.54	Take-off	84.9
13:03	Landing(Fly-by during landing)	54.5
13:06	Take-off	84.3
13:09	Landing(Fly-by during landing)	50.3
13:12	Take-off	82.6
13:13	Fly-by south-east of eastern end of runway	58.6
13:14	Fly-by south of hangar	65.6

- All the above measurements were conducted at GPS co-ordinates (0313715, 6397240) in the MGA56 datum.

7.4.9 Blast Noise and Vibration

The proposal includes three mining areas where blasting will occur. These are the Cheshunt, Riverview and South Lemington Pits.

As discussed, HVO South is located in a highly sensitive environment with both private and commercial near neighbours. The closest and therefore potentially most affected residence to the proposed blast locations is Location No. 7 (Stapleton), which is approximately 1.8 km away from current and proposed blasts. United Colliery located directly south of Riverview Pit is the closest commercial development.

The blast design is actively managed by the operation and corresponding airblast overpressure and ground vibration is minimised. HVO South's existing blast management procedures will be used to ensure appropriate charge masses are used for blasting. Charge masses (or maximum instantaneous charge, MIC) are presented in *Table 7.16*. These were derived from 95% formulae in Blastronics Pty Limited publication for monitoring data collected at similar mines in the area.

Table 7.16 Recommended Blast Charge Mass

Blast to Location Distance, m	MIC_{8ms} to Satisfy ANZECC 95% Overpressure Limit of 115 dB(Lin), kg	MIC_{8ms} to Satisfy ANZECC 95% Ground Vibration Limit of 5 mm/s (ppv), kg
1,500	163	745
2,000	386	1,324
2,500	753	2,069
3,000	1,302	2,980
4,000	3,088	5,299
5,000	6,031	8,279
6,000	10,422	11,922

- These results are derived from equations contained in the *Drill and Blast Study, Mount Pleasant* prepared by Blastronics Pty Limited for CNA in September 1994.
- In general, blast overpressure considerations limit MIC.

The highest MIC that is recommended to be used at HVO South is 386 kg when the proximity of the assessment locations is less than 2 km.

St Phillip's Church in Warkworth is located approximately 1.8 km from South Lemington Pit 1, and 2 km to 4 km from Riverview Pit as mining progresses. The MIC masses for blasts within the proximity of the St Phillip's Church will be managed to minimise impacts on the building.

Blasting will occur between the hours of 7.00 am to 6.00 pm. This will provide the mine with flexibility to blast during meteorological conditions that will result in the least impact on its neighbours. Typically, blasting operations will be conducted more than once a day. All blasts will be monitored for overpressure noise and ground vibration at several locations.

It is recommended that when a temperature inversion is known to exist, blasting should be avoided if practical. This does not apply where the effects of blasting are not perceived at noise sensitive locations. In addition to the above criteria, general best practice procedures can be used to effectively minimise noise impacts (see *Section 7* of *Annex H*).

7.4.10 Noise and Dust Interactions

Wind conditions influence dust and noise impacts differently. Dust impacts are influenced by all wind conditions with a prominent north west to south east axis in the area. Noise impacts are strongly influenced by the combination of wind direction and the requirements of the INP. This means that the primary winds are easterly through south westerly.

The Maison Dieu community happens to be susceptible to both impacts.

The noise and air quality impact assessments predict that some residences in the Maison Dieu area would experience some exceedances of the DECC assessment criteria due to emissions from HVO South alone. For noise, this occurs during mining in South Lemington Pit 1 at night time and if relatively light winds from the south west prevail. For air quality, the impact occurs for all assessed mining scenarios when measured on a 24-hour basis with an exceedance of the 50 $\mu g/m^3$ goal predicted.

These will need to be managed via real-time monitoring and noise and air quality management systems. For noise this may mean cessation of night mining in South Lemington Pit 1 during south westerly winds as determined by monitoring.

For air quality this would involve continuous monitoring of PM_{10} concentrations and calculation of the rolling 24-hour PM_{10} concentration. Rolling 24-hour PM_{10} concentrations that approached 50 ug/m^3 would trigger a review of mining operations and meteorological conditions to determine the contributing activities. If these are identified as mining operations then the activities responsible for the elevated concentrations would need to be suspended or redeployed, or otherwise modified.

7.5 MANAGEMENT MEASURES

The management of noise and blast overpressure and vibration generated by HVO activities is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle.

The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

7.5.1 Noise

The key objectives for noise management are to:

- manage the operations in a way that minimises noise impacts to the environment, neighbours and structures, and limits interference to mining production;
- review monitoring results against model predictions and modify activities to ensure compliance with the relevant criteria; and
- keep the local community and regulators informed of activities where required and to respond quickly and effectively to issues and complaints.

The technical report (*Annex H*) identified a number of control measures to minimise the potential noise impacts resulting from the proposal. These measures have been considered in the context of the existing HVO activities and the CNA EMS. Many of these measures are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

The following controls will occur under standard conditions (24 hour mining operations; construction operations during daylight hours):

- plant, machinery and haul roads will be maintained in good condition according to manufacturer's specification and all repairs conducted promptly to ensure that equipment remains in a sound operating condition;
- sound power level testing of equipment will be undertaken annually in accordance with the CNA EMS Noise Procedure
- activities that generate complaints will be monitored and modified if monitoring results confirm that DECC noise criteria are being exceeded;
- environmental inductions will ensure that relevant employees are aware of potential impacts on sensitive locations from equipment and its operation;
- noise emission levels will be considered where relevant in awarding contracts and purchasing new equipment;
- attended and unattended monitoring of noise at representative sites as detailed in the Noise Monitoring Programme, with quarterly attended monitoring undertaken by a qualified acoustic consultant to supplement site noise data;
- monitoring using both directional and non-directional monitors with frequency filtering capabilities to determine the noise source;
- maintenance of monitoring systems consistent with regulatory requirements, best practice analytical techniques and published standards;
- installation, operation and calibration of monitors in accordance with relevant Australia Standards;

- maintenance of all monitoring records in CNA's environmental monitoring database; and

- noise monitoring results for representative sites as listed in the Noise Monitoring Programme to be included in the AEMR.

If it is determined that mine operations during adverse meteorological conditions may result in exceedance of noise criteria at sensitive locations, the following options will be considered:

- review of the elevation of mining and dumping and, where possible, relocate equipment to lower elevations, until more suitable conditions return;

- amended working hours;

- temporary cessation of work within an area or from a particularly noisy piece of equipment; and

- construction of a temporary or long-term noise mitigation bund to shield the mining operation.

In the event of community concern additional noise monitoring may also be undertaken at sensitive sites.

Commitments Specific to the Proposal

In addition to the mitigation measures presented above, equipment operation within South Lemington Pit 1 and associated truck movements will cease during night time operations if monitoring identifies that unacceptable noise impacts will result from south westerly winds (occurring at or above 2.1 m/s). At lower wind speeds, real-time noise and/or weather monitoring will be used to guide modifications to operations as required.

The project's statement of commitments will adopt the derived noise limits or results of noise modelling (mitigated) as detailed in this report.

7.5.2 Blasting and Vibration

The key objectives for blast and vibration management are to:

- manage the operations in a way that minimises blast and vibration impacts to environment, neighbours and structures, and limits interference to mining production;

- review blast design and monitoring results to ensure limits to ensure compliance with the relevant criteria; and

- keep the local community and regulators informed of activities where required and to respond quickly and effectively to issues and complaints.

The technical report (*Annex H*) identified a number of control measures to minimise the potential blast and vibration impacts resulting from the proposal. These measures have been considered in the context of the existing HVO activities and the CNA EMS. Many of these measures are already in place as part of existing controls for the HVO

South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

Regular controls for blast and vibration mitigation include:

- notification procedure for nearby residents unless otherwise agreed;
- assessment of real-time weather conditions prior to blasting and no blasting when unfavourable weather conditions are present;
- blasting to occur generally within the hours of 7am to 6pm Monday to Saturday, and no blasting on Sundays or public holidays unless otherwise agreed with DECC;
- ensuring good blast design and evacuating the area within 300 to 500 m of a blast to ensure safety from fly rock;
- Road Closure Management Plan for public roads;
- completion of a GDP prior to blasting activities to avoid damage to subsurface utilities;
- a programme of regular monitoring, including at sensitive buildings where identified;
- investigation of any blasts if monitoring results confirm that DECC criteria are being exceeded;
- maintenance of monitoring systems consistent with regulatory requirements, best practice analytical techniques and published standards;
- installation, operation and calibration of monitors in accordance with relevant Australian Standards;
- review of all monitoring results in CNA's environmental monitoring database; and
- monitoring results for representative sites as listed in the Blast Monitoring Programme to be included in the AEMR.

Commitments Specific to the Proposal

In addition to the mitigation measures presented above, blasts will be designed to minimise impacts on neighbouring mine ventilation structures and minimise the potential for fracture development along pit walls to assist with pit wall stability:

- blast vibration will be managed through design and modelling;
- bench heights will be managed to not significantly exceed 15 m;
- no throw blasts will take place adjacent to final walls;
- high density explosives will be toe loaded;
- blast monitoring and post blast analysis will be undertaken where required;

- presplit blasting will be implemented on final walls where this indicates improved wall conditions; and

- visual monitoring by way of regular highwall and pit inspections will be undertaken.

7.6 CONCLUSIONS

This study considers the potential noise impacts of the proposal, which incorporates all of HVO South as described in *Chapter 5*. The acoustic assessment includes modelling of all major mining equipment at representative operational locations. The study had the following features:

- existing mine noise verification was undertaken by comparing attended quarterly measured data and ENM calculations;

- extensive site validation of the ENM software at Cheshunt, Riverview and South Lemington Pits;

- almost four years of site-specific hourly meteorological data analysed to describe prevailing winds in accordance with the DECC's INP;

- source sound power levels for all equipment measured under operational conditions at mines;

- the noise modelling addressed the DECC's INP with regard to adverse weather conditions; and

- predicted mine noise is based on predicted worst case operating scenarios and hence results in an 'outer-envelope' impact area.

The noise modelling has shown that under calm weather conditions all private residential properties not currently located within a zone of affectation experience noise levels below the operational noise limits. The noise management measure of selective equipment operation in South Lemington Pit 1 during south westerly winds at night occurring at or above 2.1 m/s will ensure all residences are below the likely acquisition criteria.

For private residences not in a zone of affectation, during INP weather conditions, exceedances of the operational limits are predicted at Maison Dieu Location No's 5, 16, 17, 24, 32, 34, 47 and 61. Exceedances are also predicted to occur at Location No. 36, located towards Jerrys Plains. With stipulated mitigation strategies applied, the likely acquisition limit will not be exceeded at any location not currently within a zone of affectation. At most locations, predicted future HVO South mining noise levels are marginally below or marginally above existing noise levels, depending on the operating scenario.

CNA's environmental plans and procedures, which include ongoing noise monitoring, will be used to assess the performance of the mining operations against the predicted noise levels.

Blast design will incorporate control on the MIC as described in this assessment and implementation of CNA's environmental plans and procedures will ensure that acceptable limits are maintained. This will include monitoring of all HVO blasts.

The cumulative industrial noise assessment demonstrates that the proposal is a significant contributor to noise at Maison Dieu residences during westerly winds as expected, although is not the sole industrial source at these locations. For noise at Warkworth Village the proposal becomes significant at one of five of the nominated residences under adverse easterly winds. However, noise levels are only marginally above INP cumulative amenity targets under such winds. Further, these residences are either owned or in affectation zones of other mines.

The relocation of the HVGC is expected to result in a negligible change in noise for residences.

8 *AIR QUALITY*

This chapter outlines the methodology adopted for the air quality assessment, describes the existing air quality environment and presents potential impacts resulting from the proposal. It includes management and monitoring measures that will be implemented to mitigate potential impacts. This chapter is based on the air quality report prepared by Holmes Air Sciences which is provided in full as Annex I.

8.1 *INTRODUCTION*

This study assesses the potential for emissions of particulate matter to give rise to concentrations or deposition rates above the air quality assessment criteria set by the NSW DECC from all of the proposed operations at HVO South (as presented in *Chapter 5)*. The proposal includes the replacement of existing consents with one Project Approval for HVO South. This will provide the opportunity for improved operational management and improved environmental control over air emissions. It will be a significant and positive step toward air emissions management, which also provides operational flexibility.

The proposal will result in the liberation of particulate matter in the form of fugitive emissions arising from handling of soil, overburden, interburden and coal, from the combustion of diesel fuel in mining equipment and from the use of explosives. In addition, there will be emissions of gases including carbon monoxide, nitrogen oxides and sulphur dioxide from diesel powered equipment and from blasting. The assessment of greenhouse gases is dealt with in *Chapter 17* and *Annex O.*

There is no history of spontaneous combustion at HVO. The potential for a spontaneous combustion event resulting from the proposal is negligible given the nature of the coal seams being mined. However, if an event did take place, management procedures outlined in the CNA EMS Spontaneous Combustion procedure would be implemented.

8.2 *METHODOLOGY*

8.2.1 *Overview*

As with the noise and vibration assessment, within this period, a number of worst case scenarios have been selected for assessment from mine plans provided by CNA. These were then assessed to identify those areas that involved mining closest to dust sensitive locations bearing in mind that the prevailing winds would carry dust mainly to the south east or north west of the mining areas. Scenarios were selected which would be expected to give rise to maximum effects in the Maison Dieu area and the Warkworth Village area. Residences to the north west were too far away to be significantly affected by emissions from the areas covered by this assessment.

Additional conservativeness has been introduced into the assessment to enable neighbouring mines to assess cumulative impacts despite the proposed flexible approach to mining. Emissions from neighbouring mines were taken from information published in EISs where it was assumed that emissions from neighbouring mines would be those that applied for the years closest to the years being modelled for HVO South.

The general locations of the future sources of dust over the assessment period are shown in *Figure 8.1* which also shows the locations of the dust sensitive areas. The prevailing winds are discussed in *Section 8.3.2.* North westerly winds are most common in winter and south easterlies in summer. This means that most dust will be transported to the south east or north west of the sources of dust. This differs from the assessable winds used for the noise and vibration assessment which are from an easterly through to south westerly wind direction. Noise and dust interactions are discussed in *Section 7.4.10*.

The relocation, reconfiguration or upgrade of the HVGC, will involve relatively minor earthworks compared with the mining operations and no special air quality assessment is required for these works.

The mine development plans provide more flexibility in the selection of equipment used. For example, it may be possible to employ up to two draglines and two large shovels or one dragline and three large shovels. The dust generation from these differing combinations of equipment have been estimated, for example, the mass of dust generated by a dragline to move 1 Mbcm is 32,000 kg of total suspended particulate matter (TSP) compared to 39,600 kg of TSP for a shovel to load a fleet of 240 t trucks to haul the material over a 3 km return distance (calculations and equations can be found in *Annex I*).

Based on these calculations and these conditions, the difference in dust generation between dragline use and truck and shovel fleet use is small. Variables include distance travelled by the haul trucks which increases dust generation with increasing distance and the size of the haul trucks used as the larger the truck, the fewer trips required. A dragline is considered to be a well defined source of dust while truck and shovel operations are a more diffuse source with most of the dust generated over the haul route. It should also be noted that the 240 t trucks may be replaced by larger, ultra-class trucks, and so there would be less vehicle kilometres travelled than in the example. Modelling was undertaken assuming 240 t trucks. This represents a worst-case assumption. These diffuse emissions result in a lower maximum short-term concentration at any particular location. Truck and shovel operations are also more flexible as it is usually possible to vary the emplacement area as meteorological conditions change, and air quality at a particular location can be protected without shutting down the operation. By contrast a dragline operation cannot be relocated at short notice so it is not as easy to manage in unfavourable weather. However, if the dragline has sufficient capacity to allow its operation to be suspended during unfavourable weather, then it is possible to manage air quality using shutdowns when adverse winds occur or when measured dust concentrations occur. Both dragline and truck and shovel operations were modelled (*Table 8.2*).

For the purpose of this study, it has been assumed that the dragline and truck and shovel options are indistinguishable in the air quality impacts that they create. To take account of the matters discussed above, CNA will continue to implement current procedures that allow for the suspension of dragline operations if emissions are causing adverse impacts in an area that is sensitive to dust. In addition, existing management measures were reviewed to identify additional measures required as a result of this proposal.

This assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. Therefore the existing and potential environmental impacts are already approved and management measures have been developed and implemented. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. The assessment results are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been approved.

8.2.2 Assessment Locations

Table 8.1 identifies the four groups of assessment locations that are potentially impacted by dust and for which detailed assessments have been undertaken. The locations are depicted in *Figure 8.1* and are consistent with those adopted for the noise and vibration assessment.

Table 8.1 Surrounding Locations used for Modelling Purposes

Location No.	Location and Name	MGA56 Coordinates Easting	Northing
Locations at Maison Dieu (East)			
5	Bowman	317887	6399172
16	Algie	318128	6397347
17	Algie	318352	6398192
24	Clifton and Edwards	318153	6398497
32	Algie (Curlewis)	317982	6397802
34	Ernst	318530	6397994
47	Moxey	317979	6399821
61	Shearer	318014	6399408
Locations at Warkworth (South)			
23	Hawkes (Springwood)	313989	6392994
33	Edward and Haynes	314699	6394353
38	Henderson	315584	6393898
43	Kannar	314648	6394680
45	Kelly	314149	6394563
Locations west along Jerrys Plains Road (West)			
3	Elisnore	305416	6401053
4	Muller	305950	6399615
13	Jerrys Plains Centre	303535	6402851
19	Birralee Feeds Pty Ltd	305655	6400600
31	Cooper (Kilburnie)	305953	6399990
36	Garland	306139	6399895
Isolated Locations			
7	Stapleton (Cheshunt) – North East	315919	6403004
8	Holz (Oaklands) - North	313711	6403979
10	Moses (Wandewoi) – North West	306970	6402069

Location No. is consistent with the HVO West Pit consent (DA 450-10-2003) and *Table 7.1* in *Chapter 7*.

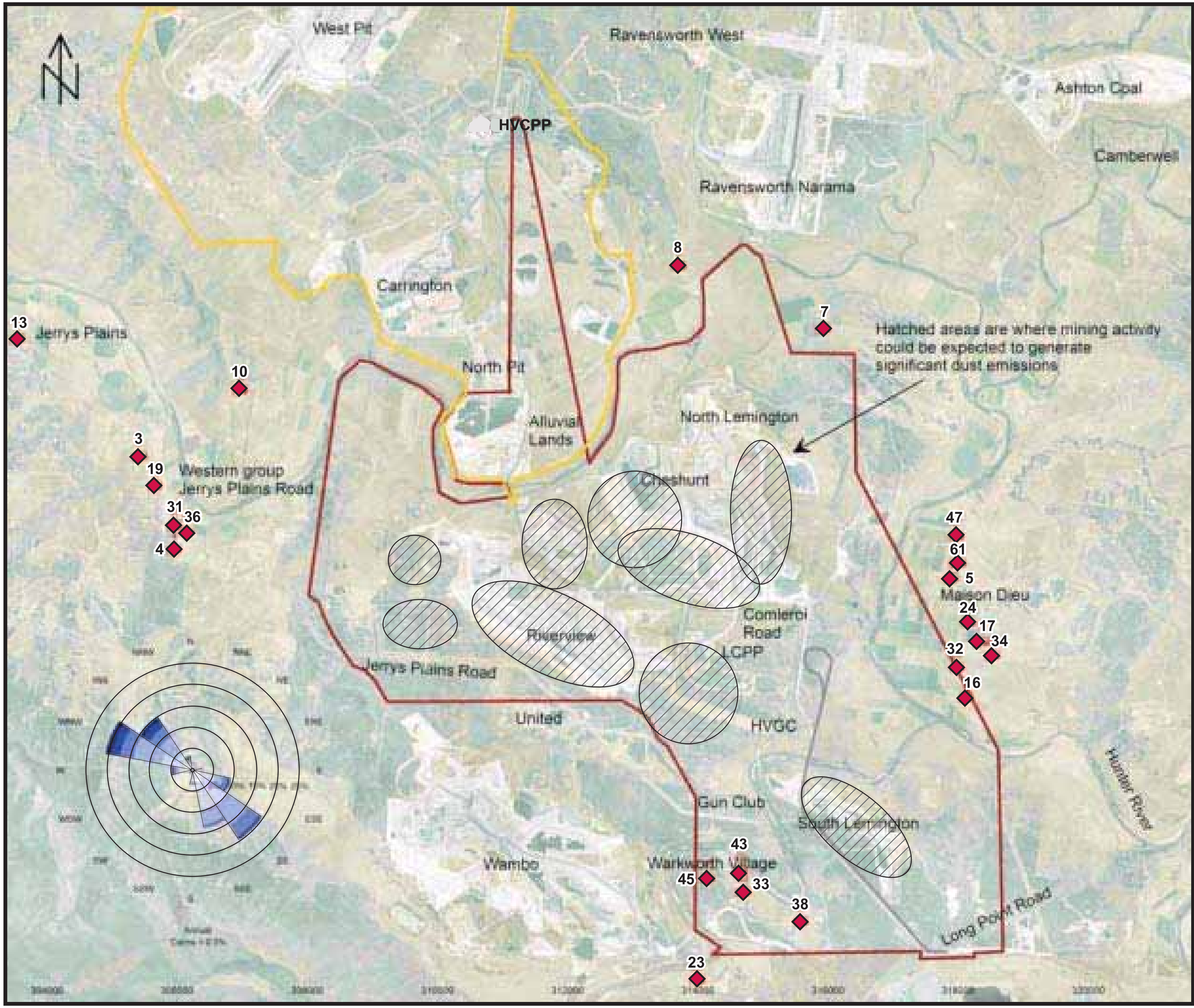
8.2.3 Mining Scenarios

Three scenarios have been selected to illustrate the worst case impacts in each of these areas. In addition, 2006 has also been modelled so that predicted concentrations can be compared with measured values. This provides a reference point that enables the performance of the model to be assessed. The scenarios are described in *Table 8.2*.

Table 8.2 Mining Scenarios

Pit	ROM coal production (Mt)	OB[1] truck and shovel (prime) (Mbcm)	OB truck and shovel (rehandle) (Mbcm)	OB dragline (prime) (Mbcm)	OB dragline (rehandle) (Mbcm)	OB Blasting (Mbcm)
Existing Situation						
Cheshunt	3.1	18.6	0.3	0	0	0
Riverview	2.7	7.9	0	10.4	5.9	0.4
Mine Plan A – approximately 2010						
Cheshunt	4.9	22.0	0.1	0	0	0
Riverview (including South Lemington Pit 2)	9.6	7.5	0.03	32.0	7.7	1.5
Mine Plan B1 – approximately 2014						
Cheshunt	10.6	42.5	0.8	0	0	0
Riverview	4.2	0	0.07	32.0	7.7	1.5
South Lemington Pit 1	0.05	0.1	0.01	0	0	0
Mine Plan C1 - approximately 2019						
Cheshunt	10.6	42.5	0.7	0	0	0

1. OB = Overburden



Legend

- Current Development Consent Boundary (HVO North Only)
- Project Application Area
- Assessment Locations

Figure 8.1

Project Application Area, Main Infrastructure and Dust Sensitive Locations

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coast Project
Drawing No:	0047820_EAR_G_03_R1
Date:	22/01/2008 — Drawing size: A4
Drawn by:	JS — Reviewed by: -
Source:	-
Scale:	Not to Scale

N

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ERM

8.2.4 *Air Quality Assessment Criteria*

In its guidelines, the DECC (DEC, 2005) specifies air quality assessment criteria relevant for mining. Three categories of particulate matter need to be considered. These are TSP, PM_{10} and deposited dust (insoluble solids)

The assessment criteria for these are summarised in *Table 8.3.* Where relevant, these criteria have been made consistent with the National Environment Protection Measures (NEPM) for Ambient Air Quality (referred to as the Ambient Air-NEPMs (see NEPC, 1998)). However, the DECC's criteria include averaging periods which are not included in the Air-NEPMs and references to other measures of air quality, namely dust deposition and TSP, which are also not part of the Air-NEPMs.

Table 8.3 DECC Air Quality Assessment Criteria

Pollutant	Averaging period	Concentration	
NSW DECC Impact assessment criteria for pollutants (for use in modelling)			
PM_{10}	24-hour	50* µg/m^3	
	Annual	30 µg/m^3	
NSW DECC amenity based criteria for dust concentrations - TSP			
TSP	Annual	90 µg/m^3	
NSW DECC amenity based criteria for dust fallout – Deposited Dust			
		Maximum increase in deposited dust level	**Maximum total deposited dust level**
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

- For mining projects, which are committed to the application of best practice controls, the 50 microgram/cubic metre (µg/m^3) is often applied as an incremental goal applicable to assessing the effects of emissions from the project alone. This goal would normally be provided in the conditions of consent.
- PM_{10} - Particulate matter with equivalent aerodynamic diameter of 10 micron millionth of a metre (µm)

The National Environmental Protection Council (NEPC) has published an advisory NEPM for $PM_{2.5}$ (NEPC, 2002). At this stage, the proposed advisory $PM_{2.5}$ standard is not part of the NSW DECC assessment criteria and for this reason is not considered further in the assessment.

The suite of ambient air quality criteria used in the assessment is comprehensive and would be expected to protect against harmful effects of emissions from the proposal including health and nuisance effects.

8.2.5 *Approach to Modelling*

The approach taken in this assessment follows as closely as possible the approaches suggested by the new DECC guidelines for the assessment of air pollution sources using dispersion models (DEC, 2005). The model used was a modified version of the US EPA ISC model which is fully described in the user manual and the accompanying technical description (US EPA, 1995A and 1995B). The modelling has been based on the use of three particle-size categories (0 to 2.5 µm - referred to as $PM_{2.5}$ (fine particulate matter FP), 2.5 to 10 µm - referred to as CM (coarse matter) and 10 to 30 µm - referred to as the Rest). Emission rates of TSP have been calculated using emission factors derived from US EPA (1985) and NERDDC (1988) work (see *Appendix B of Annex I*).

A description of the approach to modelling together with a discussion of the prediction of 24-hour PM_{10} is provided in *Section 8.2* of *Annex I.*

8.3 EXISTING ENVIRONMENT

This section provides a description of the meteorological and air quality monitoring programmes operated by CNA across HVO and provides a review of the data. The main objective of the review is to establish existing air quality conditions and to identify the best source of meteorological data to be used in the assessment. In a greenfields development, or a wholly new development, the monitoring data would provide an indication of baseline conditions onto which emissions from the proposal would be added.

With respect to air quality emissions, the current proposal is essentially a continuation of existing operations and so the assessment is modified accordingly. This is because the existing operations, which will be continued as part of the proposed operations, are already contributing to the current background. However, the review of air quality monitoring data is useful in showing the extent to which the existing operations are affecting air quality and indicating the accuracy of the modelling methodology.

8.3.1 Description of Monitoring Programmes

Meteorological Monitoring

Meteorological data are collected at six locations, two of which are relevant for this study; the Cheshunt and Corporate Centre HVO stations. The locations of the two stations and the parameters recorded are summarised in *Table 2 of Annex I.* Climatic data from the Bureau of Meteorology's monitoring station at Jerrys Plains which has been in operation since 1884 has also been used and includes rainfall, temperature and humidity among other parameters.

Air Quality Monitoring

The CNA air quality network has evolved over time. The data used for the air quality assessment was sourced from existing and historic monitoring sites. The existing sites for HVO include 40 dust deposition gauges, 14 High Volume Air Samplers (HVAS) and six real-time monitors.

8.3.2 Review of Meteorological Data

Wind Speed and Wind Direction

Wind speed and direction data were available from both the Corporate Centre HVO station and the Cheshunt Meteorological station. While the wind speeds at the Cheshunt site were slightly higher and have a more north-south orientation than the HVO South data, both data sets show a pattern of seasonal winds that is typical of central regions of the Hunter Valley. On an annual basis, winds are generally aligned along a northwest-southeast axis. In summer, winds are generally from the southeast and in winter from the northwest. A detailed description of the data available from the two stations is provided in *Section 6.3* of *Annex I.*

Appendix B of Annex I summarises the wind speed, wind direction and stability class statistics of the HVO meteorological data set.

Temperature and Humidity

Temperature and humidity data were obtained from the Bureau of Meteorology's weather station located at the Jerrys Plains Post Office and are representative of the local area. These data are summarised in *Table 3* of *Annex I* and shows that January is the warmest month, with a mean monthly maximum temperature of 31.8^{o}C. July is the coolest month experiencing a mean monthly minimum temperature of 3.7^{o}C. The annual average maximum and minimum temperatures experienced at Jerrys Plains are 25.2°C and 10.5°C respectively.

The annual average humidity reading collected at 9 am from the Jerrys Plains site is 69%, and at 3 pm the annual average is 47%. The month with the highest humidity on average is June with a 9 am average of 79%, and the lowest is November with a 3 pm average of 41%.

Rainfall and Evaporation

The mean annual rainfall at Jerrys Plains is 638.8 mm over an average of 86 rain days. January is the wettest month with a mean monthly rainfall of 78.2 mm over 7.9 rain days, while August is the month with lowest average rainfall, with a monthly mean of 36.6 mm over seven rain days.

Evaporation data are available from the *Climatic Atlas of Australia* (Bureau of Meteorology, 1988). Evaporation rates for Singleton for January, April, July and October are approximately 225, 125, 75, and 175 mm respectively. Thus, evaporation is well above the expected rainfall amount for all the months of the year.

Mixing Height and Stability Class

Stability class is used by dispersion models to determine the rate at which the plume grows by the process of turbulent mixing. Information on hourly mixing height and stability class are required as input to the dispersion model and are addressed further in *Section 6.2.4* of *Annex I*.

8.3.3 Review of Air Quality Monitoring Data

This section provides a review of the TSP, PM_{10} and dust (insoluble solids) deposition data.

TSP and PM_{10}

Twenty-four hour average concentrations of TSP or PM_{10} or both, have been measured every sixth day over various periods at the ten representative sites shown in *Figure 4* and described in *Section 6.3.1* of *Annex I*. The results of the TSP monitoring are summarised in *Table 5* and shown in *Figure 8* of *Annex I*.

Figure 8.1 shows the location of the main dust generating areas over the life of the project and the locations of the dust sensitive areas that will potentially be affected by emissions from the proposed mining. The current results for the three clusters of residences and four isolated rural residences are detailed below. As discussed above, the observations include the effects of all existing sources of particulate matter.

Annual average concentrations have been derived from 2005 data, the most recent full year of monitoring.

The following sections provide a brief summary of TSP, PM_{10} and 24–hour PM_{10} values for the four areas of potential impact. A full description of the existing data including trends and explanations for outlying data points is provided in *Section 4* of *Annex I.* Generally, concentrations comply with DECC'c assessment criteria.

i. Maison Dieu area

Currently TSP and PM_{10} concentrations in the Maison Dieu area generally comply with the DECC's assessment criteria, but some exceedances of the 24-hour PM_{10} criterion have been measured in some years.

ii. Warkworth Village

Currently annual average TSP and PM_{10} concentrations in the Warkworth Village area comply with the DECC's assessment criteria, but some exceedances of the 24-hour PM_{10} criterion are measured in some years. It should also be noted that a 1.1 $\mu g/m^3$ increase in the annual average PM_{10} concentrations in the Warkworth Village area would cause the DECC's annual average PM_{10} assessment criterion of 30 $\mu g/m^3$ to be exceeded. That is, there is very little capacity for this part of the airshed to accept additional new emissions of PM_{10}.

iii. Western Group of Assessment Locations / Jerrys Plains Area

Currently annual average TSP and PM_{10} concentrations in the western area comply with the DECC's assessment criteria. Some exceedances of the 24-hour PM_{10} criterion would be expected from time to time especially when bushfire smoke is present, but no exceedances were measured in 2005.

iv. Others

Monitoring at the Stapleton site commenced on 10 January 2006 after relocation of the HV-TSP2 monitor from the Cheshunt (Barry) property, following purchase of the property by CNA. To date only 14 measurements are available from the Stapleton site. The average TSP concentration to date is 45.6 $\mu g/m^3$. Previous monitoring undertaken as part of the Ravensworth/Narama monitoring network indicates higher annual average concentrations (60.6 $\mu g/m^3$ in 2003 and 71.7 $\mu g/m^3$ in 2004). Thus, it is possible that the annual average will be higher once the monitoring programme has continued for a full year.

8.3.4 Deposition

The locations of relevant dust deposition gauges operated by CNA are shown in *Figure 4 of Annex I. Annex I* shows the annual average deposition levels at each gauge since 1998, or whenever the gauge in question was installed. Many of the gauges are located within the Project Application area close to locations where active mining is taking place. The data from these gauges can be used to show the rate at which dust deposition levels decrease with distance from actively mined areas, but is not relevant for determining the background level.

Section 6.3 of *Annex I* provides a detailed description of dust deposition levels across HVO South and surrounding residential areas. On the basis that dust deposition levels currently experienced in these residential areas includes dust from many of the activities that are proposed to be part of the continued mining, it has been taken as reasonable that these areas could accept an annual deposition level of 2 g/m^2/month (insoluble solids). This does not mean that deposition levels would increase by 2 g/m^2/month above current levels.

8.4 IMPACT ASSESSMENT

The modified version of the ISC model (ISCMOD) has been used, with estimated emissions for mine plan Scenarios A, B1 and B2 and meteorological data for 2002, to model the dispersion and deposition of emissions for these years.

The results show the estimated:

- maximum 24-hour PM_{10} concentrations;
- annual average PM_{10} concentrations;
- annual average TSP concentrations; and
- annual average dust (insoluble solids) deposition rates for each of the years or scenarios.

Twenty two assessment locations were considered representative of the most exposed residences surrounding the mine. These locations are shown in *Figure 8.1* and in *Figures 28* to *41 of Annex I*.

The scenarios selected for presentation are intended to illustrate the area affected by the mine over its lifetime. The significance of the predicted levels has been assessed by comparing the values with the DECC's assessment criteria. In each case, the predictions show the contribution that will be made by emissions from the HVO opencut mines. In the case of the predicted maximum 24-hour PM_{10} concentrations, the predicted levels have been compared with the DECC's 50 μg/m^3 24-hour PM_{10} assessment criterion. The prediction assumes mines employ best-practice dust controls, which include real-time management for mitigating short-term impacts. Similarly, DECC's annual average increment of 2 g/m^2/month for dust (insoluble solids) deposition may be interpreted as the limit that applies to the effect of the project by itself. All the other assessment criteria the predicted values due to the project must be combined with the estimated ambient concentrations due to all other sources of dust including other mines and other non-mining sources. For sources not explicitly included in the model, the annual average background PM_{10} concentrations have been taken to be 5 μg/m^3. For annual average TSP concentrations, the value has been taken to be 27 μg/m^3 and for annual average deposition (insoluble solids) the value has been taken to be 0.5 g/m^2/month.

Background dust levels would be expected to change as other mining projects or extensions are brought into production.

8.4.1 *Year 2006*

The predictions for 2006 are different from those presented for the other years in that there is monitoring data available to compare the predictions against. The predictions provide a useful benchmark for assessing the accuracy of the model. Rather than comparing the predictions against air quality at residences the predictions have been extracted for monitoring sites. The results of the modelling for 2006 are presented in *Table 10 of Annex I.*

The comparison of the maximum 24-hour PM_{10} appears to indicate reasonable agreement between predicted levels and measured levels. In five of the six cases where the 24-hour PM_{10} predictions could be compared with the maximum measured 24-hour PM_{10} concentration for the year, the model over-predicted the value. However, two issues should be taken into account. Firstly, measurements are made every sixth day and not continuously. This means that there is the potential to miss the worst case day in any given year and this could account for some of the conservativeness. Secondly, the predictions contain no allowance for the unpredictable background (eg effects of bushfires and dust storms), whereas the measurements do include these effects. Both of these factors should be noted when comparing the predictions with the measurements.

The predicted annual average PM_{10} concentrations (including a 5 $\mu g/m^3$ allowance to account for remote sources) compare well with the measured values and again, on balance, the model over predicts the annual average PM_{10} levels by a small margin. However, as noted earlier, annual average TSP concentrations are significantly under predicted, even when the background of 10 $\mu g/m^3$ is added to account for the annual average TSP levels that might apply if no mining took place in the Hunter Valley. This is possibly due to the fact that local sources such as dust from local roads used to access residences, stock movements, agricultural activity, and the like are not in the model and these may contribute significantly to TSP concentrations. To improve the agreement between the predicted annual average TSP concentrations and measured values the assumed annual average background level has been set at 27 $\mu g/m^3$ rather than 10 $\mu g/m^3$. Annual average TSP concentrations are not the critical factor in determining the areas of impact as the critical assessment criteria are the 24-hour PM_{10} and annual average PM_{10} concentrations.

8.4.2 *Mine Plan Scenario A (Approximately Year 2010)*

In the mine plan for Scenario A, mining will be occurring in the Cheshunt and Riverview Pits and South Lemington Pit 2.

Table 8.4 summarises the impacts at all assessment locations.

Table 8.4 Predicted Dust Generation for Scenario A

Location No	Max 24-hour PM_{10} conc. due to HVO South in isolation - $\mu g/m^3$	Annual average PM_{10} conc. due to HVO South in isolation- $\mu g/m^3$	Annual average TSP conc. due to HVO South in isolation - $\mu g/m^3$	Annual average dust (insoluble solids) deposition due to HVO South in isolation – g/m^2/month	Annual average PM_{10} conc. due to HVO South and other sources $\mu g/m^3$	Annual average TSP conc. due to HVO South and other sources - $\mu g/m^3$	Annual average dust (insoluble solids) deposition due to HVO South and other sources – g/m^2/month
3	34.8	3.6	4.4	0.1	22.4	51.2	1.3
4	25.2	2.7	3.2	0.1	23.7	52.6	1.4
5	**78.6**	9.8	12.5	0.8	27.2	58.5	2.3
7[1]	27.8	1.9	2.1	0.0	22.6	51.3	1.4
8[2]	24.2	5.0	5.6	0.1	27.3	56.7	1.6
10[1]	39.7	8.5	10.3	0.4	28.6	58.1	1.5
13	18.4	3.0	3.6	0.1	19.3	47.6	1.2
16	**80.7**	10.3	13.1	0.9	29.0	59.7	2.0
17	**70.8**	9.7	12.3	0.8	26.6	57.2	2.0
19	34.7	3.5	4.1	0.1	22.8	51.7	1.3
23[1]	22.3	2.3	2.8	0.1	39.5	74.2	2.8
24	**72.8**	9.9	12.7	0.8	26.7	57.6	2.1
31	29.8	3.1	3.6	0.1	23.5	52.4	1.4
32	**80.6**	10.9	13.9	0.9	28.8	59.7	2.1
33[2]	38.6	4.3	5.4	0.3	42.9	76.8	2.5
34	**68.9**	9.4	11.9	0.7	26.3	56.7	2.0
36	30.4	3.1	3.7	0.1	23.7	52.8	1.4
38[1]	35.9	4.3	5.4	0.3	50.7	85.5	2.8
43[2]	42.3	5.0	6.3	0.4	41.8	75.4	2.5
45[1]	38.7	4.3	5.3	0.3	41.6	75.8	2.5
47	**74.4**	7.6	9.4	0.5	25.2	56.1	2.1
61	**77.4**	8.8	11.1	0.6	26.3	57.3	2.2

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- No prediction is available for maximum 24-hour PM_{10} concentration due to HVO South and other sources.
- Bold numbers indicate exceedance of limits where applicable for private residences not currently within a zone of affectation or owned by mining companies other than CNA.

It can be seen that there are some predicted exceedances (bolded) of the 50 $\mu g/m^3$ 24-hour PM_{10} concentration at private Location No's 5, 16, 17, 24, 32, 34, 47 and 61. These residences are located in the Maison Dieu area to the south east. A real-time air quality monitoring programme is already in place at Maison Dieu. If air quality criteria are exceeded at residences that are not in the zone of affectation and where no private agreement exists, further controls will be implemented as detailed in *Section 8.5*.

The annual average 30 μg/m^3 assessment criterion for PM_{10} is also predicted to be exceeded at Location No's 23, 33, 38, 43 and 45. This is a result of the cumulative effects of emissions from all sources but in particular Wambo, Warkworth and HVO South. HVO South is predicted to contribute no more than 5.0 μg/m^3 (ie 17% of the assessment criterion). It is important to note that all five of these residences are either within a zone of affectation, subject to a private land holder's agreement with mines other than HVO or owned by mining companies other than CNA.

8.4.3 Mine Plan Scenario B1 (Approximately Year 2014)

In the mine plan for Scenario B1, mining will continue in the Cheshunt and Riverview Pits and South Lemington Pit 1.

Table 8.5 summarises the impacts at all assessment locations.

Table 8.5 Predicted dust generation for Scenario B1

Location No	Max 24-hour PM_{10} conc. due to HVO South in isolation - μg/m^3	Annual average PM_{10} conc. due to HVO South in isolation- μg/m^3	Annual average TSP conc. due to HVO South in isolation - μg/m^3	Annual average dust (insoluble solids) deposition due to HVO South in isolation – g/m^2/month	Annual average PM_{10} conc. due to HVO South and other sources μg/m^3	Annual average TSP conc. due to HVO South and other sources - μg/m^3	Annual average dust (insoluble solids) deposition due to HVO South and other sources – g/m^2/month
3	48.1	5.5	6.5	0.2	16.8	40.5	0.8
4	40.9	4.4	5.0	0.1	16.7	40.4	0.8
5	**85.3**	12.9	15.5	0.7	22.8	48.1	1.3
7[1]	42.5	4.1	4.5	0.1	17.3	40.7	0.8
8[2]	49.2	9.7	10.7	0.2	23.3	47.4	1.0
10[1]	57.8	11.4	13.4	0.4	24.3	49.0	1.0
13	29.8	4.4	5.1	0.1	13.9	37.3	0.7
16	**134.1**	24.0	30.0	1.6	**33.9**	62.4	2.2
17	**95.0**	16.9	20.5	0.9	26.5	52.6	1.5
19	**50.2**	5.3	6.3	0.1	17.0	40.8	0.8
23[1]	31.2	3.8	4.4	0.1	28.0	55.0	1.6
24	**84.3**	15.4	18.8	0.9	25.1	51.0	1.5
31	48.0	4.9	5.7	0.1	17.1	40.9	0.8
32	**138.0**	23.2	28.6	1.4	**33.1**	61.0	2.0
33[2]	47.2	6.9	8.1	0.3	33.2	60.7	1.8
34	**101.5**	17.2	20.8	0.9	26.7	52.8	1.6
36	49.7	5.2	6.0	0.1	17.5	41.4	0.8
38[1]	46.7	6.6	7.9	0.3	39.6	67.8	1.9
43[2]	50.8	7.9	9.4	0.4	32.9	60.1	1.7
45[1]	42.4	7.0	8.2	0.3	32.6	60.3	1.8
47	**81.9**	9.6	11.3	0.4	19.7	44.0	1.0
61	**84.1**	11.2	13.3	0.5	21.1	45.9	1.2

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- No prediction is available for maximum 24-hour PM_{10} concentration due to HVO South and other sources.
- Bold numbers indicate exceedance of limits where applicable for private residences not currently within a zone of affectation or owned by mining companies other than CNA.

It can be seen that there are predicted exceedances (bolded) of the 50 $\mu g/m^3$ 24-hour PM_{10} concentration at Location No's 5, 10, 16, 17, 19, 24, 32, 34, 47 and 61. Inspection of *Figure 2* of *Annex I* shows that these residences are located in the Maison Dieu area to the south east with exception of Location No. 19 which is located towards Jerrys Plains. The real-time air quality monitoring programme will need to be continued and refined to protect air quality under unfavourable conditions.

The annual average 30 $\mu g/m^3$ assessment criterion for PM_{10} is also predicted to be exceeded at Location No's 16, 32, 33, 38, 43 and 45. This again is a result of the cumulative effects of emissions from all sources but in particular Wambo, Warkworth and HVO South. It is noted that only Location No's 16 and 32 are privately owned (ie not owned by CNA or another mining company).

8.4.4 *Mine Plan Scenario C1 (Approximately Year 2019)*

In mine plan Scenario C1 mining will continue in the Cheshunt and Riverview Pits. The Cheshunt Pit will be producing approximately 10.6 Mtpa of ROM coal and mining in the Riverview and South Lemington Pits 1 and 2 will be completed.

Table 8.6 summarises the impacts at all assessment locations.

Table 8.6 *Predicted dust generation for Scenario C1*

Location No	Max 24-hour PM_{10} concentration due to HVO South in isolation - $\mu g/m^3$	Annual average PM_{10} concentration due to HVO South in isolation- $\mu g/m^3$	Annual average TSP concentration due to HVO South in isolation - $\mu g/m^3$	Annual average dust (insoluble solids) deposition due to HVO South in isolation – $g/m^2/month$	Annual average PM_{10} concentration due to HVO South and other sources $\mu g/m^3$	Annual average TSP concentration due to HVO South and other sources - $\mu g/m^3$	Annual average dust (insoluble solids) deposition due to HVO South and other sources – $g/m^2/month$
3	19.7	1.7	2.0	0.0	14.0	19.0	1.1
4	16.6	1.4	1.6	0.0	13.7	18.7	1.1
5	**77.6**	6.3	7.8	0.4	19.2	24.2	1.4
7[1]	16.1	1.2	1.4	0.0	17.6	22.6	1.1
8[2]	16.0	2.7	3.0	0.1	17.4	22.4	1.1
10[1]	33.2	4.2	5.0	0.2	16.9	21.9	1.2
13	15.3	1.6	1.9	0.1	13.6	18.6	1.1
16	**74.9**	10.0	12.8	0.8	22.9	27.9	1.9
17	**59.8**	8.0	10.1	0.6	20.7	25.7	1.6
19	18.5	1.6	1.9	0.0	13.9	18.9	1.1
23[1]	17.5	1.4	1.6	0.0	22.0	27.0	1.4
24	**67.2**	7.7	9.8	0.6	20.4	25.4	1.6
31	16.1	1.5	1.7	0.0	13.9	18.9	1.1
32	**72.3**	10.2	13.0	0.8	23.0	28.0	1.9
33[2]	26.1	2.4	2.9	0.1	25.2	30.2	1.6
34	**55.4**	8.0	10.1	0.6	20.6	25.6	1.6
36	17.0	1.6	1.8	0.0	14.0	19.0	1.1
38[1]	26.8	2.4	3.0	0.1	32.3	37.3	1.9
43[2]	29.0	2.7	3.3	0.1	24.8	29.8	1.6
45[1]	24.3	2.4	2.8	0.1	22.9	27.9	1.5
47	49.4	4.2	5.0	0.2	17.2	22.2	1.3
61	**69.1**	5.4	6.5	0.3	18.2	23.2	1.3

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- No prediction is available for maximum 24-hour PM_{10} concentration due to HVO South and other sources.
- Bold numbers indicate exceedance of limits where applicable for private residences not currently within a zone of affectation or owned by mining companies other than CNA.

It can be seen that there are seven predicted exceedances of the 50 $\mu g/m^3$ 24-hour PM_{10} concentration comprising Location No's 5, 16, 17, 24, 32, 34 and 61. Inspection of *Figure 2* of *Annex I* shows that these residences are located in the Maison Dieu area and the existing real-time management system will need to be continued and refined to protect air quality under unfavourable conditions.

8.5 MANAGEMENT MEASURES

The management of air quality at HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle. The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for air quality management are to:

- manage the operations in a way that minimises air quality impacts to the environment and neighbours, and limits interference to mining production;
- minimise dust generation from mining activities;
- review emissions from operations against model predictions and modify activities to ensure compliance with relevant criteria; and
- keep the local community and regulators informed of activities where required and respond quickly and effectively to issues and complaints.

The technical report (*Annex I*) identified a number of control measures to minimise the potential impacts on air quality resulting from the proposal. These measures have been considered in the context of the existing HVO activities and the CNA EMS. Many of these measures are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

Regular controls for dust mitigation include:

- awareness through environmental inductions to ensure that relevant employees are aware of potential impacts from equipment and its operation on sensitive locations;
- ensuring that dust emissions from the use of fixed plant and equipment is appropriately managed and minimised;
- minimising the area of disturbance with restrictions on clearing, topsoil stripping and access to disturbed areas;
- progressive rehabilitation of disturbed areas;

- applying dust suppression on trafficable areas, active exposed areas and during operations that generate dust as required by weather conditions at the time;
- keeping the concentration of respirable dust in the work place below regulatory guidelines;
- monitoring of deposited dust, PM_{10} and TSP at representative sites as detailed in the Air Quality Monitoring Programme;
- maintenance of monitoring systems consistent with regulatory requirements, best practice analytical techniques and published standards;
- installation, operation and calibration of monitors in accordance with relevant Australian Standards;
- review of all monitoring results in CNA's environmental monitoring database; and
- monitoring results for representative sites as listed in the Air Quality Monitoring Programme to be included in the AEMR.

If it is determined that mine operations during adverse meteorological conditions may result in exceedance of air quality criteria at sensitive locations, the following options will be considered:

- review of the elevation of mining and dumping and, where possible, relocate equipment to lower elevations, until more suitable conditions return;
- amended working hours; and
- temporary cessation of work within an area.

In the event of community concern additional monitoring may also be undertaken at sensitive sites. If, following a request from a property owner for an independent review of air quality impacts the mine operations are found to be compliant with air quality impact assessment criteria, the independent review may be discontinued.

Commitments Specific to the Proposal

In addition to the mitigation measures, efficient mine planning and operations will ensure:

- the mine plan is regularly reviewed with a view to controlling dust emissions and keeping emissions to the lowest levels practicable;
- exposed areas are kept to the minimum practicable; and
- haul roads are kept to the shortest routes practicable and material handling is kept to the minimum levels practicable.

8.6 CONCLUSIONS

This study has assessed the air quality impacts of a proposal to continue and extend mining in HVO South. The assessment included calibration of the model against actual air quality monitoring results for 2006. The remainder of the assessment focused on impacts for three future operational scenarios representing cases that would be expected to give rise to the worst case impacts on neighbouring residential areas.

Air quality impacts have been assessed in accordance with the principles set out in the DECC's approved methods for the assessment of air quality impacts using dispersion modelling (DEC, 2005). Predicted 24-hour average PM_{10} concentrations, annual average PM_{10}, TSP concentrations, and annual average dust (insoluble solids) deposition levels have been compared with the DECC's assessment criteria.

The assessment has been conducted using a model modified with local meteorological data and estimates of the emissions associated with mining. Model predictions include emissions from a range of nearby mines and an allowance for background emissions of particulate matter from non-mining sources.

The air quality impact assessment predicts that some residences in the Maison Dieu area will experience some exceedances of the DECC's 50 $\mu g/m^3$ 24-hour assessment criterion due to emissions from HVO South alone. These will need to be managed via the real-time monitoring and air quality management system. The predicted annual average PM_{10}, TSP and deposition levels in the Maison Dieu area all comply with the relevant assessment criteria.

Some residences in the Warkworth Village area are also predicted to experience 24-hour PM_{10} levels above the DECC's 50 $\mu g/m^3$ 24-hour assessment criterion. However, on this occasion, the exceedances are due to cumulative effects and emissions from HVO South play a relatively minor role in the total exceedances. The same locations are also predicted to experience exceedances of the 30 $\mu g/m^3$ annual average PM_{10} assessment criterion and again these exceedances are largely a result of cumulative effects with HVO South's emissions playing a relatively minor role. It is important to note that residences within Warkworth Village are either within a zone of affectation, subject to a private land holder's agreement with mines other than HVO or owned by mining companies other than CNA.

The emissions from the project, or from the project and cumulative effects of other sources, are not predicted to exceed the assessment criteria at residences to the west of HVO South or in the Jerrys Plains area. However, occasional exceedances of the DECC's 24-hour PM_{10} concentration criteria of 50 $\mu g/m^3$ may occur as experienced over most of Australia as a result of bushfire smoke and remote dust storms.

9 GROUNDWATER

Chapter 9 provides an overview of the existing groundwater environment, potential impacts resulting from the proposal, the modelling approach used for this assessment, and measures proposed to manage these potential impacts. This chapter summarises the Groundwater Assessment Report presented as Annex J and is supported by Chapter 10 - Surface Water.

9.1 INTRODUCTION

The objective of the groundwater assessment was to determine the potential impacts to the local and regional groundwater systems resulting from the proposal including potential impacts to the Hunter River and Wollombi Brook. The following assessment areas have been addressed:

- groundwater movement to and from rivers – to determine the potential for water flows within the Hunter River and Wollombi Brook to be impacted by the proposal;
- regional groundwater drawdown – to assess potential impacts to regional groundwater systems. This includes resultant impacts on local groundwater users and sensitive environments;
- seepage to pits – to estimate the volume of water that will enter the pits within HVO South during the Project Approval period and predict where this water will come from;
- changes to buffer zones – to assess the potential impact of reducing the current 150 m buffer zone between the pit highwall and alluvial zones;
- water level within the Deep Cheshunt Pit final void – to estimate the water level that will result within the Deep Cheshunt Pit final void;
- leachate migration from mine spoil and TSFs – to consider the potential impact for leachate liquid to drain from mine spoil and TSFs into surface water bodies and the regional groundwater system following mine closure; and
- highwall mining – to assess the potential groundwater impacts from proposed highwall mining.

The investigation followed a three stage approach including:

- conceptual model development and model design;
- model setup and calibration; and
- simulation of impacts, sensitivity analysis and assessment of proposed management commitments.

The staged approach allowed for collation and review of data, and regulatory input prior to model development, appraisal of the model and production of modelling results.

9.2 METHODOLOGY

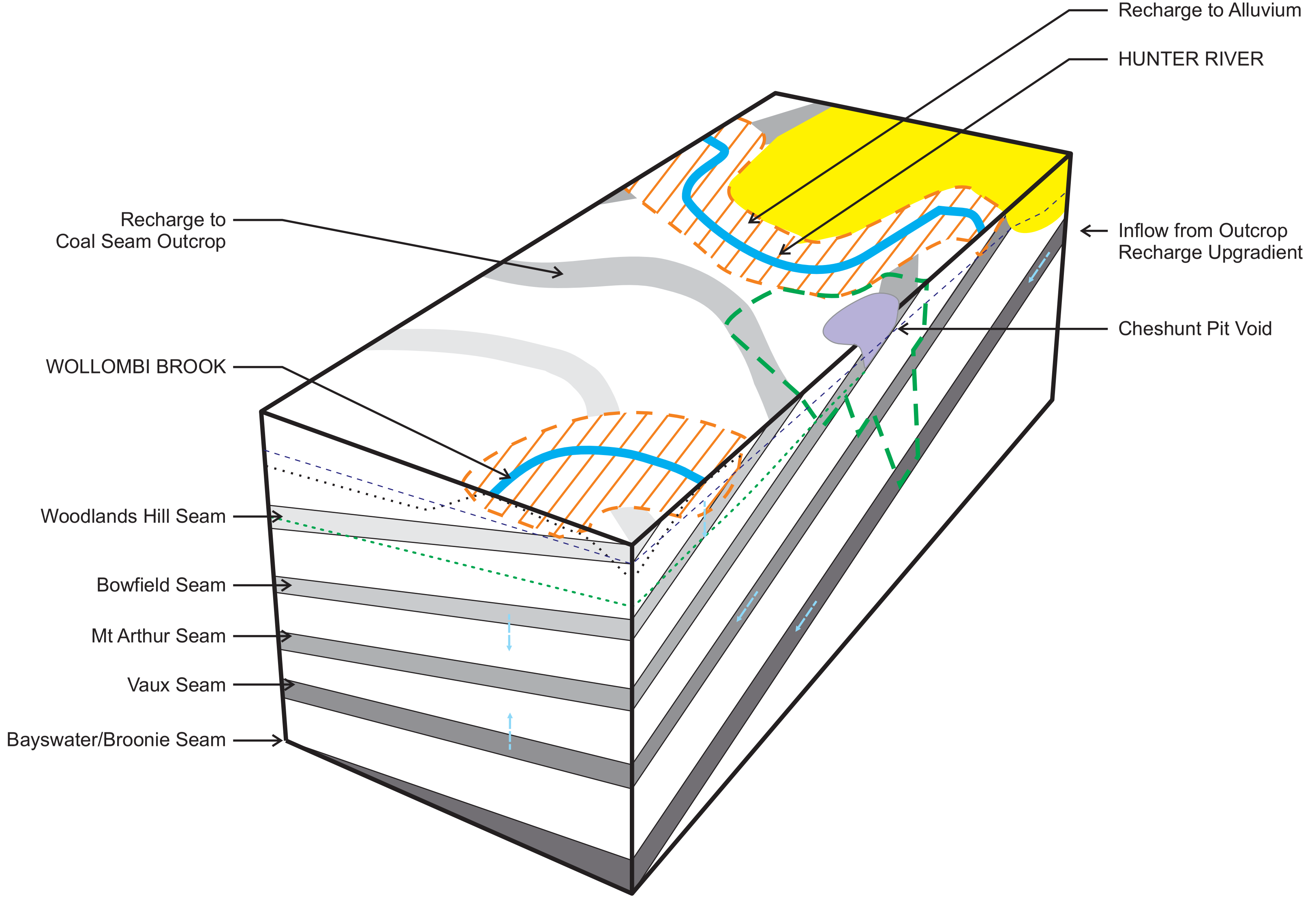
9.2.1 Overview

This assessment has considered existing and approved mining areas and proposed extensions to opencut and highwall mining operations. This assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. Therefore the existing and potential environmental impacts are already approved and management measures have been developed and implemented. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. The assessment results are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been approved.

Groundwater modelling best practice in NSW has been defined by the Murray Darling Basin Commission Groundwater Flow Modelling Guideline (2000). The methodology in the guidance document suggests the completion of updating, reporting and peer review at three key stages – conceptualisation, calibration and prediction. This assessment has been undertaken in accordance with this guideline as described in *Section 1.4* of *Annex J*.

Model development included consideration of input parameters, key assumptions and results from groundwater investigations previously undertaken for HVO South pits. Comparisons are presented in *Annex J*. The approach undertaken for this assessment allowed for potential impacts to be assessed on a regional basis as opposed to previous modelling that focused on localised impacts. The modelling assumes that the methodology for mining will minimise the potential for fracture development along pit walls. Procedures in place to manage the potential for fracture developments are incorporated into the Blast and Vibration Management Plan (refer to *Chapter* 7). In addition, existing management measures were reviewed to identify additional measures required as a result of this proposal.

Section 9.2.2 describes modelling steps undertaken for this assessment. *Figure 9.1* presents a schematic of the conceptual groundwater model.



Legend

- Slow Groundwater Flow Direction
- River/Watercourse
- Alluvium
- Alluvial Lands and North Pit Mine Spoil
- Cheshunt Pit Void
- Woodlands Hill Seam
- Bowfield Seam
- Mt Arthur Seam
- Vaux Seam
- Bayswater/Broonie Seam
- Groundwater Surface Water near Wollombi Brook
- Groundwater Elevation in Mt Arthur Seam
- Idealised Groundwater Elevations in Vaux and Deeper Coal Seams
- Approximate Future Extent of Deep Cheshunt Pit

Figure 9.1

Conceptual Groundwater Schematic

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_EAR_G_07_R0		
Date:	27/09/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	N/A		
Scale:	Schematic Only, Not To Scale		

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9.2.2 *Approach to Modelling*

A model is a computer programme that is used to simulate 'real life' groundwater behaviour. A model 'domain' is the area that is included in a model. For this assessment the Project Application area has been split into two separate domains for modelling (refer to *Figures 28* and *29* in *Annex J*). Justification for the model domains is provided in *Section 3.4* of *Annex J*. Model 1 includes the Cheshunt and Riverview Pit areas and Model 2, the South Lemington Pit 1 and 2 areas.

The modelling included a steady state calibration with a significant sensitivity analysis. A sensitivity analysis is undertaken to determine the potential range of modelling outputs using variable input parameters. Steady state modelling involves running the model until groundwater elevations and flows through the model have reached equilibrium regardless of how many years is required to reach that equilibrium. In reality, the pit voids change over time and typically only exist for periods of up to four or five years. Therefore, steady state modelling is conservative in that it allows greater opportunity for the pit voids to impact groundwater (drawdown) in the surrounding aquifer systems.

Due to the significant changes proposed for mining in the Cheshunt Pit it was decided to simulate mine progression in Model 1 under both transient and steady state conditions. Proposed modifications to mining activities in the South Lemington Pit area are minimal. Therefore Model 2 was simulated under steady state conditions only.

9.3 *EXISTING ENVIRONMENT*

9.3.1 *Overview*

The prominent surface water bodies located within or adjacent to the Project Application area are the Hunter River and the Wollombi Brook. The Hunter River borders the northern section of HVO South. The Wollombi Brook meets the Hunter River in the south east section of the Project Application area. Other creeks and tributaries located within the Project Application area flow to meet either the Hunter River or the Wollombi Brook.

Under the *WM Act*, the *Water Sharing Plan for the Hunter Regulated River Water Source* (WSP) (DIPNR, 2004) applies to the Hunter River from Glenbawn Dam to Maitland, and relates to the management of water access licences and allocations dependent upon available water determinations. The *Water Act 1912*, *WM Act* and therefore the WSP, where they apply, regulate the licencing of water seepage into pit from hard rock aquifers and water seepage into pit from alluvial aquifers associated with the Hunter River.

Flow data for Wollombi Brook recorded at the Warkworth gauging station (station no. 210004) since 1908 indicates that Wollombi Brook is ephemeral, being dry 11% of the time. No historical records provide evidence of the Hunter River being dry with minimum flows recorded at 3.6 ML/day. Surface water bodies and gauging stations are presented in *Figure 1* of *Annex J*.

The currently consented operations allow mining of all seams from surface to the bottom of the Vaux seam with two final voids remaining following mine closure; one within the Cheshunt Pit and one within the Riverview Pit.

Environmental aspects influencing the regional and local hydrological systems are addressed in detail in *Section 2* of *Annex J*. Features of the environmental setting are provided in the following sections.

9.3.2 Buffer Zone

The DIPNR *Draft Stream/aquifer Guidelines for Management of Stream/aquifer Systems in Coal Mining Developments* (DIPNR, April 2005) reference a notification zone of 150 m between the highwall of opencut mining and streams or associated alluvial zones (buffer zone). Specific merit based assessments are required for any proposed reduction of this buffer zone.

The proposal includes the option of reducing the buffer zone for the Hunter River and Wollombi Brook, hence in accordance with the Guidelines, the assessment has been undertaken to provide evidence of negligible impact to justify a reduction of the buffer zone.

The defined edge of alluvium associated with the Hunter River and Wollombi Brook at HVO have been surveyed using resistivity measurements.

9.3.3 Geology

Regional and local geological features are detailed in *Section 2.7* of *Annex J* and include:

- alluvial or unconsolidated deposits, which are present along the Hunter River, Wollombi Brook and their tributaries and comprise silts, clays, sands and gravels deposited as local flood plain and river related sediments. The thickness of the alluvium generally varies between 2 m and 20 m;

- the Singleton Coal Measures (SCM) which underlie the Project Application area. The SCM includes more than 50 individual coal seams that have been grouped by CNA geologists into thirteen lithological units as summarised in *Table 2.1* of *Annex J*. These coal seams are separated by interburden which is comprised of sandstones, siltstones and shales; and

- faults, dykes and igneous intrusions, which occur across the Project Application area and impact the nature of groundwater flows.

9.3.4 Hydrogeology

Previous investigations have found that the hydrogeological characteristics across the site include:

- the alluvial sands and gravels (alluvium) around the Hunter River and Wollombi Brook which form shallow unconfined aquifers of limited extent that are potentially in hydraulic connection with surface water bodies. These sediments intermittently intersect with sub-cropping coal measures resulting in potential hydraulic connection between these stratigraphical units;

- the inter-layered sandstones, siltstones, shale and coal measures, that form a series of sandstone/siltstone and shale aquitards with the more permeable coal seams forming aquifers beneath the alluvial deposits. Mackie (in ERM, 1998) suggests that groundwater flow within the coal measures is primarily through cleats or within occasional jointing. Previous investigations of groundwater elevations (Rust PPK 1997 in SKM, 1997) suggest that the sandstone, siltstone and shale layers act as a significant barrier to vertical flow. This is supported by sparse jointing and low seepage rates from interburden deposits in existing pit excavations (Mackie, in ERM, 1998). However, where additional fracturing associated with underground mining (ie at South Lemington Pit 1) is present an enhanced vertical hydraulic connection could exist; and

- faulting, folding and dykes that may affect the flow of groundwater within the Project Application area. Previous groundwater investigations completed by Rust PPK (in SKM, 1997) suggest that complete hydraulic disconnection of coal seams has occurred due to faulting in the South Lemington region.

The hydraulic conductivities of these materials are presented in *Table 2.2* of *Annex J* and have the following general properties:

- alluvial deposits are generally more permeable than the underlying SCM;

- coal seams are generally more permeable than the sandstone and shale interburden;

- there is significant variation in the reported conductivity values for each lithological unit; and

- the Hunter River bed alluvial deposits are unlikely to impede groundwater flow between the river and underlying Quaternary alluvial deposits.

Effective porosity values and water storage capacity of alluvium, interburden and coal seams adopted for this assessment are presented in *Section 2.8* of *Annex J*.

9.3.5 Groundwater Elevations

Available groundwater elevation data has been collated for the period 1996 to 2006 for the alluvial aquifer, the Bowfield Coal Seam, the Mt Arthur Coal Seam and the Bayswater Coal Seam (the most important seams for this study). This data provides an understanding of the level of the groundwater over time and is a significant indicator of the potential impacts from mining.

Figures 17 to *24* of *Annex J* present groundwater elevation variations within wells screened for the aquifers and coal seams mentioned above through time. Groundwater elevation monitoring points are concentrated to the north of the HVO South Coal Project Application area and around the Wollombi Brook area. The groundwater elevations suggest that:

- groundwater in alluvium is likely to be in hydraulic contact with the Hunter River and the Wollombi Brook;

- there is likely to be hydraulic disconnection between shallow groundwater and groundwater within deeper coal seams; and

- past (eg the Alluvial Lands Pit) and current mining has had a significant impact on deeper groundwater in the Project Application area.

9.3.6 DWE Listed Bores

There are approximately 63 registered bores (wells) registered on the DWE database within 2 km of the Project Application area. These are generally concentrated to the north of the Project Application area, in the Warkworth area and to the east of the LCPP. Twenty five of these are relatively shallow wells that have been installed for water supply for domestic, irrigation, stock, industrial and fire fighting purposes. These bores represent receptors that may be impacted by the proposal and are shown on *Figure 25* in *Annex J*. The remaining wells have been installed for geotechnical, geological and groundwater monitoring purposes and are not considered to represent potentially adversely impacted receptors.

9.3.7 Water Quality

Groundwater monitoring is carried out on a quarterly basis at HVO and surface water monitoring on a monthly basis to assess both the quality of mine water in onsite dams and the possible impact of mining on the surrounding surface waters. The results of this monitoring are reported in the HVO AEMR. Data collected during monitoring is predominately pH and electrical conductivity (EC). A summary of the data obtained for surface water quality, alluvium water quality, coal seam water quality, mine pit water quality and mine spoil water quality is provided in *Section 2.11* of *Annex J*.

9.4 IMPACT ASSESSMENT

9.4.1 Groundwater Flow To and From Rivers

Figure 9.2 provides an indicative overview of groundwater flows when mining near a river. As depicted, when mining near a river, the bottom of the pit becomes the new low point for groundwater in the system, which initiates groundwater flow toward the pit as opposed to toward the river. This may result in the river receiving water from one side and losing it from the other.

Hunter River

Proposed mining operations will not significantly impact water flows in the Hunter River.

Modelling predicts that potential impacts to the Hunter River resulting from the proposal include a reduction of groundwater flow *into* the Hunter River. Under current conditions, simulations show that groundwater from the northern part of the Project Application area flows into the Hunter River at approximately 1.1 ML/day. The minimum flow is predicted to be ~0.9 ML/day in 2024. As a worst case, or when flows in the Hunter River are at a minimum, this would equate to a 5% decrease in river flows down-gradient of the site.

Wollombi Brook

The groundwater modelling considered whether flows in Wollombi Brook have the potential to be significantly impacted by the proposal. It must be noted that South Lemington Pits 1 and 2 are already consented and the northern limits of the South Lemington Pit 1 already intersect the Wollombi Brook alluvium. This assessment considers the proposed extension in South Lemington Pit 1 and identifies that the intersection with the alluvium as a result of this extension is greatest in 2010 and 2019. Given that Wollombi Brook is already subject to periods of dry conditions, any reduction in groundwater flows to Wollombi Brook is unlikely to significantly change the flow regime of the Brook. The reduction in groundwater flow to the Brook is only significant relative to minimum flows of 0 ML/day recorded between 1908 and 2006. This increase in dry days will potentially impact areas owned by CNA as CNA own a significant portion of the land on either side of the Brook (*Chapter 1*, *Figure 1.3*).

As identified in *Annex L* and *Chapter 11 – Ecology*, there is a Hunter Floodplain Red Gum Woodland complex, stand of River Red Gums and several isolated River Red Gum trees located on the Wollombi Brook alluvium. The predicted increase in the number of days the Brook is dry is not anticipated to significantly impact the complex, the stand, or the isolated River Red Gums. The trees are unlikely to be affected as they rely on inundation by peak flow floods, which will not change as a result of the extension to mining. As the Brook is ephemeral, the changes to flow resulting from the proposed mining activities are not anticipated to significantly impact fish species. Potential impacts resulting from groundwater drawdown are discussed in *Section 9.4.2*.

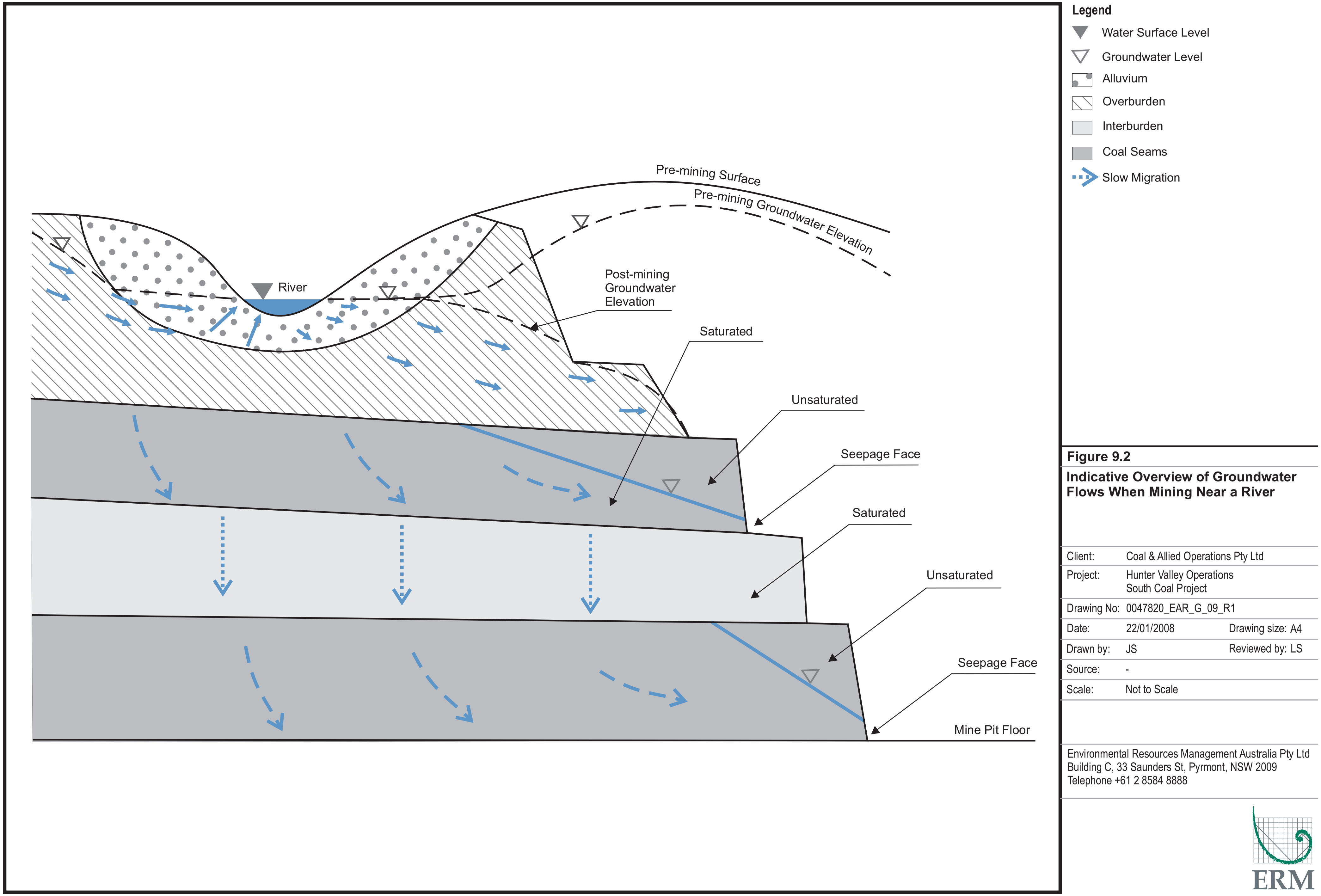

Figure 9.2

Indicative Overview of Groundwater Flows When Mining Near a River

Client:	Coal & Allied Operations Pty Ltd
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_EAR_G_09_R1
Date:	22/01/2008 — Drawing size: A4
Drawn by:	JS — Reviewed by: LS
Source:	-
Scale:	Not to Scale

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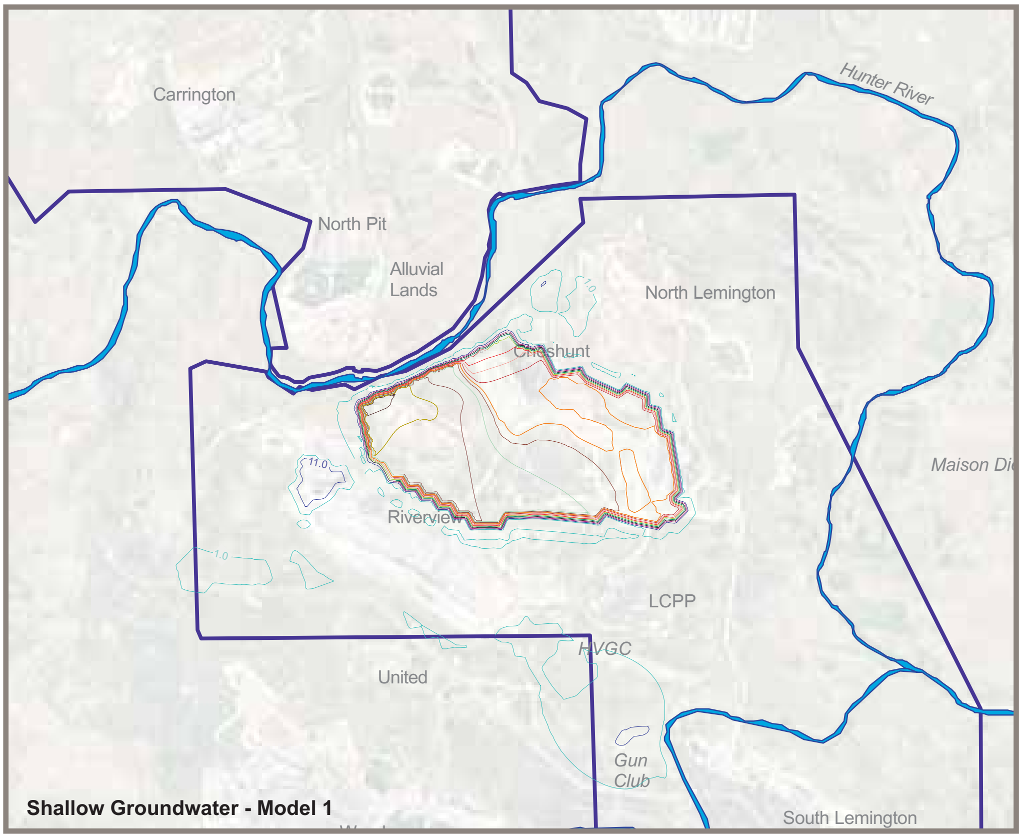
9.4.2 Regional Groundwater Drawdown

Changes to shallow groundwater levels as a result of the mine path have the greatest potential for adverse impacts on the bores discussed in *Section 9.3.6* as these bores are shallow and rely on this shallow water. These bores are shown on *Figure 25* in *Annex J*. Impacts to deeper groundwater located in the coal seams are less significant as this resource is not utilised and no adverse impacts to groundwater flows to the Hunter River and Wollombi Brook have been predicted. *Figure 9.3* presents the shallow groundwater table drawdowns for Models 1 and 2 relative to the calibrated base case models.

It is predicted that in the vicinity of the Cheshunt and Riverview Pits there is only a localised area of impact on shallow groundwater (refer to *Figure 36* in *Annex J*). This occurs at the completion of mining in 2029, predominately a result of the Deep Cheshunt Pit final void. Post 2029, as groundwater recharges in the Riverview Pit spoil and within the Cheshunt Pit void this impact is likely to reduce further. Therefore, the impact on surrounding groundwater users (predominantly extracting from alluvial deposits) is considered to be negligible. Coal seam aquifer drawdown extends to much greater distances from the pit voids (refer to *Figures 36 and 37* in *Annex J*).

Within the vicinity of the South Lemington Pits the drawdowns simulated are conservatively estimated to be less than 1 m. This is considered unlikely to adversely impact shallow groundwater users in the area. Furthermore, the predicted impacts from mining South Lemington Pits 1 and 2 are likely to be overstated due to modelling in this area (Model 2) being under steady state conditions. The actual impacts are likely to be less than this and approximate those presented for Model 1, which was completed under transient conditions.

As addressed in the preceding section there is a Hunter Floodplain Red Gum Woodland complex, stand of River Red Gums and several isolated River Red Gum trees located on the Wollombi Brook alluvium. The location of this vegetation is illustrated in *Figure 11.2*. As depicted in *Figure 9.3*, as a worst case, a maximum groundwater drawdown of 1 m is predicted within the area where isolated River Red Gums are located, which has the potential to reduce the amount of groundwater currently available to the isolated River Red Gums. The reduction of groundwater may only affect regeneration of the stands if it has significant impact on the ability of the area to flood. However, current flooding regimes are unlikely to be affected as they rely on peak flood flows, which are not expected to change significantly as a result of the mining extensions. Groundwater drawdown impacts are not predicted below the River Red Gum stand or the majority of the Hunter Floodplain Red Gum Woodland complex. CNA are currently undertaking studies to investigate the preferred water source of River Red Gums and appropriate management measures will be developed and applied as appropriate.



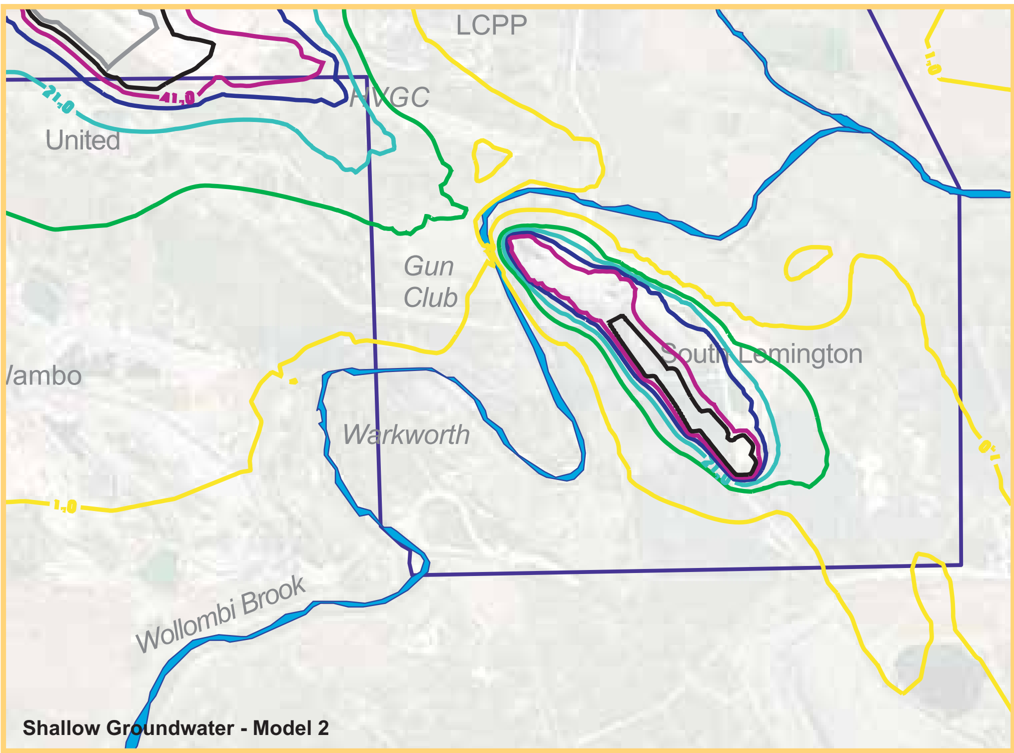


Figure 9.3

Regional Groundwater Drawdown - Shallow Groundwater

Client:	Coal & Allied Operations Pty Ltd		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_EAR_G_08_R1		
Date:	03/10/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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ERM

9.4.3 *Seepage to Pits*

Seepage to pits results mainly from the release of water from storage within the mined material (overburden, coal and interburden) and from the layers beyond the pit walls rather than from nearby surface water bodies (Hunter River and Wollombi Brook).

Seepage into the Cheshunt Pit is predicted to range from 0.7 ML/day in the initial stages of mining to a maximum volume of 7.3 ML/day when mine progression and pit deepening are greatest (approximately 2009 – 2010). *Figure 38* in *Annex J* provides predicted seepage rates into the Cheshunt Pit over the proposed mining period. As mining rates decrease toward the end of the proposed mining period the seepage rates are simulated to decrease to approximately 2.2 ML/day. This rate is likely to approximate the rate of initial groundwater flux into the pit post mining, which will gradually reduce over time as the pit void fills with water. It is important to note that seepage from the pit face into the base of the pit will be subject to evaporation losses. These losses will reduce seepage accumulation at the base of the pit from an estimated maximum of 7.3 ML/day, to between 6.5 ML/day in winter and 5.0 ML/day in summer.

Seepage into the Riverview Pit is predicted to range from 0.1 ML/day in the initial stages of mining to a maximum volume of 0.8 ML/day at the time of fastest mining rates (approx 2009 – 2014).

It is important to note that sensitivity analysis suggests that seepage into the Cheshunt Pit may vary in the order of 100% during initial stages of mining. Management of this water will be incorporated into operational activities and will allow for a potential variation of 100% of seepage into the Cheshunt Pit. Modelling predicts that this variation will reduce to approximately 0% at and after mine closure as water release from within the coal seams and interburden subsides.

Seepage into South Lemington Pit 2 from local water storages is predicted to range from 0.04 ML/day in 2010 to 0.06 ML/day in 2014. This volume of water is insignificant with no specific management measures required.

Seepage into South Lemington Pit 1 is predicted to range from 0.3 ML/day towards the final stages of mining to 0.8 ML/day at the time of fastest mining rates (approximately 2019). This volume of water is insignificant with no specific management measures required. Water into the pit is most likely sourced from the existing intersection of Wollombi Brook alluvial deposits as discussed in *Section 6* of *Annex J*.

Seepage to pits from both groundwater and surface water bodies will be offset in accordance with regulatory requirements.

9.4.4 *Changes to Buffer Zone*

Modelling was undertaken to determine the potential impacts to the Hunter River and Wollombi Brook from mining to 50 m, 100 m and 150 m from the inferred or surveyed limits of alluvium. Mining in the Cheshunt Pit is currently approved to 150 m from the edge of alluvium. The South Lemington Pit 1 has already intersected the alluvium as per the original approval.

This Project Application seeks approval to mine to 100 m from the limit of alluvium of the Hunter River therefore the results for this option are presented below. These results are discussed in terms of impacts on groundwater flows to rivers, impacts to regional groundwater drawdown and seepage to pits. *Section 6.5* of *Annex J* discusses results for all scenarios.

Groundwater Flow To and From River

The mine plan expected to have the greatest impacts on groundwater flows to rivers was adopted for modelling to ensure that results were conservative. Mining up to 100 m from the edge of the alluvium of the Hunter River is predicted to result in minor changes to groundwater flows to the Hunter River compared to what is currently approved.

Mining up to 100 m from the edge of the Hunter River alluvium is predicted to reduce groundwater flows to the Hunter River by 0.05 ML/day. This is considered to be negligible relative to Hunter River minimum flows of 3.6 ML/day recorded at gauging station 210083 between 1969 and 2006 (or a 1.6% reduction in flow under worst case or lowest recorded flows). CNA will offset reductions in groundwater flows in accordance with regulatory requirements.

Groundwater Drawdown

There will be no significant impacts to the regional groundwater system and therefore local bores resulting from the proposed reduction in the buffer zone. The simulations predict that there is a minor localised impact to aquifers not currently dewatered by mining (*Annex J*).

Seepage to Pits

Mining up to 100 m from the edge of the Hunter River alluvium is predicted to increase seepage into the Cheshunt Pit by approximately 0.05 ML/day. This can be readily incorporated into the management procedures to be updated in the HVO Water Management Manual.

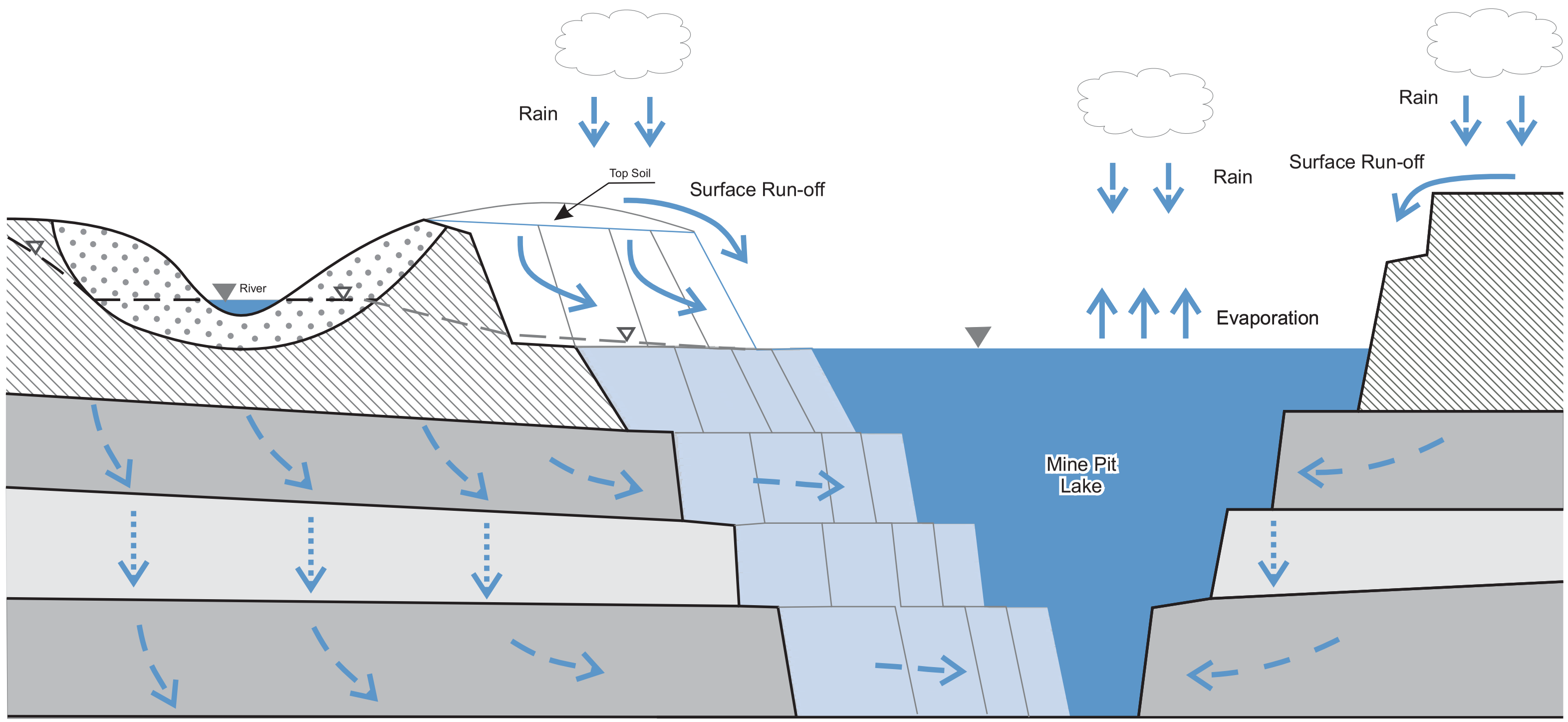
As identified in *Chapter 11,* scattered River Red Gums are located to the north of the Riverview Pit on the Hunter River alluvium. The modelling predicts that groundwater impacts will not extend to the limit of occurrence of the River Red Gum population on the Hunter River. Therefore there will be no impact on groundwater levels that would be likely to affect the persistence of the River Red Gums.

9.4.5 Water Level within the Deep Cheshunt Pit Final Void

Modelling suggests that, given average climatic conditions and an absence of input from other surface water bodies, surface water is likely to oscillate around an elevation of 0 mAHD within the Deep Cheshunt Pit final void, which is approximately 50 to 60 m below current ground surface in this area. It may take 250 years for this elevation to be reached.

The results also suggest that the Deep Cheshunt Pit final void surface water elevations will on average be significantly below other surface water body elevations within the area.

Therefore, it is likely to act as a sink to groundwater flux in the area. This will result in a constant flux of groundwater, within the coal seams and pit spoil, into the final void. The location and size of this final void and final void management details are provided in detail in *Chapter 19 - Mine Landscape Planning*. *Figure 9.4* depicts groundwater seepage into the final void and is indicative only. This figure suggests that the pit will induce minor seepage from the river. This will reduce over time as the pit void fills with water. The water level of the final void will depend on the balance between rainfall over a surface catchment and evaporation from the exposed water surface. Water quality is further dealt with in the following section.



Legend

- Water Surface Level
- Groundwater Level
- Alluvium
- Overburden
- Interburden
- Coal Seams
- Slow Migration

Figure 9.4

Indicative Schematic of Deep Cheshunt Pit Final Void and Groundwater Inflow

Client:	Coal & Allied Operations Pty Ltd		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_EAR_G_10		
Date:	20/08/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	Not to Scale		

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9.4.6 *Leachate from Mine Spoil and Tailings Storage Facilities*

Mine spoil leachate migration was only assessed post mine closure as before this time, groundwater will flow towards pit voids and there is no leachate flow outwards into the regional groundwater system.

The main findings were:

- modelling simulates that post mine closure, the Deep Cheshunt Pit final void will continue to act as a groundwater sink and capture point for spoil leachate from the Cheshunt and Riverview mining areas. Therefore, no leachate will flow towards the regional groundwater system;

- given that the final void will act as a groundwater sink, there will be a gradual net loading of salt in the final pit void 'lake' over time. It will take in excess of 200 years for the total salinity within the void lake to approximate that of the groundwater flowing into the void;

- leachate from South Lemington Pit 1 is not predicted to impact the regional groundwater system. Modelling shows that flow within the South Lemington Pit 1 spoil will migrate away from the Wollombi Brook. Some migration into coal seams down hydraulic gradient of the site is simulated. However, this is not considered to represent a potentially significant impact given that the spoil water quality was reported in Mackie (1998) to be similar to coal seam water quality. There is negligible migration within coal seams towards Wollombi Brook; and

- leachate from South Lemington Pit 2 is predicted to generally migrate northward through Riverview Pit spoil. As identified previously, this will then migrate toward the Deep Cheshunt Pit final void.

The potential for impacts resulting from migration of leachate from existing and potential TSFs including those proposed for Riverview and South Lemington Pit 1, was considered in this assessment. Fines present in TSFs within the HVO mining area generally settle out from solution over time and seal the base of the TSFs. This prevents the migration of potentially contaminated seepage out of the base of the TSFs. In addition, modelling predicts that the Deep Cheshunt Pit final void exerts such a control on the groundwater flow regime in the area, with groundwater primarily flowing into the pits that any TSF seepage potentially escaping from the facility into surrounding groundwater will migrate directly into the Deep Cheshunt Pit final void.

9.4.7 *Highwall Mining*

The assessment completed for the proposed highwall mining was specifically based upon extraction designed to result in subsidence of less than 20 mm. The areas north east of the Deep Cheshunt Pit and to the south west of South Lemington Pit 1 are located within the footprint of active mining and will be subject to active management and rehabilitation. The area south of Riverview Pit extends under Jerrys Plains Road. The current timing for highwall mining is expected to be beyond approximately 2020. More detailed designs will be undertaken utilising best practice methodologies available at that time to ensure subsidence is limited to less than 20 mm. A Subsidence Management Plan may be developed if identified as being required.

An objective of this investigation was to assess the potential impacts resulting from the proposed highwall mining, in isolation. Proposed highwall mining areas are presented in *Figure 5.3*. A qualitative assessment of the potential groundwater impacts resulting from proposed highwall mining was completed using the outputs from the modelling. The assessment is detailed as follows with further assessment discussion provided in *Annex J*.

Riverview Pit

Highwall mining was proposed on the northern and southern sides of the Riverview Pit.

On the northern side of the Riverview Pit, highwall mining of the Bowfield seam between the pit and the Hunter River was initially proposed. This is an area of coal seam identified as having a hydraulic connection with the Hunter River alluvium, which represents a potential risk of increasing seepage from the Hunter River. As the coal reserves are limited in this area it was decided not to undertake further detailed modelling at this time. Until specific modelling is completed to understand the risks posed to Hunter River by highwall mining in this area it has been excluded from the Project Application.

Modelling was undertaken for the Riverview Pit southern highwall mining and identified that it is unlikely to adversely impact the surrounding environment for the following reasons:

- the Bowfield seam dips to the south west from the Riverview Pit and has been mined out to the north within the pit and up gradient towards the Hunter River. Therefore, there is no hydraulic connection between the Bowfield seam on the southern and western sides of Riverview Pit and the Hunter River. Consequently, no additional impact to the Hunter River will result from highwall mining in this area; and
- there are currently no other surface water features or water wells located in the vicinity of the proposed highwall mining in this area.

Cheshunt Pit

The current modelling in this area conservatively simulates mining in a larger zone to the base of the Broonie and Bayswater seams in this area. This in combination with the simulated impact of the open pit creates a drawdown cone that extends beyond the zone of proposed highwall mining in this area. As such, the potential highwall mining in this area will have no additional effect.

South Lemington Pit 1

At this location the available groundwater elevation data indicates complete decoupling of the groundwater within the Bowfield seam and shallower groundwater within the Arrowfield seam and alluvial deposits. This is despite the presence of extensive underground mining within the Mt Arthur seam located below the Bowfield seam and beneath the Wollombi Brook. It is considered unlikely that the proposed highwall mining of the Bowfield seam will adversely impact surface water features, compared with the existing historic underground workings of the Mt Arthur seam. Any seepage impacts manifested are likely to be the result of surface subsidence resulting from underground workings. While the current modelling is not capable of simulating surface subsidence, the background groundwater data and anecdotal evidence indicates that surface subsidence has not occurred as a result of the existing underground Mt Arthur workings, and is therefore unlikely to occur as a result of the less invasive highwall mining proposed.

In addition, the Bowfield seam dips to the south west from the pit edge and has been mined out to the north, up gradient towards any intersection with Wollombi Brook alluvium. The potential impacts associated with seepage from Wollombi Brook as a result of consented opencut mining in South Lemington Pit 1 have already been addressed as part of the groundwater modelling assessment prepared for the initial opencut proposal.

There is likely to be some minor drawdown to the groundwater elevations with dewatering of the Bowfield coal seam during highwall mining. This is not currently simulated by the modelling. However, this is likely to be localised around the area of the highwall mining and only within the deeper coals seams being worked, and is not within the vicinity of any potentially significant groundwater resources. Therefore, potential impacts are not considered significant.

While the assessment of highwall mining at South Lemington Pit 1 is based on key field data that suggests the potential impacts are negligible, it is recognised that this assessment is qualitative. Therefore, it is recommended that monitoring of groundwater elevations within the Wollombi Brook alluvium and in shallower coal seams such as the Arrowfield seam is continued. Any changes in groundwater elevations identified will be reviewed and if necessary, management measures implemented to minimise impacts.

9.5 MANAGEMENT MEASURES

The management of groundwater at HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures. As a result of the proposal the HVO Water Management Manual will be updated to incorporate the results of the HVO South proposal.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle.

The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for groundwater management are to:

- manage the operations in a way that minimises groundwater impacts to environment and neighbours, and limits interference to mining production;
- understand the site groundwater resources and minimise impacts on quality;
- understand the zone of influence of potential impacts of operations on groundwater and aquifer pressures including alluvium;

- monitor and manage seepage of groundwater from shallow aquifers and impacts on surface streams; and

- keep the local community and regulators informed of activities where required and to respond quickly and effectively to issues and concerns.

The technical report (*Annex J*) identified a number of control measures to minimise the potential impacts to groundwater resulting from the proposal. These measures have been considered in the context of the existing HVO activities and the CNA EMS. Many of these measures are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

Regular controls for groundwater management include:

- selective backfill or construction to inhibit seepage into pits following mining;

- captured groundwater managed as mine affected water; and

- levee construction to prevent flood water inflows to pits.

- monitoring of groundwater at representative sites as detailed in the Groundwater Monitoring Programme; and

- monitoring results for representative sites as listed in the Groundwater Monitoring Programme to be included in the AEMR.

Commitments Specific to the Proposal

In addition to the mitigation measures the following controls will be implemented.

Groundwater Flow To and From Rivers

- development of protocols for monitoring and reporting of DWE stream gauge results to clearly record any reductions in groundwater flows that are attributed to mining. This will include monitoring Hunter River flows immediately up gradient and down gradient of the site. In addition, consideration will be given to tying in specific CNA water level recordings with current DWE gauging locations;

- monitoring of groundwater elevations within alluvium between the Hunter River and the Cheshunt Pit;

- measured groundwater elevations and river flow will be assessed against predictions to determine whether application of additional management measures is required; and

- offset any reduction in river flow in accordance with legislative requirements.

Regional Groundwater Drawdown

- the HVO *River Red Gum Rehabilitation and Restoration Strategy* and CNA EMS procedure for Flora and Fauna will be updated to reflect changes resulting from the proposal. This will include monitoring the health of the River Red Gums located on the Hunter River and Wollombi Brook alluvium as identified in *Chapter 11* (*Figure*

11.2). The monitoring programme will include details on frequency of monitoring, reporting and corrective actions; and

- up to three monitoring wells will be installed in the proximity of the cluster of registered DWE bores located to the east of the LCPP (*Figure 25 Annex J*). Data will be used to compare actual versus predicted impacts. Deviations away from predicted impacts will be assessed, and if predictions are exceeded, management measures will be implemented.

Alluvial Buffer Zone

- a buffer zone of 100 m will be retained from the Cheshunt Pit highwall to the edge of alluvium of the Hunter River;

- a buffer zone of 150 m will be retained from the South Lemington Pit 2 highwall to the edge of alluvium of the Wollombi Brook;

- bores will be installed to further delineate the saturated zone between the Hunter River and the Cheshunt Pit before mining commences within this area; and

- the groundwater component of the HVO Water Management Manual will include procedures for monitoring potential impacts, including accurately measuring seepage to pits throughout mining and assessment of proximity to alluvials as mining approaches.

Pit Wall Stability

Management measures relating to fracture development along pit walls are included in the Blast and Vibration Management Plan (refer to *Chapter 7*).

Deep Cheshunt Pit Final Void

- the Deep Cheshunt Pit final void will be designed to intercept leachate from overburden emplacements and minimise discharge of saline groundwater. Final void design will be reviewed at least three years prior to anticipated mine closure;

- the Final Void Management Plan will include future use options including investigation of feasibility to use the Deep Cheshunt Pit final void as a water storage that could be used as a buffer in times of flood flows in the Hunter River and as a supplementary water supply at times of scarce water supply. This would include additional investigations to refine predictions of final void water chemistry;

- a post closure monitoring programme will be developed as part of the Final Void Management Plan for water quality monitoring of the final void; and

- the mine plan will be further reviewed with a view to minimise the area of the Deep Cheshunt Pit final void as much as practicable.

9.6 CONCLUSIONS

A detailed assessment of the potential regional and local groundwater system impacts was undertaken for this environmental assessment. Two models were adopted for the assessment with Model 1 (Cheshunt and Riverview Pits) simulations being run under steady state and transient conditions and Model 2 (South Lemington Pits) simulations under steady state conditions only. Sensitivity analysis indicated that steady state simulations overstated connections between pit voids and surface water bodies and model results are therefore considered conservative.

Flows in the Hunter River are not predicted to be significantly impacted by mining. This includes mining up to 100 m of the limit of alluvium of the Hunter River. Under worst case conditions, the number of days the Wollombi Brook is dry is predicted to increase by up to 6%.

An assessment of the potential impacts to ecological values, specifically on the River Red Gums located on the Hunter River, and Hunter Floodplain Red Gum Woodland complex and River Red Gum stand located on the Wollombi Brook alluvium, found that these trees will not be significantly impacted by the proposal. Groundwater drawdown may only affect regeneration of River Red Gum stands if it has significant impacts on the ability of the area to flood. However, current flooding regimes are unlikely to be affected as they rely on peak flood flows, which are not expected to change significantly as a result of the extensions to mining.

Seepage into the Cheshunt Pit is predicted to range from 0.7 ML/day to 7.3 ML/day and is dominated by water contained within the material disturbed by mining. This range does not include the potential 100% variability in initial stages of mining. Due to losses through evaporation, this is predicted to reduce from a maximum of 7.3 ML/day, to between 6.5 ML/day in winter and 5.0 ML/day in summer. The surface water section of the Water Management Manual will be modified to reflect the predicted increase in-pit seepage from all pits and allow for a potential 100% variability in initial stages of mining at the Cheshunt Pit. All other impacts are considered minimal.

Existing CNA management system procedures and management plans currently govern the management of groundwater across HVO South. These documents will be updated to reflect changes to groundwater resulting from the proposal.

10 SURFACE WATER

This chapter provides an overview of the existing surface water environment, changes resulting from the proposal, and measures proposed to manage potential impacts resulting from these changes. This chapter has been based on the HVO South, Surface Water Assessment Report prepared by ERM, 2008 presented as Annex K.

10.1 INTRODUCTION

The primary objective of this assessment is to determine the specific and cumulative impacts of mining related activities on the local and regional surface water resources. The following assessment areas have been addressed:

- demand and water supply requirements – to determine if there will be potential changes in demand and consequential changes in the volume of water pumped from the Hunter River outside current water licences;
- changes to catchments and yields – to assess if physical changes to the catchments over the life of the operations will potentially impact on catchment yields and runoff volumes;
- diversions and surface drainage – to consider existing and modified drainage networks and to identify additional drainage required as a result of revised mine plans;
- flooding – to determine impacts of the operations and current and proposed levees on floods in adjacent waterways and of potential flood impacts on the operations themselves;
- water quality and discharges – to identify potential changes to existing water quality due to changes to operations as well as potential for changes to quantity and quality of water discharged from HVO South;
- legacy conditions – to assess expected final drainage networks including the final void and remediated areas; and
- water management and monitoring – to review current management activities and monitoring programmes and identify potential additional requirements.

Supply objectives, changes to catchments and diversion of clean water to natural waterways or to storages are based on the current mine water management plans and any revisions as a consequence of consultations with DWE and other authority requirements. Changes to the management plans may occur. Water quality issues may relate to existing and modified onsite containment and treatment methods to ensure discharges meet established environmental guidelines and licence requirements.

10.2 *METHODOLOGY*

This environmental assessment integrates water resources data and objectives with the operational objectives of the mine. Assessment of surface water is based on background data from the previous assessments as well as the current consent conditions, augmented by data collected subsequent to the previous studies.

This assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. Therefore the existing and potential environmental impacts are already approved and management measures have been developed and implemented. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. The assessment results are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been approved.

Mine plans have been reviewed to identify water courses, storages, diversions and other surface water features that are interrupted, subsumed or otherwise affected at all stages of development resulting from the proposal. Impacts on water quality as well as quantity and associated issues such as erosion, treatment, storage and discharge procedures have then been considered.

Climate data, flood data and topographic information has been input with proposed water management processes to hydrological models to determine the expected quantum of impacts. A separate water balance was also undertaken to assess the current and future uses of water for a number of development scenarios and the potential resulting consequent impacts on water demand, distribution, storage and discharges. *Figure 10.1* provides an example of the existing water balance across HVO as presented in the 2006 HVO AEMR (ie LCPP is not operational). Volumes presented are indicative with annual water balance varying in accordance with production rates, pit sizes and location, rainfall and evaporation. *Figure 10.1* presents volumes in a below average rainfall year (Bureau of Meteorology 2007).

Flood records and results from previous flood modelling have been reviewed to identify where existing and future operations and features may be affected as well as where proposed works and operations will encroach on flood affected areas.

Finally, water monitoring data has been reviewed and assessed against relevant standards and guidelines. Recommendations have then been developed to address potential shortcomings in the existing monitoring practices and modifications required to accommodate all stages of the proposed development. In addition, existing management measures were reviewed to identify additional measures required as a result of this proposal.

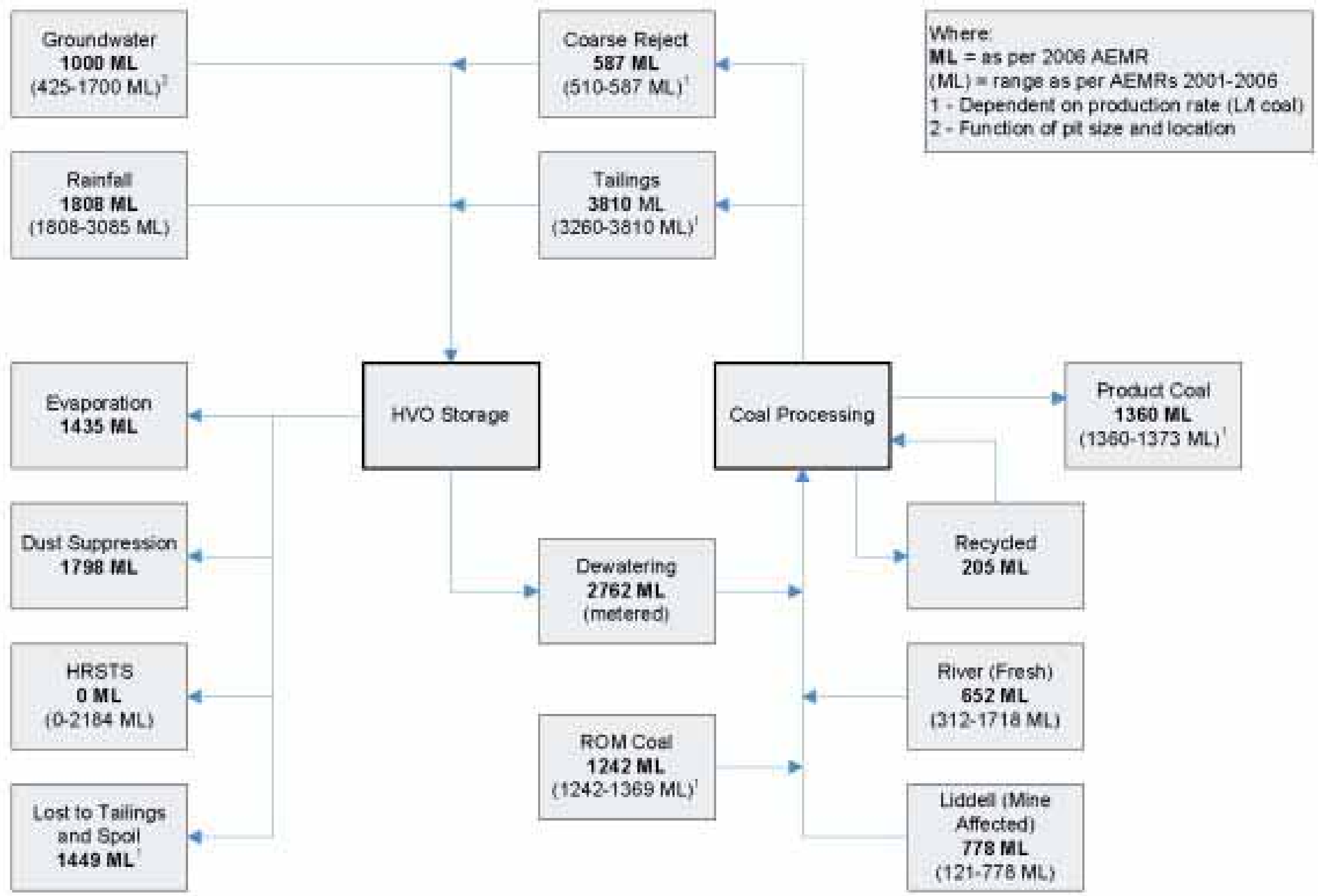

Figure 10.1

Indicative HVO Water Balance

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_EAR_G_05_R1
Date:	10/12/2007 Drawing size: A4
Drawn by:	GC Reviewed by: LS
Source:	-
Scale:	-

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10.3 *EXISTING ENVIRONMENT*

10.3.1 *Drainage*

Regional Drainage

HVO South is located close to the confluence of the Hunter River and Wollombi Brook approximately 28 km (by river) upstream of Singleton, NSW. The Hunter River has a total catchment area of approximately 22,000 km^2, approximately 14,000 km^2 of which is upstream of its confluence with Wollombi Brook near the eastern edge of HVO South. The Hunter River then continues to flow in an east-south-easterly direction from HVO South for approximately 170 km to its outlet to the Pacific Ocean at Newcastle.

As described in *Chapter 9*, the Hunter River WSP relates to the management of water access licences and allocations dependent upon available water determinations. The *Water Act 1912*, *WMA* and therefore the WSP, where they apply, regulate the licencing of water seepage into pit from hard rock aquifers and water seepage into pit from alluvial aquifers associated with the Hunter River.

The Hunter River catchment supports a diverse range of land uses including agriculture (grapes, cereal crops, grazing, and dairy etc), urban and rural residential areas, coal mining, power generation, heavy industry, tourism and fisheries.

Wollombi Brook has a total catchment area of 403 km^2 of which only approximately 13% has been cleared for agricultural uses (mainly vineyards and grazing) in the flat river valleys. The majority of the catchment comprises forests and bushland on steep to mountainous terrain.

Site Drainage

HVO South occupies an approved mining area of 2980 ha within the Hunter River Catchment. It is bounded to the north and east by the Hunter River. Wollombi Brook meanders in a north easterly direction through the southern part of the area, separating South Lemington Pits 1 and 2.

Longford Creek and several other small tributaries drain the area to the south of Wollombi Brook. Longford Creek flows in a northerly direction near the eastern edge of South Lemington Pit 1 to meet Wollombi Brook approximately 1 km upstream of its junction with the Hunter River.

To the north of Wollombi Brook, Redbank Creek and Comleroi Creek drain in a south easterly direction to Wollombi Brook. Comleroi Creek drains part of the eastern edge of the site while Redbank Creek drains the LCPP, the southern edges of South Lemington Pit 2 and the southern side of Jerrys Plains Road. The north western and central areas of the site drain to Hobden Gully which flows in a north easterly direction to meet the Hunter River.

A water management arrangement is given in *Figure 10.2*. This shows some of the predevelopment conditions as well as existing conditions. It should be noted that runoff from the HVO South mining disturbance area is intercepted either by pits or by storage or sediment dams for use on site.

The remainder that drains directly to external waterways is from undisturbed land. Approximately 16 ha south of Jerrys Plains Road contributes to flows within the HVO South mining consent boundaries.

10.3.2 Rainfall and Evaporation

The nearest long term rainfall gauging station operated by the Bureau of Meteorology is located at Jerrys Plains. The average annual rainfall, based on data collected between 1975 and 2006 is 657 mm. The 31 year rainfall period has been adopted for this assessment in accordance with recognised industry standards. Rainfall data is also recorded at the Cheshunt meteorological station at HVO.

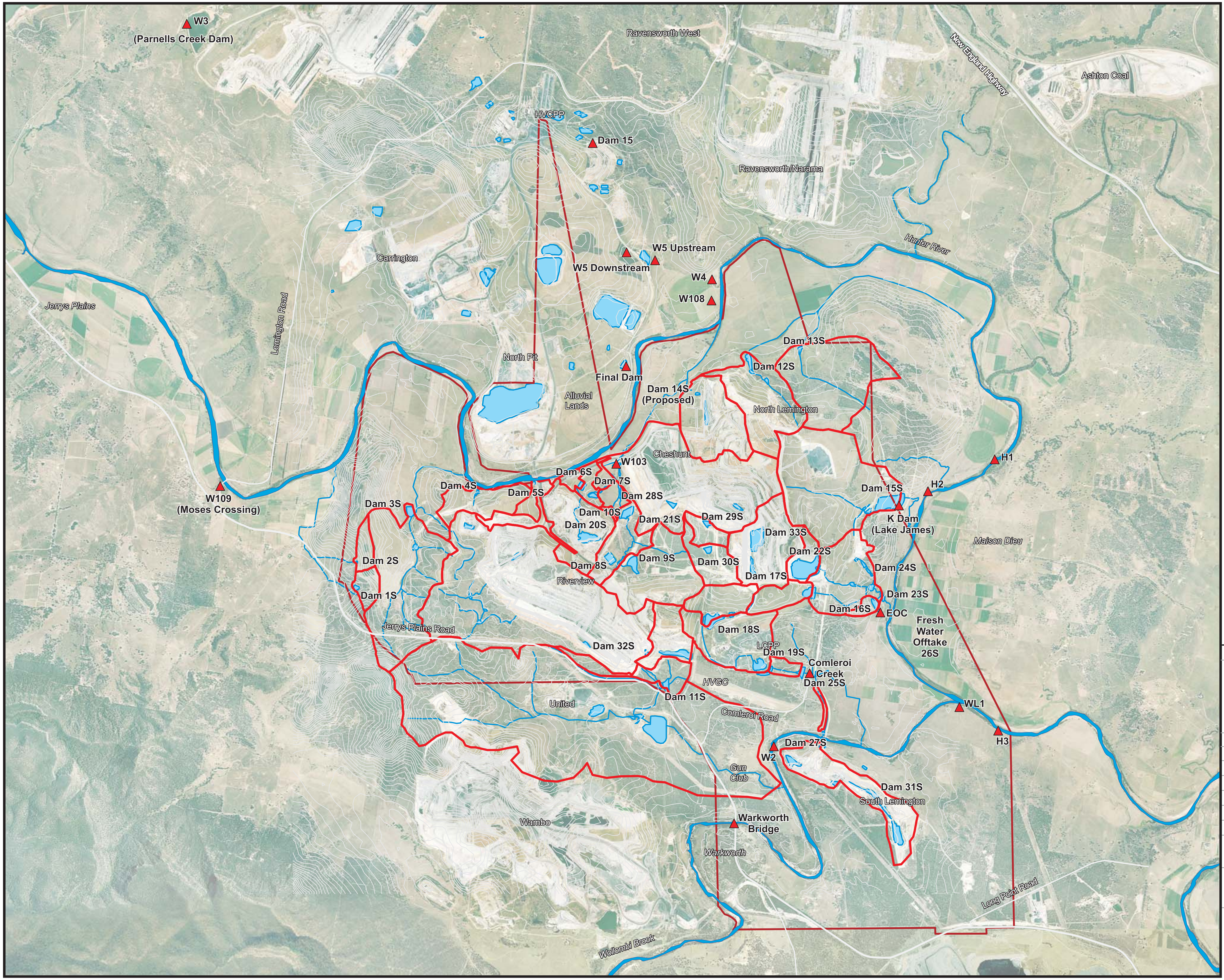
The nearest long term gauging station which records evaporation data operated by the Bureau of Meteorology is located at Cessnock. The average annual evaporation based on data collected between 1975 and 2006 is 1338 mm.

10.3.3 Streamflow Data

The DWE's PINNEENA database has streamflow and river gauging data for Wollombi Brook and the Hunter River. Stream discharge-duration data for these locations are presented in *Appendix A of Annex K. Table 10.1* contains a summary of average and maximum daily flows at locations on Wollombi Brook and the Hunter River.

Table 10.1 Summary of Streamflow Data

Gauging Station	Location	Period of Record	Average Flows (ML/day)	Max Flows (ML/day) and date of occurrence
210004	Wollombi Brook, Warkworth	1908 – Present	468	322,576 26/2/1955
210083	10 km upstream of HVO – Hunter River	1969 – Present	1008	208,070 5/3/1977
210134	6 km downstream of junction of Wollombi Brook and Hunter River	1994 – Present	1121	115,815 10/8/1998



Legend

- Catchment Boundary
- Contours
- Storages
- Streams / Rivers
- Roads
- Project Application Area
- WQ Sampling Site

Figure 10.2

Water Management Arrangement

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_EAR_G_06
Date:	20/06/2007 Drawing size: A3
Drawn by:	GC Reviewed by: LS
Source:	-
Scale:	Refer to Scale Bar

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10.3.4 Flooding

Estimates of 100-year ARI flood levels have been derived on a statistical basis from recorded flood levels in the Hunter River and Wollombi Brook. As it is not possible to equate the 100-year level to a single event for each catchment, for consistency a common (or envelope) 100-year level of 59.1 m AHD has been adopted for both the Hunter River and Wollombi Brook at the junction as a conservative estimate. An approximate extent of the 100-year ARI design flood is shown in *Figure 10.3*.

The impacts on flood levels of the approved and constructed Hobden Gully levee and the two approved and constructed Cheshunt Pit levees in combination with all other constructed and proposed levees on the northern side of the Hunter River were estimated to be insignificant and less than 60 mm total maximum afflux (increase in flood level).

Similarly, the impacts on flood levels in Wollombi Brook of the levees around South Lemington Pits 1 and 2 proposed in the South Lemington EIS (May 1998) were modelled. These levees were estimated to create less than 30 mm total maximum afflux, which is considered to be insignificant. There would be no discernible impact on flood extent as a result of these levees. All approved levees constructed or proposed to be constructed for HVO South are shown in *Figure 10.3*.

Levees are known as:

- CL1 Hobden Gully Levee (Cheshunt Pit Levee 1)
- CL2 Barry's Levee (Cheshunt Pit Levee 2)
- CL3 Cheshunt Pit Levee 3
- SLL1 South Lemington Pit 1 Levee
- SLL2 South Lemington Pit 2 Levee (Appleyard Levee).

Wollombi Brook

Two major flood events have been recorded in the lower Wollombi Brook on 17-19 June 1949 and 24-27 Feb 1955. Records vary on maximum flood levels, however, it has been determined that the 1949 flood was the largest flood in Wollombi Brook upstream of Warkworth and the 1955 flood was the largest flood for most of the reach downstream of Warkworth.

The recorded/estimated flood levels for Wollombi Brook are provided in *Annex K.*

For the South Lemington EIS (SKM 1997), design flood levels were calculated using a multiple regression analysis in conjunction with discharge frequency curves at Singleton and Bulga. Flood level profiles were calculated using a computer programme. While these estimated levels may be subject to change as flood records are extended and as refinements and changes occur to the hydraulic model, until a formal flood study is undertaken by DWE or other authorities, the estimates made in the South Lemington EIS and given below in *Table 10.2* will be adopted.

Table 10.2 Design Flood Levels at South Lemington

ARI (Years)	Flood Level at Warkworth (mAHD)	Flood Level at South Lemington (mAHD)	Flow Rate at South Lemington (m^3/sec)	Channel Velocity South Lemington (m/sec)
5	53.3	53.4	600	1.33
10	55.4	54.9	1400	1.52
20	57.5	57.2	1900	1.38
50	59.0	58.9	2500	1.39
100	59.4	59.3	2700	1.41

Hunter River

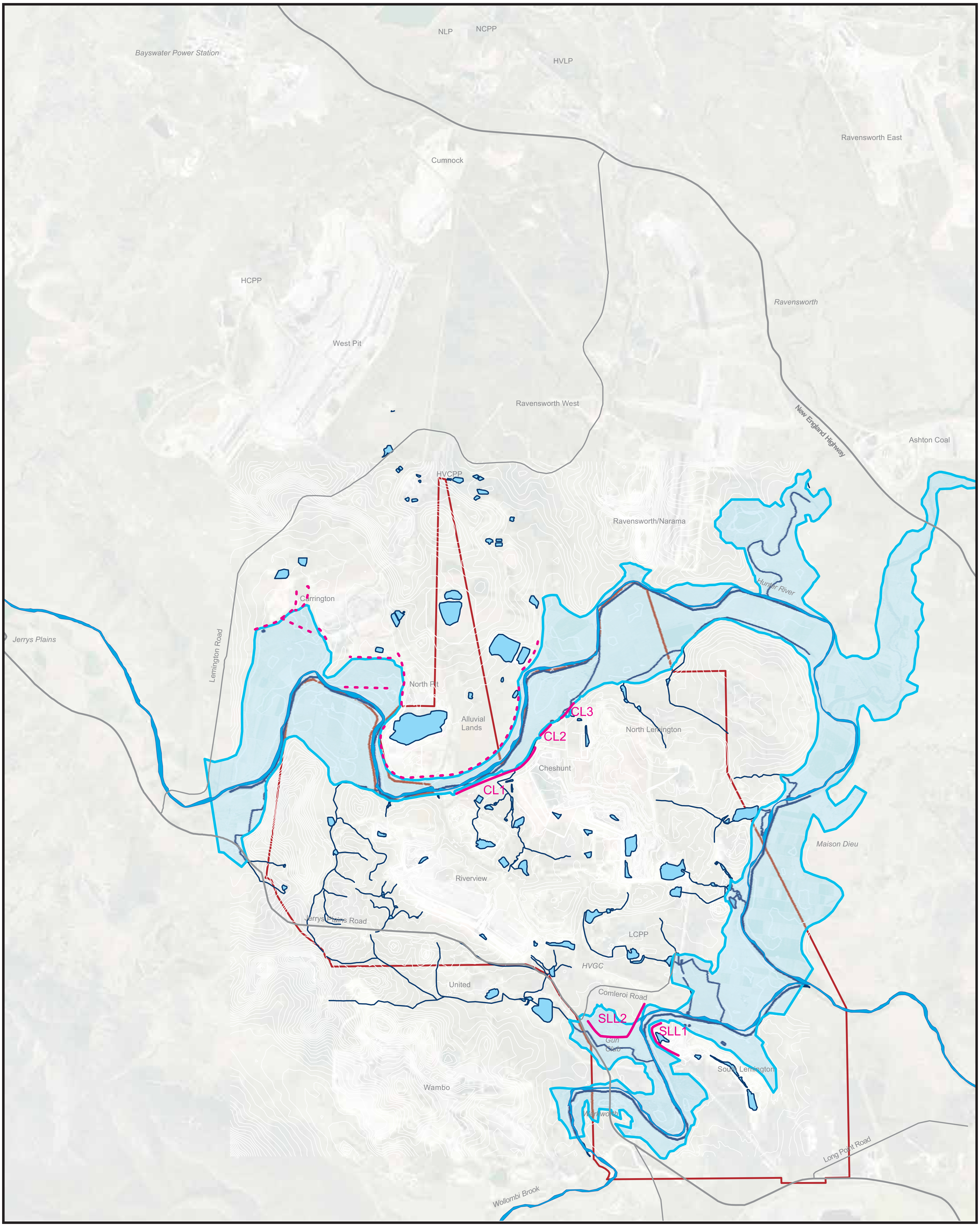
For the Hunter River, near the Project Application area, the maximum flood event is believed to have occurred on 24 February 1955. The recorded flood level at Singleton on this date was 42.2 mAHD. Insufficient recorded information is available from other nearby stations to confirm the 1955 flood levels at the HVO site.

In addition to levees constructed on the north side of the Hunter River to protect HVO North, a levee (the Hobden Gully levee) was constructed across the mouth of Hobden Gully to protect the Cheshunt and Riverview Pits from flood events up to the 185-year ARI (approximately 71.0 mAHD), which is equivalent to the estimated 100-year ARI flood level in this section of the river plus 1 m freeboard (*Figure 10.3*).

The 100-year ARI flood level in the Hunter River is estimated to vary from 59.1 m AHD at the junction with Wollombi Brook to 60.2 m AHD adjacent to Dam 23S to 66.5 m AHD adjacent to Dam 12S and 73.2 m AHD adjacent to Dam 4S (*Figure 10.2*).

Works Approvals

The existing approved and constructed levees are all licenced with DWE works approval (*Annex D*). These licences will be retained. All previously approved but not yet constructed and proposed levees will not be required to obtain works approvals under the Part 3A Project Approval. These levees include South Lemington Pit 1 levee and South Lemington Pit 2 levee.



Legend

- Extent 100 Year Flood
- Contours
- Storages
- Streams / Rivers
- Roads
- Project Application Area
- HVO South Levees:
  - CL1 Hobden Gully Levee
  - CL2 Cheshunt Pit Levee 1
  - CL3 Cheshunt Pit Levee 2
  - SLL1 South Lemington Pit Levee 1
  - SLL2 South Lemington Pit Levee 2
- HVO North Levees

Figure 10.3

Design 100 Year ARI Flood Extent and Levees

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_EAR_G_04_R0
Date:	27/09/2007 Drawing size: A3
Drawn by:	GC Reviewed by: LS
Source:	-
Scale:	Refer to Scale Bar

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10.3.5 Water Quality Monitoring

Surface water monitoring is undertaken at HVO on a monthly basis to assess both the quality of mine water in onsite dams and the possible impact of mining on the surrounding surface waters. The results of this monitoring, as reported in the HVO AEMRs for the years 2003 to 2005 indicate that:

- dry conditions generally lead to an increase in mine water salinity and pH and a decrease in total suspended solids (TSS). These trends are reversed during wet conditions with an increase in TSS and a decrease in pH and salinity;

- Dam 15S (Lake James) is the licenced discharge dam for HVO South. In general water quality monitoring results indicate pH readings from 8.9 to 9.4 and Electrical Conductivity (EC) of 5010 - 6180 µS/cm with low TSS (<50 mg/L). TSS has occasionally exceeded 50 mg/L but no releases are made when approved discharge conditions (TSS of 120 mg/L) are not met. No releases have occurred from this dam since at least 2001;

- Dam 16S (East Opencut) is located adjacent to the Hunter River within the Project Application area. In general water quality monitoring results indicate pH readings from 8.9 to 9.4 and EC of 2110 - 3050 µS/cm with low TSS (<50 mg/L);

- Hunter River water quality is monitored at seven representative sampling sites, located over an area from upstream of the mine operations to a point downstream of the junction with Wollombi Brook. WL1 is the site located furthest downstream and is influenced by saline water from Wollombi Brook. Water quality is influenced significantly by weather and flow conditions, with raised TSS and lowered pH and EC being associated with high river flow. All seven sites have similar water quality and similar responses to rainfall events;

- water is monitored at three representative locations on Wollombi Brook which has historically had saline water. One of the monitoring sites has been dry during many of the monitoring events, with the other two sites being located where flow is typically present. EC values typically range from 480 µS/cm to 3390 µS/cm. The pH readings for the Wollombi Brook were neutral to alkaline with values ranging from 7.4 to 9.2; and

- Comleroi Creek has had relatively constant pH, which is typically close to neutral. EC is typically in the range of 200 µS/cm to 900 µS/cm and TSS remains constant and below 50mg/L throughout the year.

Table 10.3 presents the EC values (average and range 2004 – 2007) for dams at HVO representing a TSF, mine water dam and discharge point.

Table 10.3 Representative Electrical Conductivity Values for Dams Across HVO

EC (uS/cm) 2004-2007	**Function and Location**		
	TSF	Mine Water Dam/ Discharge Point	Mine Water Dam
	North Pit TSF	Dam 11N	Dam 16S (EOC)
Average	5245	6556	2361
Range	4970 - 5520	3060 - 8900	570 - 5490

HVO participates in the Hunter River Salinity Trading Scheme (HRSTS), allowing it to discharge from Lake James to the Hunter River. These discharges can only take place during high flow and flood flow conditions in compliance with strict HRSTS regulations. No discharges were made under the scheme during the 2003 to 2005 period.

10.3.6 *Existing Water Management*

The existing water management system comprises a number of clean water and 'mine affected' water drainage systems connected by a network of pumps and pipelines to transfer water between locations. Mine affected water storages include TSFs, pit storages and other dams containing saline or otherwise contaminated water. An arrangement plan showing key elements is given in *Figure 10.2*. A summary of the water management facilities and operating protocols is also given in *Appendix C of Annex K*.

Various catch drains, channels, contour drains and culverts collect and convey runoff from clean and disturbed areas to the appropriate storages and watercourses. Silt traps and other pollution control devices are also used at various locations along these drains to reduce the quantities of suspended sediment reaching sedimentation dams. Overflows from most sedimentation dams flow directly to external waterways, all of which eventually flow to Wollombi Brook or the Hunter River.

Clean water runoff from undisturbed and fully rehabilitated areas is directed away from opencut mining areas, haul roads, TSFs and other disturbed areas. Catch drains also divert clean runoff from undisturbed areas around mine constructed storages wherever practical. Contour drains divert runoff towards storages from newly rehabilitated areas and from other areas where it may pick up sediment.

Current practice is to maintain sufficient freeboard in key mine water storages with overflows that flow directly to external waterways. The aim is to provide sufficient reserve capacity (air space) in these dams to store the 100-year ARI runoff from the contributing catchments.

Dams 15S, 16S, 17S and 20S are the main mine water storages. These dams contain water with elevated salinity levels and all are interconnected by the pipeline network. Water is able to be transferred north and south of the Hunter River via the Hunter River bridge, to HVO North Dams and the North Pit void.

Dams 23S and 24S are downstream of the Lemington workshop and also receive decant water and seepage from the No. 5 TSF (22S). Water quality in these dams is consequently degraded with elevated Biochemical Oxygen Demand (BOD), Carbon Oxygen Demand (COD), nutrients and hydrocarbons.

Dam locations are shown on *Figure 10.2.*

10.3.7 *Existing HVO South Water Supply*

There are four existing (high security) water licences that permit CNA to pump water from the Hunter River. The combined entitlement is 4165 Units (ML/annum or a share of the available resources). These licences were revised in March 2005 and are summarised in *Annex K*. All licences have continuing tenure and do not limit extraction rates or times.

10.3.8 *Tailings Storage Facilities*

Current TSFs 1a, 1b, 2, 3, 4a, 4b and 5 are located in Lemington (northern area). TSFs 1a, 1b, 2, 3 and 4a are capped and rehabilitated. TSF 4b is inactive and is partially capped and rehabilitated, with completion of rehabilitation following consolidation and drying of the remaining tailings. TSF 5 is currently inactive but remains available for additional future tailings storage. The locations of existing, rehabilitated and proposed TSFs are shown on *Figure 5.7*.

10.4 *IMPACT ASSESSMENT*

10.4.1 *Demand and Water Supply Requirements*

Mining of additional areas has been assessed as having a minor impact on overall water demand and consequently on the management of water supply storages. The currently licenced water extraction volume of 4165 MLpa should be adequate for both HVO North and HVO South requirements including the increase required by the upgrade of the LCPP to 16 Mtpa, provided internal water use continues to be actively managed, and provided high security water licence allocations are maintained at the current levels.

The reactivation of the LCPP to higher production levels than were previously approved will result in an increase in water demand. Up to 4500 MLpa may be required for the processing of up to 16 Mtpa ROM of which 2,700 MLpa would need to be consistently drawn from the Hunter River unless the current water system is modified. The most effective option for minimising the risk of shortage and the consequent need to pump from the Hunter River was found to be installation of direct pumping capacity from the main HVO South storage (Dam 20S) to the LCPP. As mining progresses, a replacement storage to provide capacity for storage of mine water, and an increase in pumping capacity to the LCPP will be required.

Seepage into the Cheshunt Pit is predicted to range from 0.7 ML/day (281 MLpa) to 7.3 ML/day (2900 MLpa), dominated by water contained within the material disturbed by mining. Groundwater modelling has predicted that this may vary by up to 100% in initial stages of mining. Pit seepage accumulation will be reduced by evaporation losses. These losses are predicted to reduce maximum pit seepage accumulation from 7.3 ML/day to between 6.5 ML/day in winter and 5.0 ML/day in summer.

Cheshunt Pit can eventually replace Dam 20S as the main source of water for the LCPP; however, the relocated Dam 20S may continue to operate as a central balance storage until late in the progression of mining in the Riverview Pit area. In addition, the increasing rate of seepage into Cheshunt Pit will eventually eliminate all requirements to pump from the Hunter River.

Modifications to the water management system should result in the ability to cope with changes in demand. In addition, reduction in losses, through the coordinated use of the North Pit Void as a large balance storage, is expected to improve the proportion of recycled water used and consequently reduce the risk of water shortages during extended dry periods. The North Pit Void has a theoretical ultimate capacity to store up to 29,000 ML but the proportion of useable storage will depend on modifications to the water retrieval system. The use of this storage would depend on stages of mining operations, tailings disposal options and installation of appropriate pumps and pipe networks.

Several sedimentation and mine water dams may require relocation or augmentation as a result of modifications to the final landform that differ from previously approved mine plans (*Table 4.1, Annex K*). However, any relocation or augmentation will be undertaken so that there will be little change to the overall storage capacity of the system and its ability to supply water.

10.4.2 Changes to Catchments and Yields

Several small sub-catchments will be altered in size and shape as mining progresses in accordance with the proposed mine plan (as at September 2006). This will have an insignificant impact on overall catchment yields (<1000 MLpa).

Riverview Pit will now be backfilled rather than be left as a void so that rainfall will eventually run off this sub-catchment rather than be retained in the void. The relocated final void in Deep Cheshunt will be approximately 300 ha in area and will not drain to the Hunter River. The total yield of the Hunter River catchment above Wollombi Brook will therefore be reduced by approximately 0.03% in relation to pre-mining conditions. This is insignificant in both absolute and cumulative impact terms. This new void is likely to take a considerable time to fill with water from groundwater inflows and from direct rainfall. Changes to final landforms in South Lemington Pits 1 and 2 inclusive of TSFs will not alter the final sub-catchment areas contributing to flows in Wollombi Brook.

In summary, there will be minor local changes to some final sub-catchments as a result of modified final landforms. However, the proposal will have a negligible impact on flows in Wollombi Brook and the Hunter River on the basis that the total contributing catchment area will be unchanged and only a slight change will occur in proportions of flows to the Hunter River and Wollombi Brook. The arrangement for final catchments is shown in *Figure 3.1 of Annex K.*

10.4.3 Diversions and Surface Drainage

The proposed extensions to the opencut pits will intercept several existing small watercourses which will require diversion. Some of the existing dams, channels and other drainage structures will be affected as mining operations progress and will need to be reassessed, relocated, modified or replaced by other drainage arrangements. This will ensure that clean water runoff continues to be diverted around disturbed areas and that all mine affected water is directed into the mine water management system.

Future mining and associated alterations to landforms may modify overland flow paths to a minor extent. However, there will be no significant changes to flows and local flooding as a result.

Within the Project Application area and for the revised mine plan there will be no significant changes to the water management activities previously approved with the following exceptions:

- the relocation or reconfiguration of the HVGC airstrip will require a new drainage system but will not impact on adjacent drainage systems;

- the upgraded or reconstructed LCPP may considerably alter the runoff characteristics of the existing drainage system in this area;

- increases in activity at the Lemington workshop will increase the loads on the water treatment system between the workshop and Dam 23S. This system is already considered to be inadequate so that there is no capacity for these increased loads; and

- the levee around South Lemington Pit 2 will become permanent rather than be removed (as detailed below). However, because the area behind the levee will be filled to levels above probable maximum flood level, there will be no possibility of failure of this levee after the final landform has been achieved.

These changes have resulted in management measures as detailed in *Section 10.5*.

10.4.4 Flooding

The previously approved and as yet unconstructed levee around South Lemington Pit 2 will encroach into the floodplain of Wollombi Brook to a lesser extent than previously planned and will therefore reduce the expected impact on flooding in Wollombi Brook, which was previously estimated in SKM 1997 to be insignificant at less than 30 mm of afflux in a 100-year ARI flood. This will therefore have a negligible impact on flow regimes. The South Lemington Pit 1 levee will remain unchanged as a result of this proposal.

The final landform in the vicinity of South Lemington Pit 2 will be significantly different to that shown in the 1997 EIS for this mine (as amended in 1998). The currently consented plan is to construct a levee (SLL2) to protect against the 100-year ARI flood with 0.7 m freeboard (ie crest level 60 mAHD) around Pit 2 until mining is complete. The levee would then be dozed into the pit and final surface restored to levels similar to existing. The revised plan for this proposal is to leave the levee in place and to fill behind the levee to higher levels than existing surface levels. The realignment of Comleroi Road will result in the construction of the road on top of or inside the levee (*Figure 5.8*). The retention of the South Lemington Pit 2 levee will not cause significant impacts.

The Cheshunt Pit will be protected by levees CL1, CL2 and CL3 during mining operations. After completion of mining when the Deep Cheshunt Pit final void remains, only levee CL1 (the Hobden Gully levee) may be required for long term flood protection. CL1 is capable of withstanding floods up to the 100-year ARI event with freeboard (or approximately the 180-year ARI event at the point of overtopping). Failure or overtopping of all levees as a result of floods in the Hunter River catchment will be addressed in the levee management section of the Water Management Manual. Other options to address potential flooding impacts at the final void are provided in *Annex K.*

An option exists, that has not been assessed in detail, for the Deep Cheshunt Pit final void to be used as a buffer for floods in the Hunter River by acting as an off-line storage. This would require diversion structures to direct a proportion of flood flows into the void. During times of low flows the water may be able to be diverted to the Hunter River. It could be expected that water quality would improve due to settlement of suspended solids in the void; however, changes in salinity would need to be confirmed by appropriate modelling. In addition, impacts on the downstream ecosystem would need to be assessed before this option could be considered further.

10.4.5 *Water Quality and Discharges*

Discharges of surface water from opencut voids and other disturbed areas have the potential to adversely impact on the water quality of receiving waters, including increasing sediment loads and salinity, unless the runoff is adequately treated and managed. Continued implementation of surface water management measures already in place at HVO South, including erosion and sediment control measures and containment of saline water will minimise any adverse impacts on water quality. Long term changes to surface water quality following the completion of rehabilitation works are unlikely. However, because the revised mine plan includes higher and, in some locations, steeper final landforms, there is potential for increased erosion until vegetation is re-established.

The potential for increasing salinity of receiving waters is associated with leaching of soluble salts from the spoils, tailings and surrounding ground. The potential impacts of saline water discharge into the Hunter River are addressed by implementation of the Hunter River Salinity Trading Scheme. This scheme was initiated by the EPA and only permits discharges at times of high flow in the Hunter River, with prescribed controls to manage cumulative impacts (HVO EPL). It is generally found that saline leachate diminishes rapidly after capping and revegetation of TSFs and spoil mounds. It is more common that salinity is affected by voids and their interaction with groundwater. This issue is dealt with in more detail in the *Groundwater Assessment Report* presented as *Annex J*.

10.4.6 *Tailings Storage Facilities*

The existing TSF 5 is available for an estimated additional tailings deposition capacity of 230,000 m^3. A four metre lift on the TSF is fully designed and approved by the Dam Safety Committee. It is estimated the lift will provide a further 745,000 m^3 capacity. Beyond the four metre lift, a concept design for a second lift has been prepared to provide for a further 820,000m^3 capacity.

Whilst TSF 5 has capacity for some of the tailings generated by the LCPP, an additional volume of approximately 11.8 million m^3 of material must be located within HVO South. To accommodate this volume of material, additional TSFs are proposed within the South Lemington Pit 1, the eastern section of the Riverview Pit and within the south eastern Riverview Pit extension area. As tailings disposal is in-pit, there will be no impacts from TSFs on surface water drainage.

The management of tailings is described further in *Chapter 2*. The proposed locations of the additional TSFs are shown in *Figure 5.7*.

10.4.7 *Final Void*

One final void is now proposed for HVO South; the Deep Cheshunt final void. The location and size of this void and void management details are provided in detail *Chapter 19 - Mine Landscape Planning*. Water in the Deep Cheshunt Pit final void may take up to 250 years to reach an estimated equilibrium level of RL 0 mAHD, which is approximately 50 to 60 m below current ground surface in this area. The time to fill the void would be significantly shortened if flood flows from the Hunter River were allowed to enter the void or if the levee were overtopped by a flood in excess of the 180-year ARI event.

10.5 MANAGEMENT MEASURES

The management of surface water at HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle.

The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for surface water management are to:

- manage catchments and water on the mine lease in a way that minimises surface water impacts to the environment and downstream neighbours, and limits interference to mining production;
- maintain quality control and segregation of clean and mine affected water;
- reduce reliance on fresh water usage; and
- keep the local community and regulators informed of activities where required and to respond quickly and effectively to issues and complaints.

The key objectives for sediment and erosion control are to:

- manage the activities in a way that minimises erosion and sedimentation impacts to environment and neighbours, and limits interference to mining production;
- protect natural and rehabilitated landforms and minimise erosion; and
- minimise sedimentation of natural waterbodies and watercourses.

The technical report (*Annex K*) identified a number of control measures to minimise the potential impacts to surface water resulting from the proposal. These measures have been considered in the context of the existing HVO activities and the CNA EMS. Many of these measures are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

Regular controls for mine water management include:

- managing operations to minimise river extractions and discharge, by recycling mine affected water;
- diverting clean water runoff around disturbed areas;
- ensuring contaminated water is directed to mine water storages;
- reviewing and upgrading water management structures with reference to HVO South water balance and storage requirements;
- drains, diversion banks and channels will be constructed in accordance with the CNA EMS Water Management procedure;
- all erosion and sediment control measures will remain in place until exposed areas are rehabilitated and stabilised;
- ensuring any discharge is from authorised discharge points in accordance with HRSTS protocols;
- monitoring licenced discharges and report in accordance with the conditions of the HRSTS;
- constructing levees where required to prevent flood water inflows to pits;
- the extent of disturbance (including trafficable areas) will be minimised and identified using barriers and signage;
- prior to disturbance of land, appropriate erosion and sediment controls will be established. A combination of temporary and permanent measures may be necessary for disturbances associated with construction, mining, landscaping and rehabilitation;
- progressive rehabilitation of mined areas will be undertaken as soon as practicable. Reshaped areas awaiting revegetation will be cultivated on the contour to maximise infiltration;
- soil and/or vegetation material that is removed from the area of operation will not be placed in a position where it could be swept into the Hunter River;
- monitor surface water at representative sites as detailed in the Surface Water Monitoring Programme and report in the AEMR;
- investigate any unusual water monitoring results, identify location and operations and determine if additional management measures are required; and
- regularly review Surface Water Monitoring Programme and update monitoring points and monitoring parameters as required by regulatory guidelines.

Commitments Specific to the Proposal

In addition to the mitigation measures the following controls will be implemented.

Water Supply:

- report on water use in the AEMR;
- offset seepage in accordance with regulatory requirements;
- monitor and record abstraction quantities; and
- increase pump capacity from Dam 20S (or alternative storage) to the LCPP and undertake minor improvements to the existing HVO South water system in conjunction with the design of the LCPP to minimise need to pump from Hunter River.

Water Discharge:

- review current discharge conditions in respect of the proposal and incorporate where applicable into the Water Management Manual.

Flood Mitigation:

- construct South Lemington Pit 2 Levee SLL2 as a permanent levee and ensure the outer face of the levee will withstand 100-year ARI flood flow velocities; and
- assess Hobden Gully levee (CL1) prior to mine closure to determine if protection of the Deep Cheshunt Pit final void is required.

Erosion and Sediment Control:

- erosion and sediment control structures will remain in place to divert water away from the Deep Cheshunt Pit final void unless required for use as flood flow storage.

Monitoring and Inspections:

- prior to LCPP and infrastructure construction works review the Surface Water Monitoring Programme, establish additional representative monitoring sites where required and undertake monitoring; and
- annual monitoring of water level and water quality in the Deep Cheshunt Pit final void after mining operations have ceased as part of the Post Closure Monitoring Programme. Monitoring will continue in accordance with regulatory requirements.

10.6 CONCLUSIONS

Overall impacts on surface water as a result of the proposal will be minor. The main changes that may influence surface water management include:

- increased water usage for the new or upgraded LCPP and support facilities;
- retention of South Lemington Pit 2 levee (SLL2);
- revision of the mine plan resulting in a final void in the Deep Cheshunt Pit; and
- modification to final landforms and changes to catchments.

These impacts will be addressed through improvements to the storages and drainage networks and development of a HVO Water Management Manual including a surface water management plan. Extension of modified landforms into new areas will require review and modification of existing drainage systems only and will not require new systems.

Enlargement and improvements to supply storages and to water quality management systems are proposed to fully mitigate the impacts of changes to the LCPP. It is proposed that all contaminated runoff from the new or upgraded LCPP will be maintained within the mine water management system.

The retention of the South Lemington Pit 2 levee will not cause significant impacts and mitigation measures are not proposed.

As referenced in *Chapter 9*, the management of the Deep Cheshunt Pit final void will be incorporated into the HVO Mine Life Plan for closure. In addition, a Final Void Management Plan will be prepared at least five years prior to closure. The key requirements are to ensure the ongoing stability of the void and safety of the community. Management options for the final void will be developed in accordance with legislative requirements with consideration of community expectations.

11 ECOLOGY

This chapter presents the major findings of relevant previous ecological assessments undertaken at HVO South, assesses potential impacts from the current proposal on species, populations and vegetation communities of significance, identifies opportunities to enhance biodiversity, recommends measures for management, mitigation of impacts and future ecological monitoring and provides proposed ecological commitments for the project. This chapter is based on the ecology report prepared by ERM, 2008 which is provided as Annex L.

11.1 INTRODUCTION

The flora and fauna within and surrounding HVO South have been extensively studied in the past. Currently, the area of disturbance due to mining and infrastructure inside the Project Application area is 2980 ha. This proposal would increase the area of mining and infrastructure disturbance by 250 ha. Of the 250 ha, there is only 48 ha of remnant vegetation and 92 ha of regenerated vegetation.

11.2 PURPOSE OF THE ECOLOGICAL ASSESSMENT

The specific purpose of this ecological assessment was to:

- identify and survey areas within HVO South where it was considered that further ecological field assessment was necessary to address potential impacts of the proposal on threatened species and communities and native flora and fauna; and

- identify and survey areas where field work had not been undertaken within the last two years and there was potential for vegetation and habitats to have altered.

Identifying these areas within HVO South ensured that species of conservation significance with potential to occur within the Project Application area were addressed in impact assessments, and that suitable mitigation and management measures and compensation measures could be developed.

This chapter:

- provides a gap analysis of existing ecological assessments undertaken within HVO South;

- presents the major findings of relevant previous ecological assessments undertaken at HVO South;

- describes the recent surveys undertaken for this project;

- assesses potential impacts from the current proposal on species, populations and vegetation communities of significance considered likely to occur within impact areas or previously recorded within these areas;

- identifies opportunities to enhance biodiversity;

- recommends measures for management, mitigation of impacts and future ecological monitoring; and

- provides proposed ecological commitments for the project.

11.3 METHODOLOGY

The methodology for the ecological assessment included:

- desktop assessment;
- gap analysis;
- field survey;
- assessment of potential impacts; and
- review of existing management measures to identify additional measures required as a result of this proposal.

This assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. Therefore the existing and potential environmental impacts are already approved and management measures have been developed and implemented. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. The assessment results are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been approved.

11.3.1 Desktop Assessment

A desktop assessment was undertaken to identify reports and other sources of data with respect to the ecology of HVO South. Sources of information reviewed included previous ecological assessment reports for HVO and surrounding mines as well as reports covering the region. A full list of sources reviewed is provided in *Annex L.* In addition to reports, various databases were used to obtain records of species of conservation significance and Matters of National Environmental Significance protected under the *EPBC Act* previously recorded within the locality (within a 10 km radius of HVO South). These included:

- DECC Wildlife Atlas database for threatened species listed under the NSW *TSC Act*;
- Commonwealth Department of the Environment and Water (DEW) online search for matters of National Environmental Significance listed under the *EPBC A*ct that may occur in the locality;
- Birds Australia New Atlas of Australian Birds database;
- Bird records for the locality from the Hunter Bird Observers Club;
- Australian Museum database for threatened species listed under the *TSC Act* and *EPBC Act*; and
- Sydney Royal Botanic Gardens database for threatened species listed under the *TSC Act* and *EPBC Act*.

11.3.2 *Gap Analysis*

A consolidated list of previous relevant ecological assessments and key findings was compiled to identify gaps in data across the Project Application area. The gap analysis was used to identify sites that may require field survey, and to identify any ecological issues that may require assessment of impact. Field surveys undertaken in 2006 were then conducted based on the results of the gap analysis. It was not considered necessary to resurvey the entire HVO South area, given the areas already impacted by mining and the extent and number of surveys already undertaken.

11.3.3 *Field Surveys 2006*

The gap analysis revealed that field surveys for both flora and fauna at HVO South have been extensive over the last decade, and are continuing in the form of a biodiversity monitoring programme. May 2006 surveys were therefore designed to ground-truth some of the previous field survey results and results of the desktop assessment, and to reassess some areas that had not been surveyed within the last two years.

Field surveys at HVO South were undertaken within the selected areas (shown on *Figure 2.1 of Annex L)* by two ecologists from 29 May 2006 to 2 June 2006. The survey locations selected included areas that will potentially be impacted by the proposal and remnant woodland areas that may provide opportunities for biodiversity enhancement linking to the post mining landscape. Survey activities included:

- ground-truthing of vegetation communities mapped by the Hunter Catchment Management Trust (HCMT) (2005);
- spotlighting to detect nocturnal fauna;
- mapping of occurrences of River Red Gums (*Eucalyptus camaldulensis*);
- mapping of occurrences of Coast Banksia (*Banksia integrifolia*);
- assessment of areas that may be suitable as biodiversity enhancement areas;
- assessment of the general environment of each area and the potential for the area to provide habitat for native flora and fauna species, particularly threatened species; and
- general familiarisation of all areas considered to have the potential to be impacted by planned and future extensions to mining.

11.3.4 *Impact Assessment Methodology*

Impact assessments for this current proposal considered the previous assessments undertaken and the potential direct, indirect and cumulative impacts of the existing approvals for vegetation clearance within HVO South. Any threatened species, populations or ecological communities not previously assessed under s5A of the *EP&A Act* (Eight-part Test – now undertaken as a Seven-part Test) and *EPBC Act* were identified and discussed with respect to the potential for them to be impacted by existing approvals for vegetation clearance within HVO South.

The impact assessments for this proposal are made on the basis that previous impact assessments have concluded that no significant impacts to threatened species or ecological communities were expected. Much of the habitat upon which these assessments were undertaken has since been cleared.

11.4 EXISTING ENVIRONMENT

11.4.1 Desktop Assessment Results

The desktop assessment revealed that the majority of HVO South has been assessed previously and that the general environments are low in habitat complexity. *Figure 11.1* presents the areas where ecological assessments have been undertaken within HVO South.

The greatest number of species recorded at HVO South are birds, with a general low diversity of ground-dwelling and arboreal mammal species, reptiles and amphibians. This would be expected given the isolated nature of the vegetation remnants found within HVO South, making them more suited to mobile species such as birds and bats.

The diversity of flora species varied across the site and was greatest in areas where disturbance levels were low or where disturbances have been removed. All areas contained exotic species, which were generally dominant in areas of high disturbance such as roadsides and riparian zones.

11.4.2 Threatened and Protected Species

Table 11.1 summarises the threatened species, populations and ecological communities that have been previously recorded within HVO South. Matters of National Environmental Significance protected under the *EPBC Act* with the potential to occur within the locality are shown in *Table A.1* (*Appendix A of Annex L*).

Table 11.1 Threatened Species, Populations and Ecological Communities Previously Recorded within HVO South

Threatened Species / Population / Community	Conservation Status	
	TSC Act	***EPBC Act***
Species		
Grey-crowned Babbler (*Pomatostomus temporalis*)	V	-
Brown Treecreeper (*Climacteris picumnus victoriae*)	V	-
Speckled Warbler (*Pyrrholaemus sagittatus*)	V	-
Black Bittern (*Ixobrychus flavicollis*)	V	-
Squirrel Glider (*Petaurus norfolcensis*)	V	-
Eastern Freetail Bat (*Mormopterus norfolkensis*);	V	-
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	V	-
Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)	V	-
Fishing Bat (*Myotis adversus*)	V	-
Population		
River Red Gum (*Eucalyptus camaldulensis*) (Population in the Hunter Catchment)	E	-
Community		
Hunter Lowland Redgum Forest (HLRF)	E	-
Warkworth Sands Woodland (WSW).	E	-
• V = Vulnerable, E = Endangered		

Other threatened species recorded in close proximity to HVO South include:

- Black-breasted Buzzard (*Hamirostra melanosternon*) (recorded at Mount Thorley Warkworth Mine by Andrews Neil 2006);

- Brush-tailed Phascogale (*Phascogale tapoatafa*) (recorded on Jerrys Plains Road by ERM (2005a));

- Diamond Firetail (*Stagonopleura guttata*) (recorded at Warkworth by ERM (2004)); and

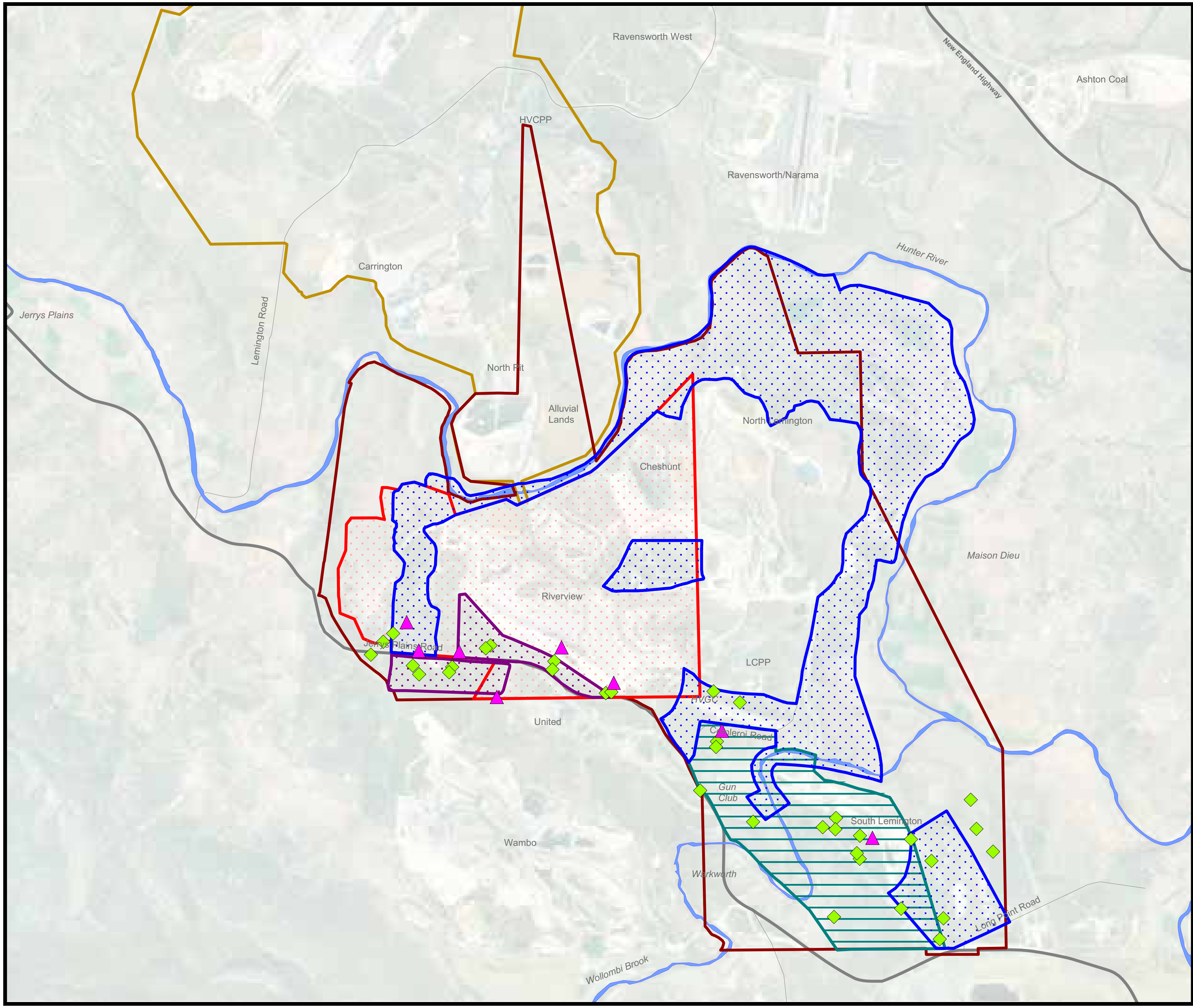
- Hooded Robin (*Melanodryas cucullata cucullata*) (recorded at Warkworth by ERM (2004)).

No species listed as threatened under the *EPBC Act* have been recorded at HVO South. However, several species listed as migratory or marine and protected under the *EPBC Act* have previously been recorded in the field (*Annex L*). These species are shown in *Table 11.2*.

Table 11.2 Migratory or Marine Protected Species Previously Recorded at HVO South

EPBC Protected species recorded at HVO South
White-throated Needletail (*Hirundapas caudacutus*)
Rainbow Bee-eater (*Merops ornatus*)
Herons (*Ardea* species)
Spoonbills (*Platalea* species)
Species belonging to the family Anatidae (Ducks, Geese, Teals, Hardhead)
Species belonging to the family Falconidae (Falcons and Kestrels)
Species belonging to the family Accipitridae (Hawks, Eagles, Harriers)

A higher level of protection is afforded to species listed as threatened. If it was considered likely that the migratory or marine species listed in *Table 11.2* would be significantly impacted by the proposal, an EPBC referral would be submitted to the Commonwealth Environment Minister for consideration. This may occur if the proposal was going to have a significant impact on large numbers of these species, or impact on habitats upon which migratory or marine species are considered reliant, such as large wetlands/lakes or known migratory breeding sites, where these species often congregate in large numbers. However, there are no such habitats within the proposed disturbance areas and the species were recorded in low numbers, or recorded flying over the site. Therefore a referral to the Commonwealth is not considered necessary for this proposal.



Legend

Sample Site Locations (ERM 2005A)

Vegetation Quadrats & Ground Truthing (ERM 2005A)

Project Application Area

HVO North Development Consent Boundary

Survey boundaries

HVO No1 South Pit (ERM 1988)

May 2006 (ERM)

Squirrel Glider Surveys (ERM 2005A)

Sth Lemington Survey Area (SKM 1997)

Figure 11.1

Ecological Assessments across HVO South

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_17 Suffix No: R1
Date:	27.09.2007 Drawing Size: A4
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

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ERM

11.4.3 GAP Analysis Results

The majority of HVO South has been assessed on numerous occasions by various ecological consultants and no areas were considered to require further intensive sampling, however, ground-truthing and assessment of new areas was warranted.

In general, previous assessments found a low diversity of fauna species at HVO South, with the greatest number of records being bird species where disturbance levels were low.

The main outcomes of the gap analysis were that some studies had been undertaken 10 or more years ago, and that some species were not listed as threatened at the time of the development, so they were not assessed formally under Part 5a of the *EP&A Act* (Eight-part Test). Despite this, the assessments recognised the significance of most of the species and recommended protection and mitigation measures for them. For example, in Gunninah's assessment of South Lemington (SKM 1997), recommendations were made to protect the River Red Gums and the Coastal Banksia that were identified in this area.

11.4.4 May 2006 Field Survey Results

Fauna

Fauna species recorded during May 2006 field surveys were all common species that have been previously recorded at HVO South. Species recorded included Ring-tailed Possums, an Eastern Grey Kangaroo, a wombat and common birds including Magpie, Magpie Lark and Thornbills.

Only one arboreal mammal, the Brush-tailed Possum (*Trichosurus vulpecula*) was recorded during spotlighting. This was also found to be the case during spotlighting undertaken at HVO South in October 2005 (ERM 2005b), despite suitable weather and timing of surveys. This most likely reflects the high levels of disturbance and isolation of vegetation that has occurred historically across HVO.

Flora

Vegetation communities at HVO South have been mapped by Hunter Catchment Management Trust (HCMT), 2005 as part of the Hunter Valley Remnant Vegetation Project and formally surveyed and ground-truthed during previous field surveys by various ecological consultants (see *Figure 3.1 of Annex L)*.

No major differences were found between the vegetation mapping undertaken by HCMT (2005) and the areas ground-truthed during May 2006 surveys.

The Coast Banksia*s* recorded south of South Lemington Pit 1 were not healthy or dying individuals. This stand of Banksias was impacted due to its location on the edge of an unformed track leading to an easement and was underlain by sandy soils affected by recent drought conditions. The Banksias recorded in the north east of the site were found to be in better condition and numbered approximately 30 individuals within two small groups. Disturbance in this area included a large powerline easement, the presence of exotic pasture species, cattle grazing and clearing.

11.4.5 Threatened Species, Populations and Ecological Communities

Fauna

One species listed as vulnerable under the *TSC Act*, the Grey-crowned Babbler (*Pomatostomus temporalis*) was recorded during field surveys in May 2006 (*Figure 11.2*).

Grey-crowned Babblers were recorded across the site, usually in groups of six to eight, foraging on the ground and in the canopy. They occurred not only in remnant vegetation, but also in disturbed environments, such as the administration building grounds.

Flora

No threatened flora species were recorded during the May 2006 field investigations.

Endangered Ecological Communities

Coast Banksias were recorded to the south of South Lemington Pit 1 and within the north east of HVO South (Archerfield Property – Area 8). This species may indicate the potential for the endangered community Warkworth Sands Woodland to regenerate (ie no other Warkworth Sands Woodland species were identified). The location of Coast Banksias at HVO South is shown on *Figure 11.2*.

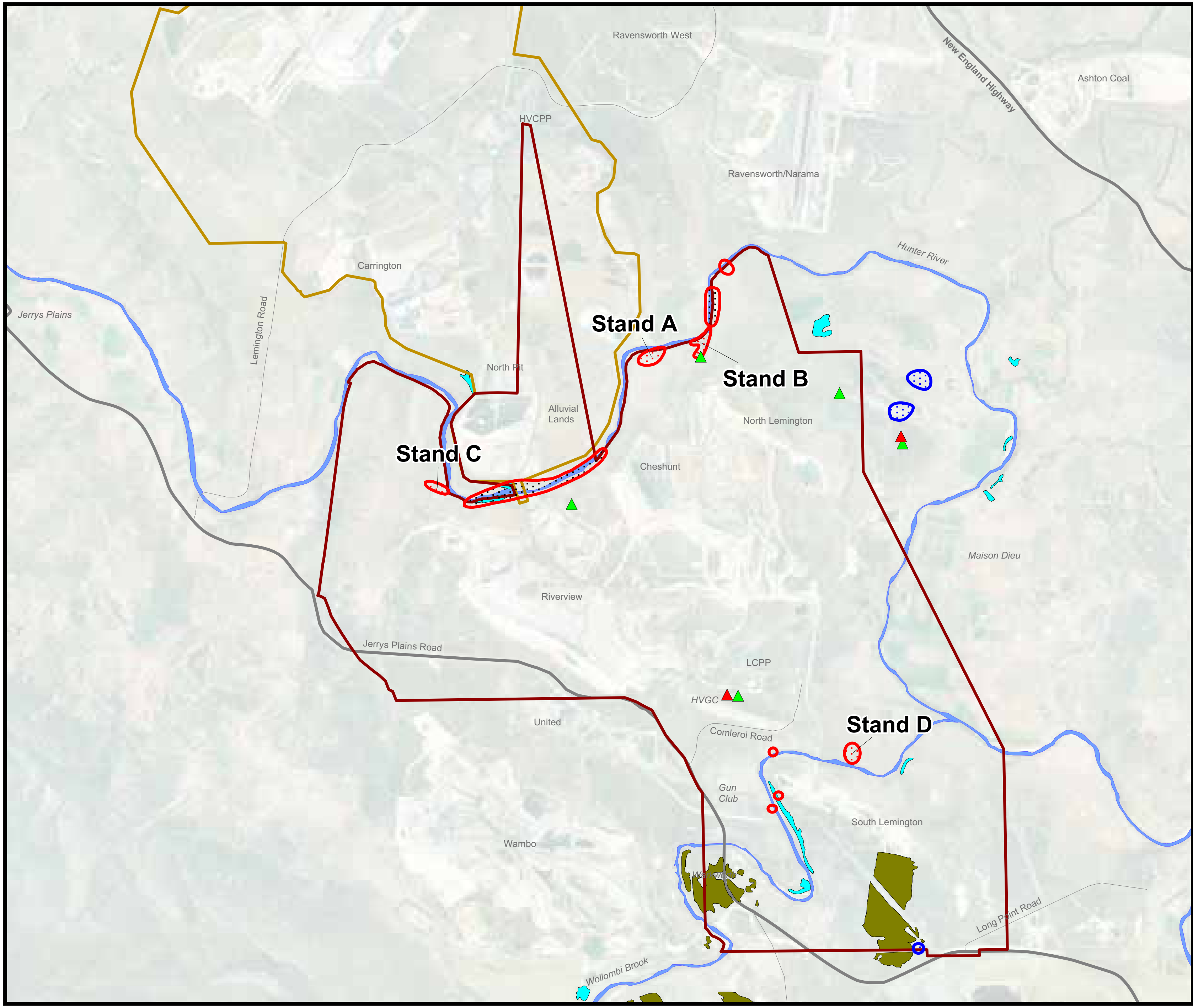
No area of Hunter Lowland Redgum Forest was identified during the May 2006 field investigations.

Endangered Populations

River Red Gums (*Eucalyptus camaldulensis*) listed as endangered under the *TSC Act*, were recorded along the Hunter River and along Wollombi Brook. They primarily occurred as scattered individuals along the banks of the watercourses, with more dense stands occurring along small tributaries (see *Figure 11.2*). Some individual Red Gum species were recorded along Redbank Creek, but due to the young age of these trees and the absence of capsules, these individuals were not positively identified as River Red Gums. However, their location along the watercourse would suggest they were River Red Gums and not Forest Red Gums (*Eucalyptus tereticornis*). Most of the mature River Red Gums recorded at HVO South were in poor condition, being affected by insect herbivory and dieback, and there was little to no recruitment occurring.

A large stand of mature River Red Gums located along the Hunter River (labelled as Stand A in *Figure 11.2*) has been impacted by cattle grazing, with no recruitment occurring in the area. This stand of trees is providing fauna habitat in the form of many tree hollows to hollow-dependent bird species such as Red-rumped Parrots (*Psephotus haematonotus*) and Galahs (*Cacatua roseicapilla*), and appears to be a remnant of considerable age, evidenced by the size of the trees and the number and size of hollows that have formed in them.

The stands of River Red Gums that occur along the tributaries of the Hunter River and Wollombi Brook (Stands B, C and D) also comprise large, mature trees that contain hollows. All tributaries were found to be dry at the time of the May 2006 field investigations, and all have been heavily eroded.



Legend

- 1-3 Individual River Red Gums
- Coast Banksia
- Scattered Occurences of River Red Gums
- Stand of River Red Gums
- Hunter Floodplain Red Gum Woodland Complex
- Warkworth Sands Woodland
- Grey-crowned Babbler Nest Site
- Grey-crowned Babblers
- Project Application Area
- HVO North Development Consent Boundary

Figure 11.2

2006 Field Survey Results

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_18		
Date:	02.07.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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SEPP 44 Koala Habitat Assessment

HVO South is within the Singleton LGA and therefore *SEPP 44* applies. No evidence of Koala activity has been recorded in previous assessments at HVO South, and no direct or indirect evidence (such as scats or scratches on tree trunks) were recorded during the May 2006 surveys. The Koala feed trees, Forest Red Gum and River Red Gum, were recorded at HVO South in the May 2006 surveys. However, there are no areas greater than one hectare in size where these two species make up more than 15% of the canopy species. Therefore the remnant vegetation at HVO South is not considered to represent core Koala habitat, as defined under SEPP 44.

11.5 IMPACT ASSESSMENT

11.5.1 Previously Assessed Potential Direct and Indirect Impacts

Direct and indirect impacts that have been previously assessed at HVO South are summarised below:

- removal of woodland and shrubland that provide foraging and breeding habitat for threatened species;
- removal of hollow-bearing trees that provide habitat for native fauna, specifically microchiropteran bats, birds and arboreal mammals;
- direct loss of fauna and flora;
- removal of waterbodies that provide habitat for amphibians, reptiles and wading birds;
- relocation of transmission poles that provide nesting habitat for raptor species;
- removal of grassland habitat and ground debris that provide habitat for reptiles, small ground-dwelling mammal species and insectivorous birds such as the threatened Speckled Warbler and Hooded Robin;
- competition between fauna due to displacement of species and relocation of animals into adjacent areas that are already occupied;
- increased fragmentation and isolation of vegetation remnants within the locality;
- proliferation of weeds in areas of native vegetation due to increased disturbance and edge effects; and
- disturbance to fauna in adjacent areas from increased noise, dust and artificial lighting.

11.5.2 *Extension Areas and Infrastructure Upgrade Areas*

Only one of the extension areas has not been assessed in previous ecological impact assessments undertaken at HVO South. This area is located to the south east of the Riverview Pit, and includes part of the HVGC property (see *Figure 4.1 of Annex L).* The area contains previously disturbed and cleared land with some regrowth woodland (immature trees to 8 m and Diameter at Breast Height of 10 cm) and is considered to be of limited value as fauna and flora habitat. Threatened birds such as the Grey-crowned Babbler may forage in this area but it is unlikely that any fauna species would rely on this area for resources given its current condition, and the availability of habitat in adjacent areas. Therefore, it is considered that the removal of this small area is unlikely to impact on any threatened species such that potential impacts would be significant.

11.5.3 *Threatened Species, Populations and Communities*

This section considers the potential impacts of the proposal on threatened species previously recorded at HVO South.

Table 11.3 shows the threatened species that have been recorded previously at HVO South and summarises the findings of previous assessments of impact (Eight-part Tests) undertaken for each species. The most recent and thorough assessments of impact were undertaken by ERM in 2005 (ERM 2005b). These assessments addressed impacts from the extension to the Riverview Pit (removal of 35 ha of remnant and regenerating woodland). A list of species addressed is provided in *Section 4.3* of *Annex L*.

None of the threatened species previously recorded at HVO South were considered to be significantly impacted by previous proposals. This was found to be the case, even when species were recorded at several of the sites within HVO South during the assessment. In addition, impacts to other threatened species considered likely to occur within HVO South were not considered to be significant (ERM 2005a, SKM 1997, ERM 1998 and HLA 2000). Therefore, approval for this project is not expected to impact on those threatened species previously recorded at HVO South.

Species not addressed in impact assessments are not considered likely to occur within HVO South, due to lack of appropriate foraging, breeding or roosting habitats. A consideration of the occurrence of all locally occurring species is provided in ERM (2005a).

River Red Gums

Potential direct impacts of the proposal on River Red Gums at HVO South are not expected to be significant and may include an increase in dust and microclimatic changes. The proposal will not result in the removal of any of the River Red Gums within HVO South. In addition, CNA engaged Umwelt to prepare the *Carrington Billabong River Red Gum Rehabilitation and Restoration Strategy* (Umwelt 2007) in accordance with the Carrington Pit Extended SEE Consent Conditions (DA 450-10-2003 M2), which will ensure the long-term viability of this population and further improve the habitat for these trees across the whole of HVO. The principles of this strategy can then be referenced and refined for the management of River Red Gums within HVO South.

The current condition of the River Red Gums and habitat for these trees within HVO South is considered to be poor, with erosion, weeds, and feral and domestic animal activity impacting on the ability of the species to recruit. Other factors that may be influencing regeneration and recruitment include the current drought and the impacts from agricultural activities.

The River Red Gum obtains its water from three main sources: groundwater, rainfall and river flooding. While the species utilises groundwater, it relies on flooding regimes for recruitment.

The groundwater study showed that the predicted worst case scenario of 1 m of groundwater drawdown in the Wollombi Brook area as a consequence of the extension to mining at HVO South has the potential to reduce the amount of groundwater currently available to the River Red Gums in the immediate vicinity. The reduction of groundwater may only affect regeneration of the stands if it has significant impacts on the ability of the area to flood. However, current flooding regimes are unlikely to be affected as they rely on peak flows, which are not expected to change significantly as a result of the extension to mining. CNA are currently undertaking studies to investigate the preferred water source of River Red Gums and appropriate management measures will be developed and applied as appropriate.

Warkworth Sands Woodland

Eighty two hectares of Warkworth Sands Woodland was approved for removal from the Lemington South Pit 1 footprint under DA 215/97 prior to Warkworth Sands Woodlands being listed as an endangered ecological community (under the *TSC Act*), with no offset requirements. This area has already been disturbed by mining activities.

The nearby Warkworth Green Offset area includes a comprehensive research programme prepared by the University of New England Armidale (UNE) into regeneration of the Warkworth Sands Woodland. Sand removed in the process of mining the South Lemington Pits 1 and 2 will be utilised as part of this research programme. No additional Warkworth Sands Woodland will be disturbed as part of this proposal.

Hunter Lowland Redgum Forest

A small area of this community has been mapped in the south of HVO South. No area of this community will be removed as part of this proposal.

Table 11.3 Threatened Species, Populations and Communities Previously Recorded at HVO South and Findings of Impact Assessments

Threatened Species / Population / Community	Assessed Previously under *EP & A Act* (Yes/No)					Significant Impacts (Yes/No)
	Riverview Pit Extension SEE (ERM 2005a)	Cheshunt Pit Extension SEE (ERM 2005)	JPCT EIS (HLA 2000)	Hunter Valley No. 1 Mine South Pit Modifications EIS (ERM 1998)	South Lemington Opencut Mine EIS (SKM 1997)	
Grey-crowned Babbler *(Pomatostomus temporalis)*	Yes	No	No	No	No	No
Brown Treecreeper *(Climacteris picumnus)*	Yes	No	No	No	No	No
Speckled Warbler *(Chthonicola sagittata)*	Yes	No	No	No	No	No
Black Bittern (Ixobrychus flavicollis)	No	No	No	No	Yes	No
Squirrel Glider (*Petaurus norfolcensis*)	Yes	No	No	Yes	No	No
Eastern Freetail Bat (*Mormopterus norfolkensis*)	Yes	No	Yes	Yes	Yes	No
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	Yes	No	Yes	Yes	Yes	No
Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)	Yes	No	Yes	Yes	Yes	No
Fishing Bat (*Myotis adversus*)	Yes	No	Yes	Yes	No	No

Note: River Red Gums, Warkworth Sands Woodland and HLRF were either not in the assessment study areas or not listed under the *TSC Act* at the time of the assessment.

11.5.4 *Cumulative Impacts*

Cumulative impacts arise when individual disturbances act in unison. Cumulative impacts have the capacity to be greater than the sum of individual impacts, being additive either in space or time (NSW Department of Urban Affairs and Planning, 1997). Potential cumulative impacts relevant to the proposal include:

- loss of connectivity and movement corridors due to removal of native vegetation within the locality;
- increased pressure on resources in remaining habitats;
- loss of genetic diversity from the region;
- chain of events leading to loss of a suite of species; and
- potential impacts to species dependent on resources such as groundwater.

Potential cumulative impacts to some threatened species were considered as part of the Riverview Pit Extension SEE (ERM 2005a). Eight-part Tests found that cumulative impacts were likely to result in the loss or decline of some threatened bird species from the locality, namely the Grey-crowned Babbler, the Brown Treecreeper and the Speckled Warbler. However, these impacts were not found to be significant and no further studies were deemed necessary.

In addition, the recent field surveys at HVO South suggest that Grey-crowned Babblers may be more adaptable to changes in habitat area and structure, as they were recorded in developed areas (around administration buildings) and in small cleared grassland areas in between pits (see *Figure 11.2*). The species was also recently recorded by CNA nesting in an isolated paddock tree with no adjacent remnant woodland.

Previous and existing approvals to clear vegetation at HVO South may result in cumulative impacts to flora and fauna within the locality. However, this proposal will result in the enhancement of 140 ha of woodland and the regeneration and rehabilitation of additional areas adjoining the Project Application area (refer to *Section 11.5.5*). This will provide secure compensatory habitat for species within the region. This habitat and its proposed management for the sustainability of native flora and fauna are discussed in *Annex L.*

11.5.5 *Biodiversity Enhancement Areas*

Biodiverse Landscapes

The cumulative effects of agriculture and mining have resulted in significant clearing of native vegetation and the removal of habitat for native fauna in the Hunter Valley.

The *Synoptic Plan - Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of NSW* (DUAP 1997) was developed to encourage vegetation corridors across the Hunter Valley floor. In addition, the EPA prepared a concept paper in 2002, '*Green Offsets for Sustainable Development*' to provide offsets for clearing of native vegetation. The principles of these documents have been considered in identifying opportunities to enhance biodiversity to compensate for clearing of remnant vegetation required by the project.

These opportunities have been incorporated into the *HVO Landscape and Rehabilitation Strategy* (the Strategy) with the identification of existing remnant vegetation and planning for linkages with vegetation corridors and Warkworth and Wambo Green Offset areas through mine rehabilitation programmes. The Strategy is discussed further in *Chapter 19 – Mine Landscape Planning*.

The 250 ha to be cleared for the project has been assessed for conservation significance. Of the 250 ha, a total of 140 ha contains remnant or regenerated vegetation. The specific flora and fauna values of these areas have been identified and will need to be made available or enhanced in the surrounding remnant vegetation or in areas planned for rehabilitation. The options available are described below.

Proposed Measures for Enhancement

Biodiversity enhancement can be achieved by a number of potential options. The broad objectives of the Strategy are to develop an expanded and sustainable land system that:

- maximises the likelihood of long term landform stability and minimises erosion;
- ensures the final landform is compatible with surrounding landforms;
- optimises the final void dimensions and rehabilitation of tailings storage areas;
- ensures removal and/or containment of hazardous or contaminated material;
- determines suitable vegetation for re-establishment (pasture, agroforestry, shelter belts, cropping, native woodland, riparian corridors);
- returns appropriate areas of land to a sustainable and productive grazing use;
- ensures the final landform is compatible with surrounding land use;
- encourages sustainability and diversity of land use; and
- minimises weeds and pests.

Conservation Significance Assessment

Specific areas required for and surrounding the project were assessed for coverage and value of remnant vegetation. These areas include:

- Area 1 Cheshunt Pit (surface disturbance currently approved);
- Area 2 Riverview south west extension;
- Area 3 Riverview south east extension;
- Area 4 South Lemington Pit 1 extension;
- Area 5 Rail loop options areas;
- Area 6 North west of HVO South (Carrington Stud and surrounds);
- Area 7 South of HVO South (south of Jerrys Plains Road); and

- Area 8 North east of HVO South (Archerfield Property).

The flora and fauna values of the areas required for the project (Areas 1 – 5) were compared to the values of the areas proposed as potential enhancement areas (Areas 6 – 8) using a site-specific conservation significance assessment. This assessment rated the various ecological parameters of each area (see *Figure 2.1* of *Annex L*). The parameters assessed were derived from those factors considered to have the greatest impact on the viability of native species known from the locality. For example, many of the threatened woodland birds recorded at HVO South require larger vegetation remnants for populations to remain viable, therefore this was one of the values included for assessment.

As some remnant vegetation areas have a component of cleared or highly modified areas, these were considered in the context of their potential for regeneration and biodiversity of native vegetation and native fauna species. All areas were assigned a conservation significance ranking from zero to three, with a maximum possible score of 20. Parameters to determine scores are provided in *Annex L.*

The results of the conservation significance assessment are provided in *Table 11.4.*

From these results a preferred potential enhancement area was identified (Area 8 – Archerfield Property). The intention is to allocate the existing vegetation within this area as a specific biodiversity enhancement area to compensate for the loss of the vegetation required for the project. Areas 6 and 7 were not preferred as Area 6 is isolated with restricted regional corridor connectivity and Area 7 contains coal reserves that may be of future value.

The Archerfield Property was identified as having the highest conservation significance (with a score of 17 from a possible 20) of all the areas assessed. The conservation ranking of this area was also considered higher than the areas to be cleared as part of the project. Field investigations of this area found that it contained a high diversity of vegetation communities and native flora species, some habitat and structural complexity and threatened fauna species. This area is also considered to have a high potential for rehabilitation as it has been subject to minimal soil disturbance.

The Archerfield Property (refer *Figure 11.3*) comprises cultivated land and grazing land. A 330 kV transmission line easement is also located within the property. This property is currently leased for dairy farming purposes with no biodiversity management actions required. Within the grazing land, approximately 140 ha of existing vegetation (as identified in *Figure 11.3*) will be allocated as a formal biodiversity enhancement area to compensate for the area to be cleared for the project. This vegetation will be fenced to exclude grazing. The remainder of the property will continue to be leased for farming purposes and access to the farmhouses will be retained.

Biodiversity is expected to be enhanced with the retention of this area, the removal of stock, and the regeneration of native vegetation. The remnant vegetation and any new regeneration will provide a significant area of habitat for native flora and fauna within the locality and within HVO South. More detail on the how this remnant vegetation will be managed as a biodiversity enhancement area is provided in *Chapter 19 – Mine Landscape Planning.*

Legend

Archerfield Property Boundary

Area with Remnant Vegetation for Biodiversity Enhancement

Figure 11.3

Archerfield Biodiversity Enhancement Area

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0077323_GIS03_R0 Suffix No: R0
Date:	18/01/2008 Drawing size: A4
Drawn by:	JS Reviewed by: LS
Source:	-
Scale:	Refer to Scale Bar

N

0 200 400 600m

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R0	Preliminary Issue	18-01-08	JS
Suffix	*Revision*	*Date*	*Init*

Table 11.4 Site-Specific Conservation Significance Assessment

	Extension Areas					Remnant Vegetation Areas		
Parameter	(Currently Approved) Cheshunt Area 1	Riverview south west Area 2	Riverview south east Area 3	Lemington Area 4	Rail Loop options Area 5	North western corner Area 6	Jerrys Plains Road Area 7	Archerfield Area 8
Size of remnant (1-3)	2	2	1	1	1	3	3	3
Connectivity within locality (1-3)	1	2	2	2	2	2	3	1
Connectivity within site (0 or 1)	0	1	1	1	1	0	1	0
Diversity of native species (0-2)	0	1	1	1	1	Unknown*	2	2
Extent of weed invasion (0-2)	1	1	1	1	2	Unknown*	2	2
Significant habitat features (0 or 1)	1	1	0	0	1	Unknown*	1	1
Threatened species, populations or communities (0 or 1)	0	1	1	1	0	Unknown*	1	1
Structural complexity (0-2)	0	2	1	1	0	Unknown*	1	2
Natural regeneration (0 or 1)	1	0	1	0	0	Unknown*	0	1
Soil disturbance (0-2)	2	1	1	1	2	Unknown*	1	2
Identified for future potential mining activities (0-2)	0	1	1	1	1	2	1	2
Total (out of 20)	*8*	*13*	*11*	*10*	*11*	7	*16*	*17*
Conservation Ranking	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**-**	**High**	**High**

- Conservation Significance Ranking: 1-6 = low, 7-14 = moderate, 15 and greater = high.
- * Unknown = This area was not assessed during field investigations and was therefore not included in the ranking.

11.6 MANAGEMENT MEASURES

The management of flora and fauna and biodiversity at HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle. The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for management of flora and fauna are to:

- minimise the impact of activities on native flora and fauna;
- ensure the preservation of threatened species if found to occur on the site; and
- protect and enhance the biological diversity of the area.

The technical report (*Annex L*) identified a number of control measures to minimise the potential impacts to ecology resulting from the proposal. These measures have been considered in the context of the existing HVO activities and the CNA EMS. Many of these measures are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those that are mitigation measures applied to the operation and those that are specific to the proposal.

Mitigation Measures

Regular controls that are applied prior to clearing include:

- threatened communities or flora or fauna are recorded in a GIS database;
- habitat trees are identified ahead of clearing, marked and recorded in the GIS database in accordance with EMS Flora and Fauna procedure; and.
- a GDP is required for clearing in areas previously not disturbed by construction or mining activities.

Regular controls that are applied when clearing include:

- habitat trees are inspected prior to and during clearing and any fauna are removed/relocated to the nearest appropriate vegetation community;

- clearing is to be undertaken outside of the breeding periods of threatened fauna known to occur at the site. In cases where this is not practicable, pre-clearing surveys will be undertaken as above;

- if suspected threatened communities or flora or fauna species are encountered during clearing further direction must be sought from the Environmental Coordinator; and

- cleared timber will be stockpiled until the area is required for topsoil stripping and where practical intact trunks with hollows will be moved to established rehabilitation or non-disturbance areas to be used as logs for habitat.

In addition controls have been developed for management of those areas proposed to be rehabilitated and/or revegetated to provide habitat for native fauna and flora. Controls apply to feral and pest animal control, vegetation improvement, weed control, threatened species protection and riparian zone enhancement.

Further details are provided in *Chapters 18 and 19*.

Commitments Specific to the Proposal

These specific commitments are derived from existing consent conditions that remain applicable, and management measures that relate to proposed mining extension areas and infrastructure upgrades. Note that commitments relating to the biodiversity enhancement area are captured in *Chapter 19*.

1. The River Red Gum Rehabilitation and Restoration Strategy prepared by CNA (2007), will be updated to include the stands of River Red Gums identified along the Hunter River and Wollombi Brook, will include collection and storage of seed from these stands and will ensure the health of these trees is periodically monitored.

2. Studies will be undertaken to investigate the preferred water source of River Red Gums and develop appropriate management measures.

3. Areas identified with sand profile will be included in the Warkworth Green Offsets research programme.

4. The Coast Banksias will be assessed and fenced to exclude stock and provide for enhancement opportunities.

5. Rehabilitation planning will identify opportunities to create similar ecological characteristics (such as habitat types) of proposed extension areas.

6. Remnant vegetation areas not required to be disturbed by the proposal will be managed to ensure security of flora and fauna habitat in the future.

7. The Warkworth and Wambo Green Offset areas and the Hunter Valley Synoptic Plan will be considered with rehabilitation planning to enhance linkage where practical.

11.7 CONCLUSIONS

This proposal involves increasing the area of mining and infrastructure disturbance by 250 ha, which includes 48 ha of remnant vegetation and 92 ha of regenerated vegetation. The assessment of extension areas concluded that no threatened or endangered species or communities will be significantly impacted by the proposal.

A site-specific conservation significance assessment was developed as part of this assessment to identify areas that provided the greatest biodiversity enhancement opportunities. This assessment rated the various ecological parameters of each area to be cleared and of adjoining remnant vegetation areas as identified by CNA. The Archerfield Property, located to the north east of the Project Application area, was ranked highest and 140 ha of remnant vegetation will be retained and managed for its potential to provide a significant area of habitat for native flora and fauna. The conservation and ongoing management of this high value woodland and the potential for Warkworth Sands Woodland to regenerate will result in the ongoing viability of a large area of flora and fauna habitat within HVO South and the locality. Given the proposal includes the removal of 48 ha of remnant vegetation and 92 ha of regenerated vegetation (of low biodiversity value), it is considered that the current proposal will not result in a net loss of flora and fauna values from the region.

A draft *HVO Conceptual Landscape and Rehabilitation Management Strategy* (CNA 2007) has been developed to provide an overview of how strategic landscape and rehabilitation planning and management is developed, implemented and maintained at HVO. The Strategy has incorporated the Archerfield Property vegetation and identified other areas of existing remnant vegetation and linkages with vegetation corridors that are planned as part of mine rehabilitation programmes. The Strategy demonstrates how measures will be implemented, the targets for rehabilitation, indicators of success and considerations for design and implementation. Linkages will contribute to connectivity with the Warkworth and Wambo Green Offset areas.

The management of flora and fauna across HVO South will be in accordance with existing CNA EMS procedures and management plans detailed in *Table 21.3* and biodiversity enhancement will be encouraged in accordance with the Strategy.

12 ABORIGINAL CULTURAL HERITAGE

This chapter provides an overview of CNA's approach to the management of significant Aboriginal cultural heritage, discusses the results of surveys undertaken as part of this assessment and outlines management measures that will be implemented to mitigate or avoid potential impacts resulting from the proposal.

12.1 INTRODUCTION

All places and values of archaeological, traditional, spiritual, historical or contemporary significance are deemed to constitute cultural heritage. This definition is wide and addresses the notion of cultural heritage as set in both state and federal legislation. In practical terms, this definition will allow, for instance, recording of places which are archaeological sites, any places which have traditional stories associated with them, places which are historically important and places which are important today.

A detailed cultural heritage assessment was undertaken for the proposed mining extension areas and associated surface disturbance areas for the HVO South Coal Project Application in addition to previous assessment results and management outcomes.

12.1.1 Cultural Heritage Management System

In March 2005 Rio Tinto introduced the Rio Tinto Cultural Heritage Management System (CHMS) policy and guidelines. The policy and guidelines apply to all Rio Tinto business units. The key principles of the CHMS policy are:

- Rio Tinto recognises and respects the significance of Australia's cultural heritage, and in particular the cultural heritage of Aboriginal people who have traditional ownership or historical connections to the land on which Rio Tinto businesses operate;
- Rio Tinto businesses will take all reasonable and practicable measures to prevent harm to cultural heritage sites;
- where prevention of harm to cultural heritage sites is not possible, operations will take steps to minimise or mitigate impacts in accordance with processes set out in the CHMS; and
- the CHMS will ensure appropriate protection and preservation of non-Aboriginal places of cultural heritage significance, such as historical buildings, graves and mining artefacts.

Accordingly CNA applies these principles to their existing operations, new projects and any company owned land across NSW.

CNA, through detailed consultation with the Aboriginal community (with the support of the Upper Hunter Valley Cultural Heritage Working Group) and the DECC, has developed and implemented a comprehensive community engagement and consultation process for Aboriginal heritage management. This methodology has referenced the *Queensland Aboriginal Cultural Heritage Act 2003* which is the most recently developed legislation relating to Aboriginal cultural heritage.

CNA's approach enables Aboriginal community representatives to conduct and manage their own cultural heritage investigations in partnership with CNA with independent technical advice and support as required. Archaeologists were engaged on behalf of the Aboriginal community to act in the capacity of technical advisors, assisting in the identification and recording of cultural heritage sites located during the survey assessments.

CNA in consultation with the Upper Hunter Cultural Heritage Working Group (the 'Working Group') have drafted a detailed Aboriginal Cultural Heritage Management Plan (ACHMP) which has been developed from the outcomes of the assessments. The draft ACHMP has been sent to DECC for review and comment, to be finalised in 2008. A summary of the draft ACHMP is included in *Annex M*.

12.2 METHODOLOGY

The Aboriginal cultural heritage management process applicable to this proposal and used for the assessment involved:

- review of previous assessments;
- development of Terms of Reference for survey with the Aboriginal Community;
- field survey;
- assessment of potential impacts; and
- review of existing management measures to identify additional measures required as a result of this proposal.

Comprehensive community consultation in accordance with the *Interim Community Consultation Requirements* (DEC, 2004) and *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005) has been undertaken specifically for the Aboriginal cultural heritage assessment. A complete copy of the extensive consultation undertaken has been provided to the DECC (Coffs Harbour) independently of this report. *Annex M* provides a summary of the public notices, agendas, minutes, general terms of reference (ToR) for the surveys and survey report references.

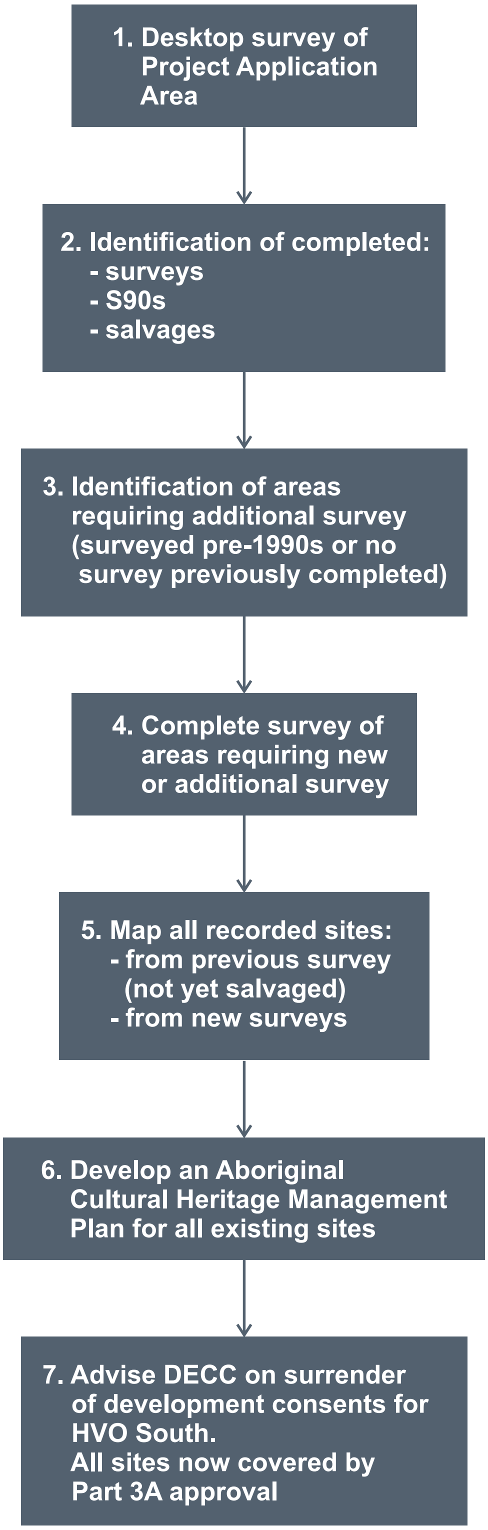

Figure 12.1

Aboriginal Cultural Heritage Management Process under Part 3A

Client:	Coal & Allied Operations Pty Ltd		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_EAR_G_12_R0		
Date:	27/09/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	Coal & Allied Operations Pty Ltd		
Scale:	N/A		

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12.2.1 *Review of Previous Assessments*

Various cultural heritage investigations and associated salvages have been undertaken across the HVO mining area since 1981 (*Table 12.1*). With the exception of a portion of Riverview south east extension area, all four of the proposed extension areas have previously been subject to cultural heritage investigations and salvages. It was determined that there was a need to undertake a range of supplementary investigations in the three proposed extension areas (Riverview south west, Riverview south east and South Lemington Pit 1) that had previously been salvaged but where no disturbance by mining had yet occurred. These investigations were required for the following reasons:

- investigations undertaken since 1981 were not sufficiently comprehensive in their coverage of the Project Application area when compared to current best practice;

- the site location data was collected prior to well-developed methodologies involving the use of Global Positioning Systems (GPS) and Geographic Information Systems (GIS). This had significant implications in reconciling data included in various maps and tables in previous reports, and between this data and that which is held in relevant DECC databases. This, in turn, was critical to determining what effect the proposed development programme would have on identified cultural heritage sites, and in complying with statutory requirements pertaining to such sites;

- although there is a long history of Aboriginal community involvement in cultural heritage investigations at HVO, there was a need to provide an opportunity for relevant Aboriginal parties to participate in development of the new ACHMP and other measures related to the environmental assessment of this proposal. Consequently, the parties were afforded an opportunity to examine the areas to be disturbed by the proposal and the cultural heritage sites found therein; and

- a narrow definition of Aboriginal cultural heritage was previously adopted that had a distinct material dimension. These additional investigations allowed for a more inclusive view of the cultural heritage values of the area to be generated in the formulation of the ACHMP.

Consequently, additional systematic investigations were initiated to supplement the development of the ACHMP. As shown in *Table 12.1*, all salvages required by previous assessments were completed prior to disturbance by mining. All sites previously recorded but not yet salvaged will be incorporated into this Part 3A Project Approval. Under the Part 3A process Section 87 or Section 90 permits under the *NPW Act* are not required. Therefore, these previously recorded sites will be incorporated into the ACHMP for HVO South and managed accordingly.

Table 12.1 Previous Surveys across HVO

Survey Date	Survey Area	Survey Report	Report Author	Section 87 / 90 Permit Number	Permit Date	Salvage Completion Date
1981	Cheshunt Riverview	Archaeological survey of Hunter Valley No. 2 Authorisation Area and out of pit overburden emplacement area (Brayshaw 1981)	Brayshaw	S90 # SZ315	22/01/02 Reissued 5/09/02	Feb-Mar 2001
1982	North Lemington (north)	A brief archaeological investigation of an area to be mined by opencut method at the Buchanan Lemington Mine near Warkworth, Hunter Valley 1982 (Annex 1 of Dames and Moore report)	Brayshaw	Not activated (see #431)	-	-
1982	Alluvial Flats	Archaeological survey of Hunter River alluvial flats. Buchanan/Lemington Coal Mine near Warkworth NSW 1982 (Report to Dames and Moore)	Brayshaw	Project did not proceed	-	-
1982	Conveyor and haul road route	Archaeological survey of proposed routes for conveyor belt and haul road linking Hunter Valley No. 2 Authorisation Area with Hunter Valley No. 1 Mine 1982 (Report to Croft and Associates)	Haglund	S90 # SZ315	22/01/02 Reissued 5/09/02	Feb-Mar 2001
1981 (Brayshaw) 1982 (Haglund)	Cheshunt Riverview	Archaeological investigations in the Hunter Valley No. 2 Authorisation Area August 1983 (Report to Croft and Associates) Archaeological Survey of the Site for the Proposed Hunter Valley No. 2 opencut Coal Mine	Brayshaw and Haglund	S90 # SZ315	22/01/02 Reissued 5/09/02	Feb-Mar 2001
1983	West Pit (south east)	Archaeological Survey of Additional Mining Extension Proposed at Howick – Liddell opencut Coal Mine 1983	Brayshaw, through Sinclair Knight and Partners	S90 #3393	19/08/83	-

Survey Date	Survey Area	Survey Report	Report Author	Section 87 / 90 Permit Number	Permit Date	Salvage Completion Date
1984	Cheshunt Riverview	Archaeological Investigations (Study 4, Volume 2 of Hunter Valley No. 2 Mine EIS 1984)	Croft and Associates	S90 #798 S90 #SZ315	19/03/85 27/10/00	 Feb-Mar 2001
1984	North Lemington	Archaeological Investigation (Appendix J of Northern Opencut Extension Lemington Mine EIS 1984)	Dames and Moore (Brayshaw)	Not activated (see #431)	-	-
1986	South Lemington Pit 1 (central, north and west) South Lemington test pit	Section 5.7 of Lemington Mine Southwestern Opencut and No. 3 Underground Mine EIS 1987	Brayshaw	Has not proceeded to date	-	-
1989	West Pit (far south east) Howick Mine near Liddell, NSW June 1989	Archaeological Survey of Proposed Southern Extension (Appendix C of EIS for Proposed Extension of Howick Mine 1989)	Brayshaw	Some items salvaged under S90 # SZ315	22/01/02 Reissued 5/09/02	Feb-Mar 2001
1990	Cheshunt Riverview	Additional Archaeological Survey West of Hunter Valley No. 2 Authorisation Area 1990	Brayshaw	S90 # SZ315	22/01/02 Reissued 5/09/02	Feb-Mar 2001
1992	North Lemington	Salvage of Archaeological Sites in the North West corner of the Lemington Colliery Lease, Hunter Valley 1995 (Report to Lemington Mine and NPWS)	Dean-Jones	S90 #431	8/10/92	Late 1992 Salvage Report

Survey Date	Survey Area	Survey Report	Report Author	Section 87 / 90 Permit Number	Permit Date	Salvage Completion Date
1992	North Pit Alluvial Lands	Section 9.4 of Hunter Valley Mine Extension of Mining EIS December 1992	Mitchell McCotter	S90 Lapsed S90 #566 southwest S90 #656 northeast S90 #657 Stage 1 S90 #734 Stage 2 S90 #245	4/02/88 8/11/93 9/09/94 15/09/94 19/04/95 11/03/99	- Mar-Apr 2000
2000	North Pit Alluvial Lands	Report of a Salvage Excavation at Site 37-5-63 Hunter Valley.	Hiscock, Hughes, Shawcross and Paton (2000)	S90 # 566, 656, 657, 734 and 245		Salvage Report
1995	West Pit (south)	Archaeology and Anthropology: Authorisation 72, Howick Coal Mine, September 1995	ERM Mitchell McCotter	(see SZ300)	-	-
1995	South Lemington Pits 1 and 2 Comleroi Road (LCPP access)	Archaeological Survey for Aboriginal Sites May 1995 (Appendix F of South Lemington Opencut Mine EIS September 1997)	Brayshaw McDonald Consultant Archaeologists	S90 #254	26/05/99	Jun-Sep 1999
1996	Howick Southern Extension	Section 3.10 of Howick Joint Venture Proposed Expansion of Howick Coal Mine EIS March 1996	ERM	(see SZ300)	-	-

Survey Date	Survey Area	Survey Report	Report Author	Section 87 / 90 Permit Number	Permit Date	Salvage Completion Date
1998	North Pit	Hunter Valley Mine Mining of Site 37-5-63 August 1998	Victor Perry – Wonnarua Tribal Council	S90 Lapsed S90 #566 southwest S90 #656 northeast S90 #657 Stage 1 S90 #734 Stage 2 S90 #245	4/02/88 8/11/93 9/09/94 15/09/94 19/04/95 11/03/99	- Mar-Apr 2000
2000	North Pit	Report of A Salvage Excavation at Site 37-5-63 Hunter Valley, New South Wales - A Report to ERM Mitchell McCotter Pty Ltd, June 2000	Robert Paton Archaeological Studies Pty Ltd	S90 #657 Stage 1 S90 #734 Stage 2 S90 #245		Salvage / Excavation Report
1998	Cheshunt Riverview	Hunter Valley No. 1 Mine South Pit Modifications Archaeology Report December 1998	ERM	S90 # SZ315	27/10/00	Feb-Mar 2001
1998	Jerrys Plains Rail Spur	Archaeological Assessment for a Proposed Rail Spur Line and Coal Loading Facility, Jerrys Plains, NSW February 1998 (Appendix I-2 Volume 3 of Proposed Jerrys Plains Coal Terminal, Rail Spur Line and Associated Infrastructure EIS and SEE)		Outside CNA's Mining Area	-	-
1999	Carrington	Chapter 11 of Carrington Mine EIS May 1999 Carrington Mine Supplementary Archaeological Information August 1999 Carrington Mine EIS and Supplementary Information February 2000	ERM	S90 #SZ311	25/09/00	Oct-Nov 2000

Survey Date	Survey Area	Survey Report	Report Author	Section 87 / 90 Permit Number	Permit Date	Salvage Completion Date
1999	Carrington	Wonnarua Cultural Heritage Assessment January 2000	Junburra ACS	S90 #SZ311	25/09/00	Oct-Nov 2000
1999	Glider airstrip	An Aboriginal Archaeological Assessment of a Proposed Extension to the South Lemington Coal Mine Lease, Hunter Valley, November 1999	Kuskie – South East Archaeology	Has not proceeded to date	-	-
1999	Carrington	Archaeological and Geomorphological Excavations at the Proposed Carrington Mine Site, Hunter Valley, April 2000	Hughes and Hiscock	SZ288 Research Permit S90 #SZ311	25/09/00	Oct-Nov 2000 Excavation / Salvage Report
2000	Cheshunt / Riverview	Cultural Heritage Assessment for Hunter Valley No. 1 South Extension 2000	Junburra ACS	S90 # SZ315	22/01/02 Reissued 5/09/02	Feb–Mar 2001
2000	Howick Coal Mine Southern Extension	Archaeological Site Assessment Howick Coal Mine, Hunter Valley 2000	AMBS	S90 #SZ300	4/08/00	Aug-Sept 2000
2001	Howick Coal Mine Southern Extension	Howick Coal Mine Archaeological Salvage Excavation Hunter Valley NSW Vols 1 and 2 – Use Wear and Residue Analysis Volume 2 of 2 volumes report AMBS Consulting November 2001	AMBS	S90 #SZ300		Salvage Report
2000	Jerrys Plains Rail Spur	Archaeological Survey Proposed Coal Terminal, Rail Spur and Associated Infrastructure, Warkworth November 2000 (Appendix I-1, I-3 Volume 3 of Proposed Jerrys Plains Coal Terminal, Rail Spur Line and Associated Infrastructure EIS and SEE)	HLA Kuskie - South East Archaeology	Outside CNA's Mining Area	-	-

Survey Date	Survey Area	Survey Report	Report Author	Section 87 / 90 Permit Number	Permit Date	Salvage Completion Date
2002	Lemington to Warkworth Heavy Equipment Access Track	Archaeological Assessment of Aboriginal Heritage Lemington to Warkworth Heavy Equipment Access Track October 2002 (Appendix D of Draft Proposed Lemington to Warkworth Heavy Equipment Access Track SEE 2003)	AMBS	No Sites Recorded	N/A	N/A
2002	HVO Western Haul Road	Hunter Valley Operations - Western Haul Road SEE 2002	ERM	No Sites Recorded	N/A	N/A
2003	Cheshunt / Riverview	Archaeological Excavations at Hunter Valley South, Report to CNA 2003	AMBS	S90 # SZ315		Excavation / Salvage Report
2003	West Pit Extension	Aboriginal Cultural Heritage Assessment for Extension of West Pit Hunter Valley Operations September 2003	Victor Perry – Junburra Aboriginal Consultancy Services	S90 #2086	14/12/04	31/01/05 – 4/02/05
2004	Riverview 330kV Transmission Line Corridor	An Aboriginal Archaeological Study and Non-Indigenous Heritage Overview of the Proposed Liddell-Newcastle 330kV Transmission Line Realignment (Appendix 3 of Liddell to Newcastle 330kV Transmission Line Deviation for Coal & Allied Mine Expansion February 2005)	Central West Archaeological and Heritage Services	S90 #2091	19/01/05	8/05/05
2005	West Pit Extension	Aboriginal Cultural Salvage at West Pit Extensions July 2005 ERM	ERM	S90 #2086		Salvage Report

2005	Cheshunt Pit Extension	Aboriginal Assessment May 2005 (Annex K of Cheshunt Pit Extension SEE July 2005)	ERM	S90 # 2491 S87 #2488	7/07/06 7/07/06	18-20/07/06

Survey Date	Survey Area	Survey Report	Report Author	Section 87 / 90 Permit Number	Permit Date	Salvage Completion Date
2007	Cheshunt Pit Extension	Cheshunt Pit Extension Archaeological Report for Cheshunt Site HVO NSW Excavation and Salvage Report May 2007 ERM	ERM	S90 # 2491 S87 #2488		Salvage Report
2005	Carrington Pit Extension	Archaeological Assessment October 2005 (Annex G of Carrington Pit Extended SEE October 2005)	ERM	S90 #2547	9/03/07	12-14/03/07
2007	Carrington Pit Extension	Hands On Culture Aboriginal Heritage At Carrington Hunter Valley, Cultural Heritage Salvage Report, June 2007.	ERM	S90 #2547		Salvage Report

12.2.2 *Terms of Reference*

A ToR for the HVO South Aboriginal cultural heritage assessment was developed through a collaborative process between CNA and various Aboriginal Parties in the Hunter Valley. CNA and these Parties established the 'Working Group' in September 2005 (*Chapter 6*). *Annex M* provides a generic ToR for the assessment undertaken for the project.

The ToR details the nature and extent of the proposed development activity, the area to be surveyed including those areas previously surveyed but not yet disturbed, and those areas not previously surveyed. The ToR also details scope and scale of the heritage assessment work to be undertaken, assessment methodology, composition of assessment team, timelines, duration of work and hours, payment, safety and all other technical and procedural aspects of the cultural heritage assessment work programme. The ToR were designed to be consistent with draft guidelines prepared for Part 3A projects under the *EP&A Act*.

12.2.3 *Survey Methodology*

The archaeological survey methodology for the project consisted of a comprehensive and systematic assessment of the entire study area (ie 100% of the area was inspected). The study area comprised all areas within the proposed consolidated consent area that has not been previously assessed for Aboriginal cultural heritage or where RTCA determined that the previous survey methodologies were not consistent with current best practice assessment methodologies. The standard methodology used for the surveys are included in the generic ToR in *Annex M*.

The surveys were undertaken in stages due to access and weather restrictions. The Stage 2 areas were on land not owned by CNA so access approval was required.

CNA, on the advice of the Working Group, engaged representatives to act as administrative coordinator and independent technical advisor for each of the HVO South Stage 1 and 2 Aboriginal heritage assessments (*Table 12.2*).

Table 12.2 Stage 1 and 2 Surveys

	Stage 1	**Stage 2**
Date	September - October 2006	July 2007
Administrative Coordinator	Ungooroo Aboriginal Corporation	Hunter Valley Aboriginal Corporation
Technical Advisor	HLA-Envirosciences	McCardle Cultural Heritage

The ground assessment work was conducted by six Aboriginal cultural heritage field officers selected by the administrative coordinator from the Working Group field officers register. The Aboriginal field teams were assisted by their technical advisor in interpreting and recording all cultural heritage items identified during the fieldwork. CNA also supplied a data management officer to ensure all survey areas were subject to comprehensive inspection as per the planned transect programme and that all cultural objects and areas were accurately recorded.

The surveys involved the completion of a series of 100 m wide transects across the assessment areas aimed at ensuring that a comprehensive survey of the areas was completed, with the field team covering between 8 and 10 km of transects each day.

12.2.4 *Survey Areas*

The largest of the proposed mining extension areas, Deep Cheshunt, has existing surface rights consent. This area was comprehensively surveyed in 1990 (Brayshaw), 1992 (Dean-Jones survey of North Lemington) and again in 1997 (ERM 1998) and the sites recorded were salvaged under Section 90 (of the *NPW Act*) permits #315 and #431. Therefore, with the agreement of the Working Group, this area was excluded from the HVO South ToR as it is unlikely that new sites will be identified.

The three proposed mining extension areas without existing surface development consent cover approximately 250 ha in total. Surveys were completed for the Riverview south west and South Lemington Pit 1 mining extension areas during the Stage 1 fieldwork. The Riverview south east mining extension area was accessed during the Stage 1 assessment, along with the area surrounding the existing LCPP and the proposed rail spur and loop development areas, in anticipation of future surface disturbance.

Additional areas of proposed surface disturbance and infrastructure were surveyed during the Stage 2 fieldwork.

A portion of the 'Archerfield' property was also surveyed to contribute to the knowledge of cultural heritage in the region. See *Table 12.3* for survey areas.

Table 12.3 Survey Areas

Survey Area ID	Total Area (Approx ha)	Disturbed Area (Approx ha)	Area to be surveyed (Approx ha)
Cheshunt (Survey Area 1)	650	650	0
Riverview south west (Survey Area 2)	105	5	100
Riverview south east (Survey Area 3)	58	5	53
South Lemington Pit 1 (Survey Area 4)	69	20	49
Proposed Glider Airstrip (Survey Area 5)	50	N/A	50
Proposed Rail Easement (Survey Area 6)	20	N/A	20
South Lemington south east (Survey area 7)	80	N/A	80
South Lemington south west (Survey Area 8)	150	N/A	150
Lemington CHPP & rail line easement	194	14	180
Archerfield area	220	N/A	220

Survey Area ID	Total Area (Approx ha)	Disturbed Area (Approx ha)	Area to be surveyed (Approx ha)
Total	**1596**	**694**	**902**

12.2.5 *Recording and Reporting*

The site inspections were undertaken on 18 to 24 September and 6 October 2006 (Stage 1) and 9 to 13 July 2007 (Stage 2), resulting in a total of 13 survey days. A summary of results documenting the archaeological findings is attached in *Annex M*. Potential impacts, limited interpretation, scientific significance, and suggested management options for the surveyed extension areas are detailed in *Section 12.3*.

All Aboriginal cultural material identified during the assessment surveys was recorded using a differential GPS and entered into a GIS database. In addition, a programme of consultation with local Aboriginal people as referenced by the Working Group was undertaken regarding the significance of the places identified in the development area, and the presence of any other cultural places known to those people in the development area.

All Aboriginal cultural places and values identified were accorded equal importance in deliberations.

12.3 *IMPACT ASSESSMENT*

The surveys resulted in the identification and recording of 138 sites at which Aboriginal cultural heritage material was identified, with a total of 674 artefacts (21 stone artefact scatters, 116 areas containing isolated artefacts and 1 possible scarred tree (detailed in *Table 12.4* below and illustrated in *Figure 12.2*). Although located across all landforms present, the distribution of these sites was very closely tied to the location and nature of water, with the majority of the recorded sites located across the low slopes adjacent to and along a first order creek that flows into Wollombi Brook near its confluence with the Hunter River in the LCPP survey area. Sites 80-83 were located near the Hunter River. The remainder of the sites were located evenly between the Riverview south west and South Lemington Pit 1 mining extension areas.

Table 12.4 Cultural Heritage Sites Identified and Recorded in Surveys

Survey Area	Site Number	Isolated Stone Artefact/s	Stone Artefact Scatter	Possible Scarred Tree	Total
Cheshunt (Survey Area 1)	-	-	-	-	-
Riverview south west (Survey Area 2)	1-24	24	-	-	24
Riverview south east (Survey Area 3)	137-138	1	1		2
South Lemington Pit 1 (Survey Area 4)	59-79	21	-	-	21

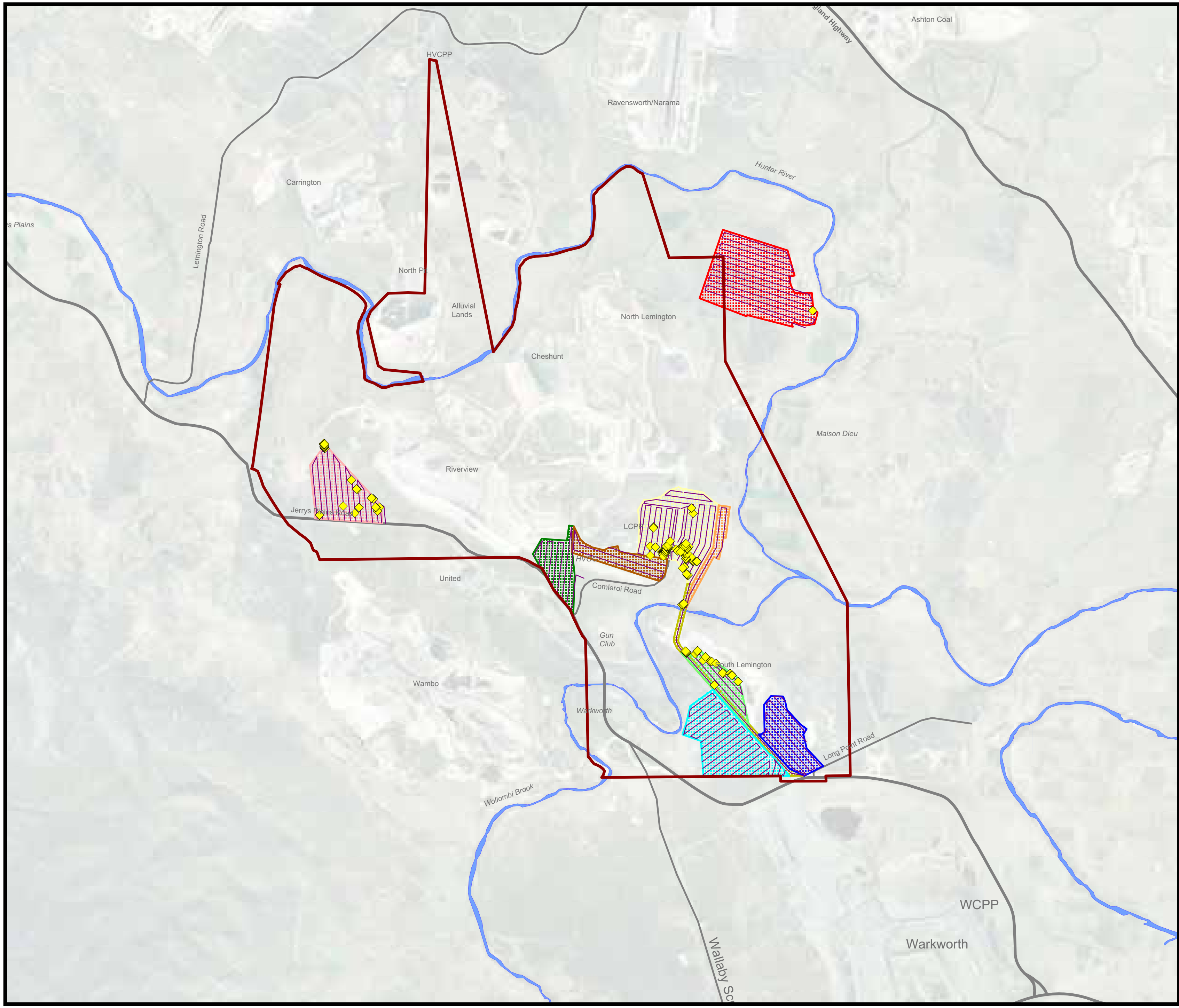
Survey Area	Site Number	Isolated Stone Artefact/s	Stone Artefact Scatter	Possible Scarred Tree	Total
Proposed Glider Airstrip (Survey Area 5)	110-118	8	1	-	9
Proposed Rail Easement (Survey Area 6)	133-136	1	3	-	4
South Lemington south east (Survey Area 7)	119-124	4	2	-	6
South Lemington south west (Survey Area 8)	125-132	5	3	-	8
LCPP	26-58 84-109	49	9	1	59
Proposed rail spur and loop easement	80-83	2	2	-	4
Archerfield	25	1	-	-	1
Total		**116**	**21**	**1**	**138**

As summarised in *Table 12.4*, aside from the possible scarred tree (Site 44), all sites were classified as being isolated finds or artefact scatters. The size of these varied from one artefact up to about 100 (in the case of Sites 98 and 99). The vast majority of the sites (approximately 75%) contained less than five stone artefacts, while less than 15% contained greater than 10 artefacts.

Of the artefacts identified and recorded, most were chert and silcrete flakes, with minor numbers of petrified wood, mudstone, siltstone and chalcedony artefacts.

Generally, the artefactual material was of an early reduction phase, early flakes or blanks deriving from cobble or outcrop sources. Sites surrounding the first order creek in LCPP however, typically exhibited traits of later reduction stages, with extensive dorsal scarring, shaping, and other indications of earlier flakes being removed from cores.

Only a small proportion of the flakes (about 3% of the recorded assemblage) possess retouch (secondary modifications such as trimming or sharpening). Of these, seven complete or partial backed blades and a possible tula adze slug were noted. The backed blades were found throughout the LCPP survey area (Sites 36, 39, 49, 52 and 85-87) and the possible tula adze was located in the railway easement survey area. The only other formal 'tool' types observed were a possible hammerstone and possible basalt hand axe, both located in the LCPP survey area (Sites 98 and 106 respectively); and a broken axe head manufactured from basalt located east of Wollombi Brook (Site 125).



Legend

- Aboriginal Cultural Heritage Site
- Survey Transect
- Area 2
- Area 3
- Area 4
- Area 5
- Area 6
- Area 7
- Area 8
- Archerfield Area
- LCPP Area
- LCPP Rail Easement
- Project Application Area

Figure 12.2

Areas Surveyed and Aboriginal Cultural Heritage Sites Identified

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_23	Suffix No:	R1
Date:	27.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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0 1 2km

Environmental Resources Management Australia Pty Ltd
Building C, 33 Saunders St, Pyrmont, NSW 2009
Telephone +61 2 8584 8888

ERM

12.3.1 *Review of Scientific and Archaeological Significance Assessment*

The significance assessment of the sites in the survey areas incorporated the potential research value, representativeness, rarity, educational value and aesthetic potential associated with each site. In addition, the level of significance was determined in consultation with the Working Group and a full copy of meeting minutes confirming this consultation has been provided to the DECC (Coffs Harbour). A summary is available in *Annex M*. Research potential is the potential of a particular site or group of sites to answer questions about the past through the use of archaeological methodologies. The integrity of sites, connectivity to other sites and potential for providing a chronology are also considered. If a site is defined as 'representative' of a particular type or class, it can then be assessed for conservation value. The criterion of rarity or 'distinctiveness' reflects whether the 'nature' of the archaeological site being investigated is common or rare. Rarity is considered at local, regional, state, national and global levels. None of the sites identified in the survey were considered to have educational or aesthetic potential, due to impacts resulting from past land use.

Table 12.5 shows the level of significance assigned by the technical advisors to the sites in the survey area, with six sites categorised as having high scientific interest. One site was assigned moderate to high significance, based upon an assumption that the site is a scarred tree. This assumption has yet to be validated.

Table 12.5 Summary of Significance Assessment

Significance	Site ID
High	51, 52, 86, 97, 98, 99
Moderate / High	44
Moderate	55, 85, 87, 100, 118, 120
Low / Moderate	7, 13-19, 26-30, 36, 38, 39, 46, 50, 74, 80-83, 107-110
Low	1-138, excluding sites listed above

In virtually all cases, the recorded sites were located on ground previously disturbed by either human activities or natural processes such as erosion. Across the majority of the survey areas the nature and extent of impacts from natural processes have been greatly exacerbated by human activities, such as extensive pastoralism and mining. This disturbance of the original land surface has also altered the stratigraphic and chronological history of sites. As a result of these findings the majority of sites identified in the assessment surveys consisted of surface evidence only.

High Significance

As previously stated, the field assessment found that the research potential of a majority of open artefact scatters and isolated finds had been compromised by the soil and geomorphology flux and land use practices, which have impacted the integrity of the sites. Sites with intact stratigraphic integrity and chronology are assigned a high significance value.

Sites 51 and 52 were identified as having the potential to retain subsurface material, showing clear evidence of subsurface deposits, albeit of a colluvial nature, with artefacts leaching from vertical soil sections. Site 51 in particular contains a potential silcrete knapping floor, and is situated on the interface of an orange clay subsoil (most likely of Tertiary origin) and a sandy loam colluvial layer above. This is a typical duplex soil profile found across a number of areas in the Hunter Valley lowlands, and one that has the potential to provide both stratigraphic and temporal information on its formation. Given the numerous other sites found in this particular area, it seems likely that other buried cultural heritage material could be expected to be found within this colluvial layer, considered to extend across much of the area immediately adjacent to these sites.

Site 86 was considered highly significant due to the presence of petrified wood artefacts, which are not well represented in the local and regional environment.

The high significance of Sites 97, 98 and 99 was identified due to the potential to contribute to the research knowledge of artefact technology and manufacture, due to the high concentrations of reduction materials (having local and regional significance).

Moderate / High Significance

Site 44 is a potential scarred tree which was assigned a moderate / high value due to the low representation of scarred trees in the Hunter Valley.

Moderate Significance

Site 55 was assigned moderate significance due to its proximity to Site 51, which has potential for providing stratigraphic and temporal information for this and surrounding sites (Site 40-55).

Sites 85, 87 and 100 are a series of large artefact scatters with evidence of latter reduction stages and uncommon raw materials. These sites are in a heavily disturbed context, and have been assigned moderate significance based on technological and material aspects of their assemblages. Site 100 has the potential to contribute to the research knowledge of artefact technology and manufacture, due to the high concentrations of reduction materials (having local and regional significance).

Sites 118 and 129 are artefact scatters located in a disturbed context, but have potential for deposits at depth which remain undisturbed, resulting in a moderate rating for significance.

Low/Moderate or Low Significance

The allocation of low/moderate or low significance to remaining sites typically relates to their connection to, and relationship with, other more significant sites, their research potential, rarity and representativeness. The position of these sites with respect to other more significant sites may provide insights into Aboriginal settlement patterns, technology and chronology of occupation within these areas.

Concentrations of sites of technological interest, specifically those exhibiting latter stage reduction and/or retouch, are considered of higher significance than flaked pieces. Hence, sites such as Sites 13-19, which are all located close together and are considered to be component exposures that form a much larger artefact scatter of numerous materials and reduction strategies, have been identified as having low/moderate significance. Sites 36 and 46 were also found to be low / moderately significant due to the presence of retouched artefacts which, while not rare in the Hunter Valley, are by no means universally present on sites in this region.

The connectivity of Site 50 with highly significant Sites 51 and 52 resulted in a low/moderate significance classification.

Sites 38-55, 84-101, and 107-109 demonstrate either stratigraphic integrity (as in the case of Site 51), and/or evidence of extensive latter stage reduction strategies. The combination of these two factors is considered to be relatively uncommon.

Other sites identified throughout the remainder of the survey areas generally provide neither contextual nor obvious technological information. The sites in the South Lemington Pit 1 mining extension area, for example, are all heavily disturbed and damaged, with many originating from mounded soil heaps and subsequently being moved around through recent colluvial and sheetwash processes. Similarly, sites in Riverview south west are predominantly found along a recent transmission line and/or series of dams. Sites 80 to 83 (within the railway easement) have also been extensively affected by a new dam and the existing haul road in this location.

12.4 MANAGEMENT MEASURES

The management of cultural heritage at HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle. The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for management of cultural heritage are to:

- avoid cultural heritage sites where possible;
- implement zones of management for sensitive areas; and
- undertake mitigation where avoidance or management is not possible.

Many control measures to minimise impacts to Aboriginal cultural heritage are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

CNA acknowledges that the Aboriginal community of the Upper Hunter Valley view the stone artefact scatters and isolated finds that constitute the greater part of the cultural landscape as being the 'footprints of the ancestors'. That is, they identify these sites as being a material manifestation of the 'old people' who once occupied this country, and who still occupy it in a spirit form. The Aboriginal community attaches considerable significance to each and every example of this manifestation because of this, and accepts that they have a duty of care to such places to manage them as best they can in the context of development. This view is at the root of their interest in not removing or disturbing such sites unless it is absolutely necessary.

However the Aboriginal community does not attach similar significance to petrified wood artefacts. It should be noted that the Terms of Reference (scope and works and methodology) for these surveys made express provision to consider just such matters but none have been raised in the field surveys nor at the subsequent community meetings to review the outcomes of the fieldwork or to review the draft CHMP.

Following the provision and review of the results of the Aboriginal heritage assessment and the meetings with the Working Group, it was agreed that cultural heritage places located in HVO South Stage 1 cultural heritage assessment areas will be designated as significant and will be managed as detailed below. A formally agreed motion to this effect was passed at the meeting of the Working Group in February 2007.

As a consequence, it was identified that two highly significant sites (51 and 52) and concentrations of cultural material in the surrounding area, would be impacted by the location of the proposed rail loop. As the preferred management strategy is to avoid cultural sites where possible, the rail loop was realigned to avoid the greater majority of sites. Cultural heritage restricted access areas were proposed and agreed with the Working Group. These restricted access areas aim to reduce mining related disturbance but allowing the continuation of those activities authorised under the current agricultural land leasing arrangements (*Figure 12.3*).

Where site avoidance was not a viable management option, alternative management measures were proposed. For the Stage 1 survey, these proposed measures were provided to all members of the Working Group for their review and comment, and ultimately for inclusion in the ACHMP. Additionally, three meetings were held with the Working Group to review the results of the field investigations and the proposed management activities for the ACHMP. Comments made at those meetings were noted and the proposed ACHMP modified to reflect all agreed variations.

The sites identified during the HVO South Stage 2 cultural heritage survey will be managed in a manner consistent with the management principles employed in the ACHMP to minimise impacts to Aboriginal heritage from the development, whereby surface artefacts will be salvaged if site avoidance is not possible. Specific management measures for the Stage 2 survey will form part of the ACHMP once endorsed by the Aboriginal community.

Following any salvages, a report will be prepared as a record of the works being completed, and a copy will be provided to the relevant parties.

Mitigation Measures

1. The approved ACHMP (the HVO South Proposed Management Strategies – Aboriginal Cultural Heritage document),will be the primary management tool for the Project Application area. This will make provision for the following general and specific management measures and actions.

2. Develop and implement a cultural heritage zoning scheme. This zoning scheme is to control mine-related land use activities in all assessment areas and includes:

    - areas zoned as cultural heritage restricted access areas;
    - areas zoned as assessed and salvaged;
    - areas zoned as available for development subject to the implementation of agreed management measures;
    - areas zoned as environmental management areas where cultural heritage issues will be factored into the general plan; and
    - the boundary of any restricted access area and the limit of disturbance boundary defining where mining or mine-related activities are authorised to take place will be suitably demarcated and the zoning scheme will be regularly revised to ensure its currency for planning purposes.

    Additional subsets of each of these zones may be created as needed.

3. Access into the restricted access zoned areas will be subject to formal authorisation. Proposed conditions of access will prevent ground disturbance without consultation with the Working Group. These conditions are qualified by conditions pertaining to existing land use activities as outlined below.

    - existing non-mine related activities will continue in the general areas containing the restricted access areas.
    - access to the restricted areas will continue as required for environmental monitoring or site maintenance activities where impacts to sites will not occur. Environmental Services will be consulted regarding all access to these areas.

4. Existing activities that may continue on the restricted access areas include:

    - traversing the area using the existing roads and tracks;
    - maintaining existing fences;
    - implementation of any existing weed, pest and fire management regimes; and
    - general stock management measures.

    CNA will initiate discussions with the lessee regarding their existing activities so they are aware of the cultural sites and values.

5. CNA will ensure that its GDP process is applied in all areas:

    - any GDP that is issued will be compliant with the cultural heritage zoning scheme and specific management requirements for any area or site;
    - where cultural heritage sites have been identified in a proposed work area (other than those within a restricted access or management area), a buffer will be agreed on a case by case basis, to be applied beyond the identified extent of each site; and

- no ground disturbance activities will be permitted to take place within that area until such time as all agreed management measures have been implemented in full.

6. Storage of artefacts will be in the Temporary Storage Facility (DECC Application for Care Agreement (Application Date 19 December 2007)) to be located at the Hunter Valley Services offices, as endorsed by the Working Group. Collected material may either be stored in this Facility or placed within a cultural heritage restricted access area as agreed with the Working Group.

7. Cultural heritage awareness training will be included in Mine Site Inductions and will involve the provision of information detailed in the ACHMP and CNA's EMS procedure for Cultural Heritage Management.

Commitments Specific to the Proposal

In addition to the mitigation measures detailed above a number of management measures specific to the proposal have been agreed with the Aboriginal Working Group. The outcome is that the specific commitments as detailed in the ACHMP are acceptable and may form the basis for a submission under Part 3A of the *EP&A Act.*

1. Management Measures for ACHMP HVO South Stage 1 include:

   - all management measures will be undertaken in accordance with the Aboriginal Heritage Assessment as outlined in the ACHMP;

   - if at a later date it is found necessary to undertake an action that would impact sites described within the Aboriginal cultural heritage assessment, additional and specific management recommendations may be implemented in consultation with the Working Group;

   - provision is to be made for the management of collected cultural heritage material;

   - provision will be made in the ACHMP for the Working Group to undertake an independent compliance audit of the management programme on a six monthly basis. In the event that any non-compliant activities are identified at any time, further investigation may occur and an additional compliance audit may be undertaken as part of the investigation process.

   - where any mitigation is required it will be undertaken by representatives of the Working Group and suitably qualified technical advisers;

   - implement a management programme providing for the controlled collection of the following sites where site avoidance is not possible. Until management measures (which may involve the collection of cultural material) have been implemented, mine-related impacts to the sites will be prevented:

     i) Riverview South West Mining Extension Area Sites 1-24

     ii) South Lemington Pit 1 Mining Extension Area Sites 59-79;

     iii) Proposed rail spur and loop easement Sites 80-83

     iv) LCPP Sites 101 and 105-106

- the alignment of the proposed rail spur and loop have been amended to avoid impacts to Sites 26-44, 47-58 and 107-109;

- restricted access zones will be defined for Sites 26-44, 47-58, 84-100, 102-104 and 107-109. The boundaries (*Figure 12.3*) are indicative only; and

- land management activities on the Archerfield property will avoid any impacts to Site 25.

Management measures to be implemented in accordance with agreed ACHMP HVO South Stage 2.

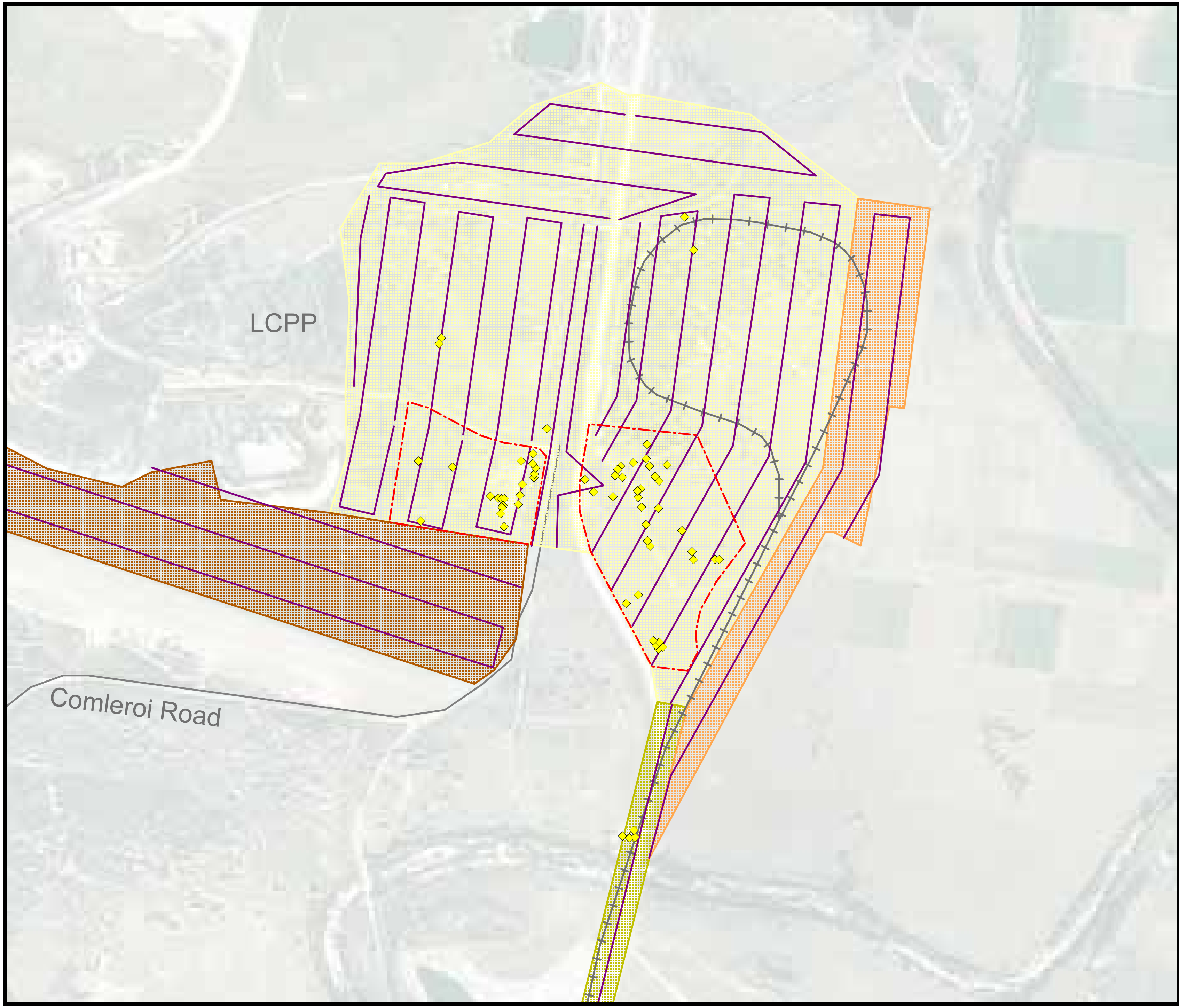

Figure 12.3

Indicative Restricted Access Areas

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_24	Suffix No:	R1
Date:	27.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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12.5 CONCLUSIONS

The Stage 1 and 2 investigations of Aboriginal cultural heritage have resulted in the discovery and recording of 138 separate locations. These included sites deemed to be of high cultural heritage significance. All sites previously recorded but not salvaged and new sites identified through this assessment process will now be subject to the ACHMP. Due to the Part 3A Project Application process, Section 87 and 90 permits are not required. Management measures have been and will be developed in consultation with the Upper Hunter Valley Cultural Heritage Working Group and will include avoidance of cultural sites, cultural salvage and/or controlled collection as detailed in the ACHMP.

13 HISTORIC HERITAGE

This chapter provides an overview of the historically significant heritage items located within, and in the areas adjacent to, the Project Application area. It also outlines existing and proposed management measures to mitigate potential impacts resulting from the proposal.

13.1 INTRODUCTION

Historic heritage includes non-indigenous items considered to be of particular importance to the state, region or local community. Historic heritage items in NSW are conserved under the *Heritage Act 1977*. Historic heritage under the Act is defined as including buildings, works, relics, places which are of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance to the state. Examples may include early settlement infrastructure relating to the late nineteenth or early twentieth century.

13.2 METHODOLOGY

The methodology involved a review of assessments previously undertaken within and surrounding the Project Application area, database searches of all relevant local, regional, state and national heritage registers, and documentation of sites identified during surveys and site inspections. In addition, existing management measures were reviewed to identify additional measures required as a result of this proposal.

James Phillips of Weir and Phillips also undertook a specific assessment of the Warkworth Airfield. This included a detailed literature review and site inspection.

13.2.1 Literature Review

Previous environmental assessments have included the completion of historic heritage assessments. These documents were reviewed to consolidate all items previously identified.

Documents reviewed included:

- CNA (2002) Extension of Warkworth Coal Mine Environmental Impact Statement, prepared by ERM;
- CNA (2004) HVO West Pit Extension and Minor Modification Environmental Impact Statement, prepared by ERM;
- CNA (2005) Cheshunt Pit Extension Statement of Environmental Effects, prepared by ERM;
- CNA (2005) Riverview Pit Extension Statement of Environmental Effects, prepared by ERM;
- Wambo Mine Pty Limited (2006) Wambo Mine Statement of Environmental Effects, prepared by Resource Strategies;

- TransGrid (2005) Liddell to Newcastle 330kV Transmission Line Deviation For Coal & Allied Mine Expansion – Review of Environmental Factors;

- CNA (2006) Draft RTCA Heritage Register Update Summary Report prepared by ERM;

- Gillison, Douglas, Australia in the War of 1939-1945: Royal Australian Air Force, 1939-1942, Canberra, Australian War Memorial, 1962; and

- Scholes, J., 'Bulga/Milbrodale History', Hunter Valley News, 20 March 1985.

A large volume of material relating to the Warkworth Airfield is located in the National Archives of Australia and NSW State Library. These references are detailed in *Section 1.6* of *Annex N*.

13.2.2 *Database Searches*

In addition to the literature review, a desktop database search was conducted of all relevant local, regional, state and national heritage registers, to identify local heritage items, their significance and their general locality.

The database searches included the:

- Australian Heritage Places Inventory;

- Register of National Estate (Australian Heritage Database);

- NSW Heritage Register;

- RTA Heritage and Conservation Register;

- Singleton LEP;

- CNA Heritage Register; and

- Singleton Historical Society.

13.3 *IMPACT ASSESSMENT*

The literature reviews of previous assessments along with the database searches confirmed that historic heritage items do exist within and surrounding the Project Application area, although there are no registered historic heritage items located within the proposed mining extension areas.

The results of the heritage register searches for the Project Application area and surrounding areas are summarised in *Table 13.1*. Ten items are located both inside and outside of the Project Application area. However, all items are located outside the proposed mining extension areas and currently approved mining and infrastructure footprint, and therefore will not be impacted by current HVO activities or by the proposal.

Heritage items not listed on the databases detailed in *Section 13.2.2* but identified in previous historic heritage assessments as being potentially significant are described in *Table 13.2*. All items with the exception of the Archerfield Homestead, the Dight Family Grave, the Cheshunt Creamery and Moses Crossing are located in the Project Application area. Of the items in *Table 13.2* located in the Project Application area, only the Warkworth Airfield has the potential to be impacted by the proposal as this is the only item located within the disturbance footprint of the proposed operations .

An historic heritage consultant was engaged to undertake a site inspection and assessment of the heritage value of the Airfield, with the outcomes detailed in a *Warkworth Airstrip Historic Heritage Assessment Report*. The report concluded that the Warkworth Airstrip and associated facilities do not warrant listing as items of cultural significance, as the historical understanding of the place is derived from records rather than the physical manifestation of the Airfield on site. It was found that the proposed alterations to the runway will have no effect on the heritage significance of the Airfield and associated facilities. A full copy of the assessment report is provided as *Annex N*.

It is also noted that access to the airfield for mining purposes is dependent on the outcomes of negotiations with HVGC as detailed in *Chapter 5*.

The location of registered heritage items and potentially significant non-registered historical heritage items located in the vicinity of the Project Application area are illustrated in *Figure 13.1*.

Table 13.1 Local and Regional Registered Historic Heritage Items

Heritage Site Number[1]	Heritage Item Name	Location / Brief Description	Significance	CNA Owned	Located within Project Application Area	Potential impact from proposal
1	Wollemi National Park	Boundary of the Park is the Putty Road, Singleton. The Wollemi National Park is known for its unique, rich and diverse fauna and flora. Eighteen rare and endangered plant species have been identified within the park.	Register of National Estate and World Heritage List	No	No	No
2	Wambo Homestead	Located on the western side of the Wollombi Brook, south of the existing Wambo Coal Mine.	NSW Heritage Register LEP – State Significance	No	No	No
3	Bulga Bridge over Wollombi Brook	Main Road 213 or Putty Road, Bulga.	NSW Heritage Register and RTA Heritage and Conservation Register	No	No	No
4	Archerfield Outbuildings	Located on Archerfield Road, Warkworth. Two of the outbuildings are vertical slab construction stable / workshop / barn structures with shingle roofs. The third outbuilding is sandstock brick structure with basement.	LEP – Regional Significance	Yes	No	No
5	St. Phillip's Church	Located on High Street, Warkworth. St. Phillip's church is an Anglican Church.	LEP – Regional Significance	No	Yes	No
6	Clifford (ruins only) and Stafford Homestead	Long Point Road, Warkworth. A concrete slab, wall footings and scattered bricks, marks the Clifford Homestead site. The Stafford Homestead is a Victorian Georgian style rural homestead with multi-paned sash windows and encircling verandah. The Stafford homestead is presently unoccupied.	LEP – Local Significance	Yes	No	No

Heritage Site Number[1]	Heritage Item Name	Location / Brief Description	Significance	CNA Owned	Located within Project Application Area	Potential impact from proposal
7	Hotel Ruins	Warkworth	LEP – Local Significance	No	Yes	No
8	Former Queen Victorian Inn (Ruins)	Long Point Road, Warkworth	LEP – Local Significance	No	No	No
9	Chain of Ponds Inn and Outbuildings	Located on Old Singleton Road, Liddell. The complex comprises a two-storey Victorian Georgian Inn and two associated buildings. The Chain of Ponds Inn complex is presently unoccupied.	NSW Heritage Register – State Significance LEP – State Significance	Yes	No	No
10	Mount Thorley Brick Farmhouse	Located off Golden Highway, Mount Thorley. The brick farmhouse is early Victorian Georgian. The homestead is presently unoccupied.	LEP – Local Significance	Yes	No	No

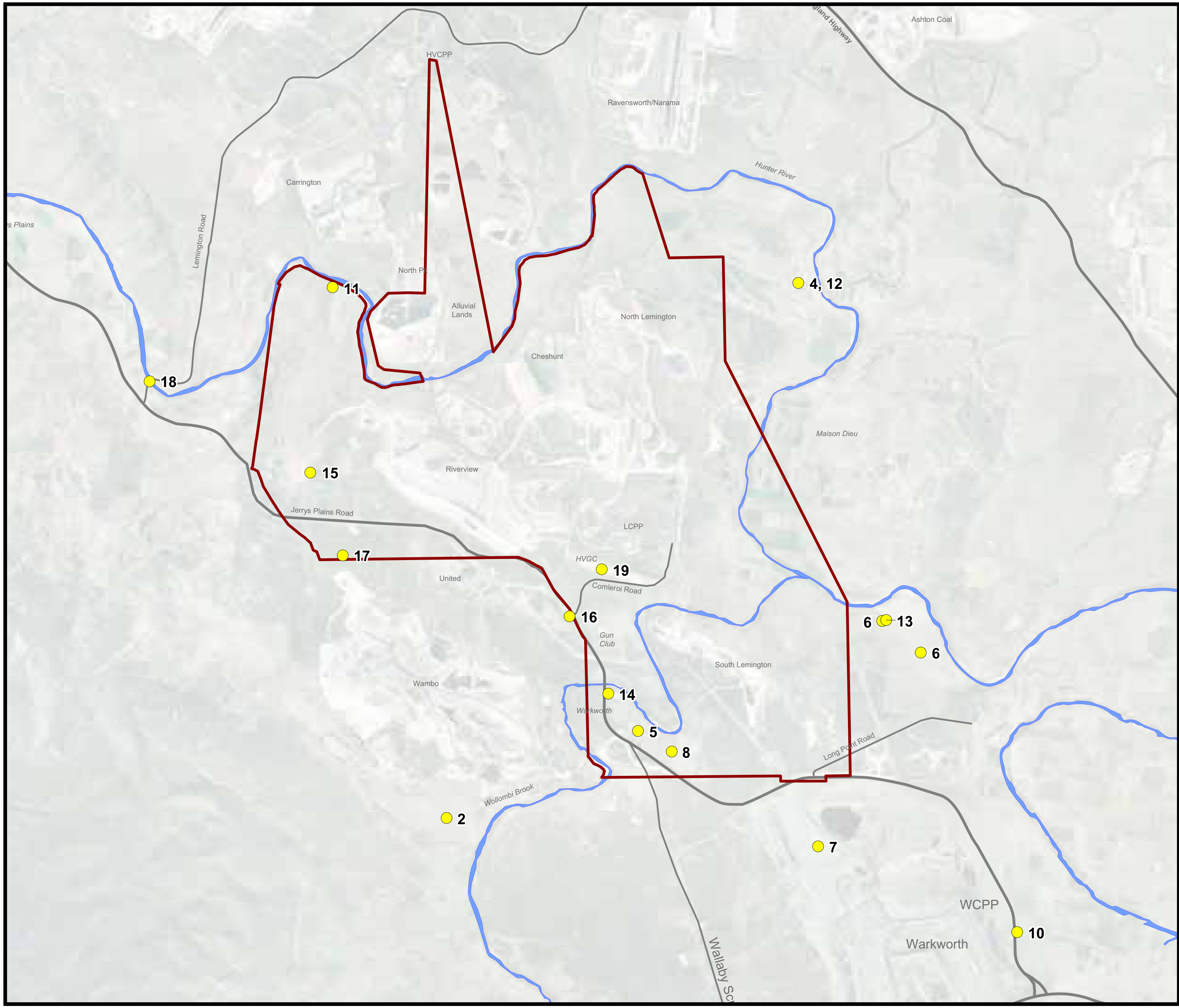
1. Refer to *Figure 13.1*

Table 13.2 Non-Registered Potentially Significant Historic Heritage Items

Heritage Site Number [1]	Heritage Item Name	Location / Brief Description	Significance	CNA Owned	Located within Project Application Area	Potential impact from proposal
11	Malabar Homestead	Located on Carrington Road, Warkworth. The homestead is a cottage constructed of vertical hardwood slabs. The homestead is presently unoccupied.	Potential Heritage Significance	Yes	Yes	No
12	Archerfield Homestead	Located on Archerfield Road, Warkworth. The homestead a federation-style building associated with the Archerfield outbuildings. The homestead and property are presently leased out for residential and farming purposes.	Potential Heritage Significance	Yes	No	No
13	The Dight Family Grave	Located on the Clifford Homestead property portion, Long Point Road, Warkworth. Nine family members of the Dight Family are buried in the family grave overlooking the Hunter River.	Potential Heritage Significance	Yes	No	No
14	The Former Warkworth Public School	Located on Jerrys Plains Road, Warkworth. The former school is Victorian Gothic in style. The former school is presently leased for residential use.	Potential Heritage Significance	Yes	Yes	No
15	Dilapidated Bridge Structure over unnamed ephemeral creek	Location – along secondary road near the junction of the old (pre-mining) Jerrys Plain – Singleton Road, Warkworth.	Potential Heritage Significance	Yes	Yes	No

Heritage Site Number [1]	Heritage Item Name	Location / Brief Description	Significance	CNA Owned	Located within Project Application Area	Potential impact from proposal
16	Creamery	Formerly located on the Barry Property – Archerfield Road, Warkworth, now located at the intersection of Jerrys Plains Road and Comleroi Road, Warkworth. The creamery was relocated as a result of the Cheshunt mining extension.	Potential Heritage Significance	Yes	No	No
17	Cockatoo Fence	Located west of Jerrys Plains Road, Warkworth. The Cockatoo fence was likely to have been built by the early settlers, in order to keep cattle entering steep mountainous country.	Potential Heritage Significance	Yes	Yes	No
18	Moses Crossing over Hunter River	Lemington Road, Ravensworth. The bridge is constructed of timber and is prone to flooding in times of high rainfall and flooding events.	Potential Heritage Significance	No	No	No
19	Warkworth Airfield	Located on Comleroi Road, Warkworth. The Warkworth Airfield was one of a number of airfields used for training purposes in World War II, including the Bulga Airfield. The Warkworth Airfield is now owned by the HVGC, and used for gliding activities.	Potential Heritage Significance	No	Yes	Yes

1. Refer to *Figure 13.1*



Legend

Historic Item

Project Application Area

Figure 13.1

Historic Items Within or Adjacent to Project Application Area

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_25	Suffix No:	-
Date:	30.08.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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13.4 MANAGEMENT MEASURES

The management of historic heritage at HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle. The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objective for management of historic heritage is to ensure that historic heritage sites and objects are identified and appropriately managed.

Many control measures to minimise impacts to historic heritage are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

A Historic Heritage Management Plan is currently being prepared that will include procedures for management of historical heritage items located on CNA owned land near HVO.

To manage items of local heritage in the area, CNA has developed a Heritage Register for historic heritage sites presently registered and also for potential historic heritage items identified on CNA owned land (including those presented in *Table 13.2*).

Consistent with Rio Tinto Cultural Heritage Management System policy and guidelines, CNA have adopted a precautionary management principle for all potential historic heritage features using the CNA GDP until such time as these sites have been properly assessed and appropriate management regime established. The GDP requires management approval prior to any disturbance or clearing on CNA owned land.

In addition to the standard control measures the *Draft RTCA Heritage Register Update Summary Report*, prepared by ERM (January 2005) for CNA, provides background on historic heritage items, a summary of the physical assessment, nature, condition, potential heritage significance and management of the sites located on CNA owned lands in the Hunter Valley. The report also recommends management measures for the CNA items listed in *Tables 13.1* and *13.2*, which include:

- that those items that are presently in use continue to be appropriately maintained including the Archerfield property and the former Warkworth School (leased from RTCA and used for residential purposes); and

- for those properties that are not occupied (including Mount Thorley, Stafford, Malabar and the Chain of Ponds Inn) a review is undertaken to determine a possible function if suitable.

Commitments Specific to the Proposal

A targeted field assessment will be undertaken by an historic heritage professional where required to supplement existing information to report on the relative significance of the additional sites identified on CNA land including a derelict bridge structure over an unnamed ephemeral creek and the cockatoo fence and recommend additional management measures.

13.5 CONCLUSIONS

This assessment included a search of all relevant databases and a study of relevant historical heritage assessments that have undertaken with the proximity of the Project Application area. One item, the Warkworth Airfield, has the potential to be impacted by the proposal. An additional study was undertaken concentrating exclusively on the Airfield. It concluded that the proposal will have no effect on the heritage significance of the Airfield and associated facilities. Existing management measures will continue to be implemented across HVO South, to ensure that heritage items listed in *Tables 13.1* and *13.2* are not impacted by the proposal.

14 VISUAL AMENITY

This chapter presents an assessment of the potential impacts to visual amenity associated with the proposal. It also outlines existing and proposed management measures to mitigate potential impacts resulting from the proposal.

14.1 INTRODUCTION

The objective of this visual assessment was to determine the potential impacts to visual amenity resulting from the proposal, within both the local and regional landscape setting. The assessment has been based on an analysis of visual absorption capacity, visual sensitivity and the nature and extent of landscape mitigation and rehabilitation measures.

14.2 METHODOLOGY

The methodology used in this assessment included:

- a review of the existing and historic regional and local landscape setting and previous visual surveys;
- a description of the visibility and sensitivity of the proposed operations from significant viewer locations;
- an evaluation of the visual character of the existing HVO South activities, proposed extension and infrastructure upgrade areas based on site inspection, aerial photography and topographic map interpretation;
- determination of the likely visual impacts of the proposal, based upon an analysis of the visual absorption capacity, visual sensitivity and timing of the proposal; and
- review of existing management measures to identify additional measures required as a result of this proposal.

Receptors potentially impacted by the proposal include residences within Maison Dieu, Warkworth, several individual residences and road users. The significance of visual impacts depends on the type and extent of change from the existing visual environment.

This assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. Therefore the existing and potential environmental impacts are already approved and management measures have been developed and implemented. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. The assessment results are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been approved.

14.3 *EXISTING ENVIRONMENT*

14.3.1 *Regional Setting*

The primary landscape features in the region surrounding HVO South include:

- steep sloping ridges along the escarpment boundaries;
- slightly undulating hills; and
- alluvial flats on the floodplain of the Hunter River and Wollombi Brook.

The visual landscape of this part of the Hunter Valley is dominated by mining and supporting industrial infrastructure. This area of the Upper Hunter Valley has the highest proportion of coal mines in NSW, with 90% being opencut mines. Large areas of the surrounding landscape have also been cleared for agricultural purposes, primarily for dairy and cattle farming.

Other landscape features include Wollemi National Park with Brokenback Ranges and Barrington Tops National Park which were established in 1979 and 1969 respectively. These parks form the western and north eastern edges of the Upper Hunter region respectively and provide a scenic natural backdrop to the entire landscape.

14.3.2 *Local Setting*

HVO South is situated in undulating land south of the Hunter River, with elevations between 70 m and 165 m AHD. The Hunter River flows west to east along the northern boundary of the site, creating a floodplain of lower lying land between the river and HVO to the north. Wollombi Brook passes through the south eastern portion of the site.

HVO South and neighbouring mining operations (and their associated infrastructure) are a locally dominant feature in the landscape and are visible from a range of viewer locations including roads and residential properties.

The village of Warkworth is located approximately 2 km to the south west of South Lemington Pit 1, Maison Dieu approximately 3 km to the east of North Lemington Pit, and Jerrys Plains approximately 8 km to the north west of the Riverview Pit. These villages are composed of a number of rural residences, and possess a visual character typical of many regional towns throughout NSW.

14.3.3 *Visual Catchment*

The visual catchment of the area is defined as the area in which the development is visible, and is limited by distance and topography. The boundaries of this catchment are generally formed by ridgelines. A visual catchment may extend further in some directions due to higher ridges or mountains, however these may be discounted due to their distance from the site. Distant views are less significant as more landscape is viewed and details are obscured by distance. Regional and local topographical features are discussed further in *Chapter 18 – Land Use and Management.*

Figure 14.1 defines the visual catchment of the area surrounding the proposed activities.

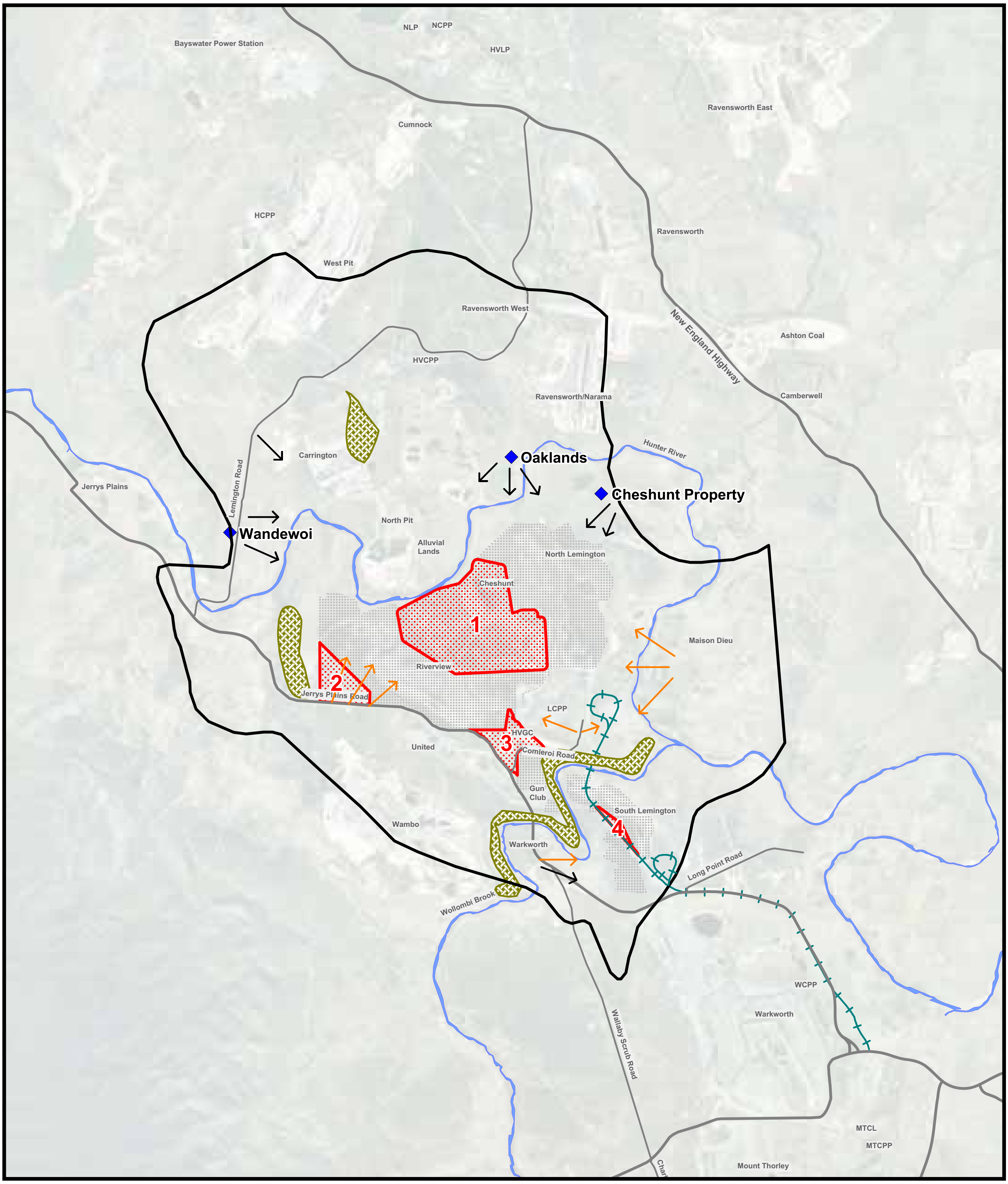
The catchment is defined to the north west by a ridgeline with elevations reaching 235 m AHD. To the north and north east the visual catchment extends to the Narama and Ravensworth Mines north of the Hunter River. The higher elevations of the South Lemington Pit 1 and the ridgeline behind Maison Dieu form the boundary to the east. A ridgeline behind Warkworth forms the boundary to the south east of the site as does a ridgeline extending to the north west of Warkworth to Jerrys Plains Road. The western boundary is defined by a ridgeline running south from Carrington Pit (located within HVO North). This ridgeline visually screens properties to the west of the site with the exception of some elevated residences along Jerrys Plains Road. *Table 14.1* lists the viewpoints assessed and provides a brief description of the existing views from these locations.

Table 14.1 Viewpoints around HVO South

Viewpoint	Description	Existing View
Maison Dieu	Residences	Operations at Lemington.
Warkworth Village	Residences	Low ridgeline and vegetation that follows Wollombi Brook. Views of existing operations are screened.
Individual residences	Wandewoi[1], Oaklands[2] and Cheshunt[1]	Distant views of both HVO North and South.
Public roads	Jerrys Plains Road	Distant views of HVO South.
	Comleroi Road	Distant views of HVO South.
	Lemington Road	Distant views of both HVO North and South.

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.

2. During the assessment period 2006/07 the Oaklands property was purchased by Xstrata (Pty Ltd) and is no longer considered a private receptor.



Legend

- Viewpoints
- Visual Catchment Area
- Natural Visual Screening
- Proposed Extension Areas
- Existing Approved HVO South Mining Areas
- Proposed Rail Line
- Full View
- Partial View

1 Deep Cheshunt
2 Riverview Pit South West
3 Riverview Pit South East
4 South Lemington Pit 1

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_08	Suffix No:	R2
Date:	13.06.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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Figure 14.1

HVO South Visual Catchment and Receptors

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14.4 *IMPACT ASSESSMENT*

The impact of a proposal is assessed based on the visual absorption capacity of the setting and the visual sensitivity of the receptors within that setting. The visual absorption capacity is the level of contrast of the proposed development to the visual setting within which it is placed. A high visual absorption capacity exists where there is minimal contrast and a high level of integration. Conversely, a low visual absorption capacity will occur when the proposal has a high visual contrast to the surrounding landscape and there is little or no visual screening, resulting in a more extensive visual impact.

The visual sensitivity of a receptor is a measure of the level of concern attached by surrounding land users to a change in the existing landscape dependent upon visibility and distance from critical viewing areas. The visual sensitivity of a receptor is also influenced by land use, degree of exposure to the style of development and the length of viewing time.

Table 14.2 summarises the impact assessment for the receptors described in *Table 14.1* on the basis of visual absorption capacity and visual sensitivity.

Table 14.2 Summary of Impact Assessment for Receptors around HVO South

Receptor	Visual Absorption Capacity	Visual Sensitivity	Impact Assessment	Changes Resulting from the Proposal	Proposed Management Measures
Maison Dieu residences	High	Low	Pit extensions and infrastructure areas will not have a significant visual impact on these residences.	These residences have views of the existing operations. As mining progresses, residents will view sections of Riverview south east extension area and the rail loop and overland conveyor if constructed.	Tree planting adjacent to the overland conveyor and rail loop will screen views of this infrastructure from Maison Dieu. Progressive rehabilitation will reduce visual impacts over time.
Warkworth Village	Medium	Medium	The mine extension and infrastructure areas will not have a significant visual impact on these residences.	Residents of Warkworth Village do not currently have views of operations of HVO South. As mining progresses in the South Lemington Pit 1, the operations may become visible; however, these will be partially screened by existing vegetation.	Existing vegetation and tree planting could be used to screen operations within South Lemington Pit 1. As mining progresses in South Lemington Pit 1, field assessments will determine whether supplementary tree planting through the low ridgeline which currently screens Warkworth Village from South Lemington Pit 1 is required. If existing tree screens are not adequate, rehabilitation plans will include additional tree planting as required.

Receptor	Visual Absorption Capacity	Visual Sensitivity	Impact Assessment	Changes Resulting from the Proposal	Proposed Management Measures
Individual residences (Wandewoi, Oaklands and Cheshunt)	High	Low	The mine extension and infrastructure areas will not have a significant visual impact on these residences.	These residences have views of the existing operations. As mining progresses, distant views of the Deep Cheshunt extension area will be visible from the Wandewoi property (from a distance of approximately 4 km). Oaklands and Cheshunt will both have views of the Deep Cheshunt extension area (from a distance of approximately 2.5 km and 3 km from the Oaklands and Cheshunt Properties respectively).	No mitigation is proposed for these residences as the view from these residents is unlikely to significantly change in composition. Progressive rehabilitation will reduce visual impacts over time.
Public roads (Comleroi Road, Jerrys Plains Road and Lemington Road)	High	Low	The mine extension and infrastructure areas will not have a significant visual impact on road users.	The proposed extension will not change the composition of the view for road users, however, mining will approach Jerrys Plains Road, creating a close view of mining operations. These views will be partially screened by vegetation and topography. In general, road users will only view the mining area for a short period of time as the speed limit is 100 km/hr. In addition, most users of Jerrys Plains Road, Comleroi Road and Lemington Road are either locals or mine workers who are accustomed to the existing landscape.	Visual assessments will be undertaken annually. Tree planting or visual bunding is proposed along Jerrys Plains Road where mining operations approach the road, and sufficient screening is not in place.

- *Figure 14.1* identifies these view points and indicative line of sights.

Photograph 14.1 Existing view west along Jerrys Plains Road where vegetation will form a visual barrier to mining

Photograph 14.2 Existing view west along Jerrys Plains Road where vegetation is absent

Photograph 14.3 Typical expected view along Jerrys Plains Road during works with vegetation and transmission lines bordering the road verge

Photograph 14.4 Indicative outlook across mine spoil dumps where road side vegetation visual barrier is present

Photograph 4.1 depicts a typical view for motorists travelling east along Jerrys Plains Road in areas where vegetation borders the road verge, and where vegetation is absent in *Photograph 4.2*. *Photographs 4.3* and *4.4* were taken from Putty Road (12 km north west of Singleton) where the road borders the Warkworth Pit. These photos are indicative of the views that will be encountered by vehicles transiting Jerrys Plains Road when the road verge is vegetated (*Photograph 4.3*) and in the absence of vegetation (*Photograph 4.4*). These photographs have been sourced from the *Riverview Pit Extended, Statement of Environmental Effects* prepared by ERM, 2005.

14.4.1 Impacts at Night

Mining operations are proposed for 24 hours a day at HVO South. To ensure that night time operations are carried out in a safe and efficient manner a substantial amount of lighting is required. This lighting will be located at the following places:

- each active emplacement area;
- current coal or interburden extraction points;
- on board excavators, shovels, drills and other heavy equipment;
- along haul routes; and
- infrastructure zones, such as hardstand areas, demountable offices, etc.

Of the light sources listed above, the emplacement area and extraction points have the greatest potential to cause annoyance to viewers at night. Lighting of emplacement areas will be directed inwards and will generally be seen as a low distant glow, similar in intensity to that which is currently experienced.

14.5 MANAGEMENT MEASURES

The management of the visual amenity of HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle. The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objective for management of visual amenity is to:

- ensure that site activities are conducted in a manner that will minimise visual impacts to surrounding areas.

Many control measures to minimise impacts to visual amenity are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

Regular controls include:

- awareness through environmental inductions to ensure that relevant employees are aware of potential impacts of lighting equipment and its operation on sensitive locations;

- ensuring lighting is directed away from residences through the use of directional lighting equipment and shielding but in accordance with safety regulations;

- the use of colours that will complement the surrounding environment. Muted greens or beige will be preferred over bright colours unless necessary for safety;

- overburden emplacement areas being designed to provide visual shielding to active mining operations;

- minimising the area of disturbance;

- maintenance of existing vegetation where possible or construction of a physical bund where practicable to visually screen the extension areas;

- progressive rehabilitation; and

- ongoing annual visual survey.

Commitments Specific to the Proposal

In addition to the mitigation measures, review of the extension areas that adjoin Jerrys Plains Road and the proposed rail spur and loop easement will be undertaken prior to construction of the rail spur and loop, to determine if additional screening is required.

14.6 CONCLUSIONS

HVO is a well established landscape feature with mining commencing over 50 years ago. The proposed extension of mining within HVO South is not considered to significantly alter the existing viewscape. It includes extensions to an existing operation, with certain areas becoming increasingly visible to a small number of receptors. The potential rail loop and spur will not be overly visible from Maison Dieu and can be screened with appropriate tree plantings if required. Other infrastructure upgrades are minor, and not expected to significantly impact on the visual amenity of the site.

Retention of much of the original vegetation and landscape features together with tree plantings and other mitigation measures will minimise short term impacts to the visual amenity of the locality. Progressive rehabilitation will ensure longer term impacts are also reduced.

15 TRAFFIC AND TRANSPORT

This chapter describes the existing traffic and transport conditions in and around HVO including a review of relevant assessments undertaken to date. The impacts of the proposed changes are assessed and appropriate management measures presented.

15.1 INTRODUCTION

This chapter describes those aspects of the proposal which are likely to have an impact on traffic and transport around HVO as a whole. This approach has been taken as the transport of coal within, and out of, HVO South and HVO North is partially integrated under the West Pit consent which also assessed the number of employees within HVO as a whole rather than as separate operations.

The traffic and transport aspects of the proposal focus on the following key factors:

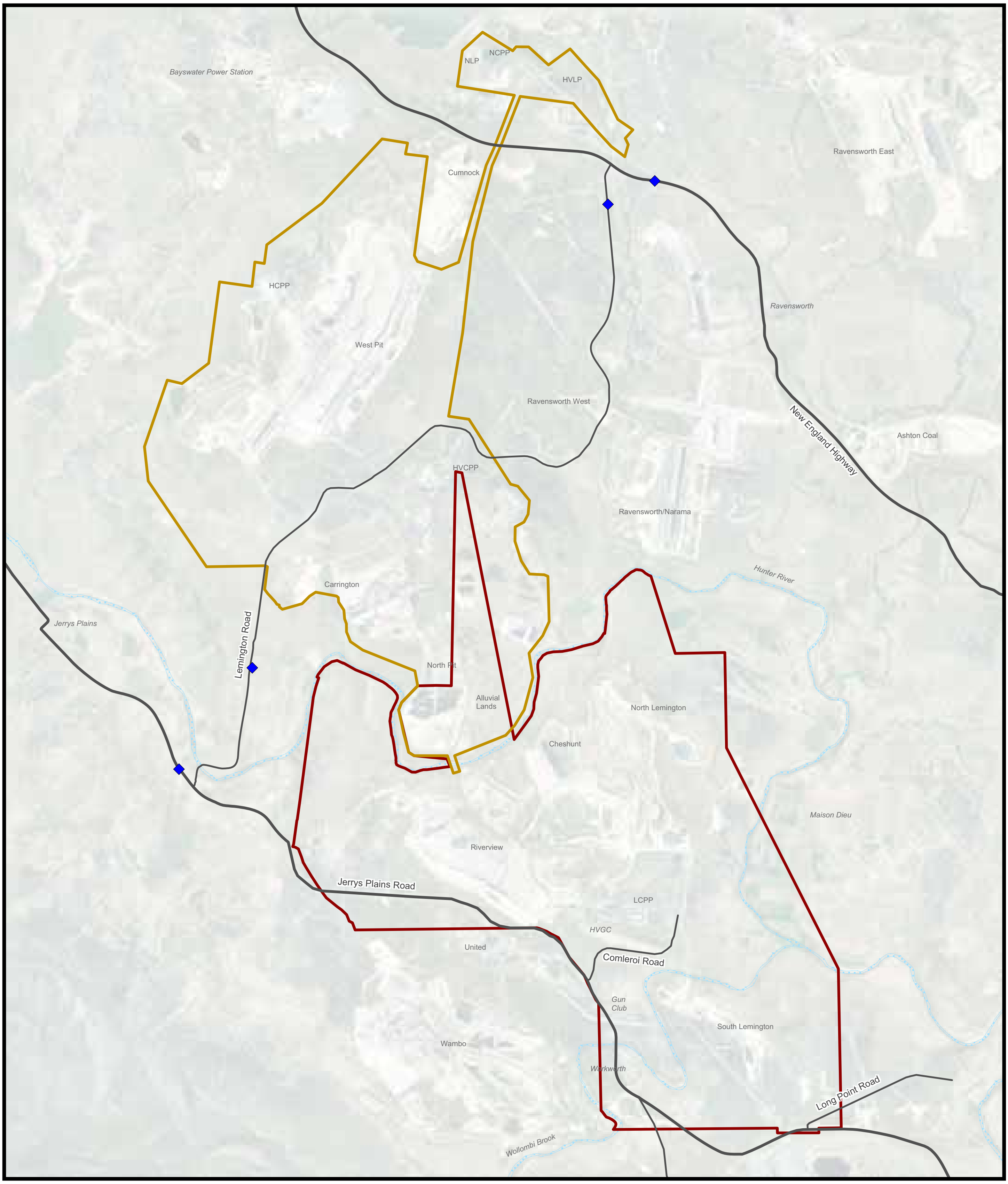
- approximately 50 additional employees across all of HVO travelling to and from the site;
- short term increase of up to 100 contractors or employees entering the site during the construction of the LCPP and associated coal transport infrastructure;
- realignment of Comleroi Road;
- potential impacts to road users due to the proximity of mining to Jerrys Plains Road (Golden Highway) as mining progresses in the Riverview Pit;
- infrequent short term closure of Jerrys Plains Road when heavy equipment is transported between HVO South and MTW; and
- construction of a rail spur and loop or conveyor from Wambo Rail spur to the LCPP.

Traffic and transport aspects which will remain unchanged include:

- trucking of ROM coal on internal haul routes
- the intersection of Comleroi Road and Jerrys Plains Road; and
- road closures due to blasting along the Jerrys Plains Road undertaken in accordance with CNA's Road Closure Management Plan – Jerrys Plains Road.

Of note, the transport of up to 4.4 Mtpa of product coal along the Jerrys Plains Road to the MTCL (approved under DA 215/97) will no longer be required if Project Approval is obtained.

Existing management measures were reviewed to identify additional measures required as a result of this proposal. This assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. Therefore the existing and potential environmental impacts are already approved and management measures have been developed and implemented. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. The assessment results are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been approved.



Legend

Project Application Area

Current Development Consent Boundary (HVO North)

Traffic Count Locations

Figure 15.1

Local Road Network

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_06
Date:	02.07.2007 Drawing Size: A4
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

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0 1 2 3km

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ERM

15.2 *EXISTING ENVIRONMENT*

15.2.1 *Existing Road Conditions*

HVO is located between the New England Highway in the north and Jerrys Plains Road in the south. These roads are connected by Lemington Road and provide access to operations both north and south of the Hunter River. Access to HVO South is provided directly from Jerrys Plains Road, however, HVO South can be accessed via internal haul roads from HVO North. *Figure 15.1* shows the existing road network around HVO.

The following sections provide details of the surrounding roads, access points, traffic volumes and existing levels of service currently experienced.

Local External Roads

The characteristics of the local roads around HVO, including the type of road, access points to HVO, typical road users and road conditions are described in *Table 15.1*.

Table 15.1 Characteristics of Local External Roads

Road Name	Type of Road	Access Points to HVO	Road Users	Description
New England Highway	State Highway	Intersection with Lemington Road.	• Local traffic from Singleton and Muswellbrook Shires; • Regional traffic to Queensland; • Coal mine employees.	High standard, single carriageway rural highway with frequent overtaking lanes constructed to a minimum 100 km/hr standard with the exception of a section that passes through the village of Ravensworth (90 km/hr).
Jerrys Plains Road/ Golden Highway	State Highway	2.2 km west of Wollombi Brook at Warkworth.	• Local traffic from Singleton and Muswellbrook Shires; • Regional traffic to inland NSW; • Coal mine employees.	High standard two lane rural highway constructed to a minimum 100 km/hr standard with the exception of a section that passes through Warkworth Village (80 km/hr).
Lemington Road	Local road	9.6 km north of Jerrys Plains Road and 12.2 km north of Jerrys Plains Road (both intersections have been upgraded with auxiliary passing lanes).	• Major access route to HVO and Ravensworth Narama mine.	Relatively modern two lane rural road which has been upgraded and relocated a number of times and has a 100 km/hr limit. It connects the New England Highway with Jerrys Plains Road.
Comleroi Road	Local road	This road leads into part of HVO South.	• HVGC members; • Gun Club members; • A local dairy farm and property lessees; • HVO employees.	Two lane rural public local road.

Traffic Volumes

Traffic volumes for roads around HVO were last recorded in 2003 for the *West Pit Extensions and Minor Modifications EIS* (ERM, 2003) and by the RTA in 2001. *Table 15.2* contains a summary of these traffic volumes and the current level of service. Level of service is the capacity of a road to carry traffic at the speed limit and the level of congestion experienced. These traffic volumes include existing traffic generated by HVO including truck and employee movements.

Traffic volumes were recorded at two locations for both Jerrys Plains Road and Lemington Road. Each location was chosen to demonstrate the impact of mining on traffic levels. The difference between the two sites on the Jerrys Plains Road indicates that mining related traffic contributes up to 1,717 traffic movements per day. For Lemington Road, mining related traffic contributes up to 739 traffic movements. Jerrys Plains Road and Lemington Road currently operate at good and high levels of service respectively. The New England Highway also operates at a good level of service at this location. Traffic count locations are depicted in *Figure 15.1*.

Table 15.2 Traffic Volumes on Local External Roads

Road	Traffic Count Location	Daily Traffic Volume	Level of Service
New England Highway	East of Lemington Road	11,611[1]	Good level of service at this location.
Jerrys Plains Road	West of Lemington Road	2,107[2]	Good level of service at this location.
	North of the Putty Road[3]	3,824[2]	Good level of service at this location. Counts at this location show impact of mining trucks on traffic volumes.
Lemington Road	Near intersection with New England Highway	1,134[2]	High level of service with free flowing traffic conditions.
	Near intersection with Jerrys Plains Road	395[2]	High level of service with free flowing traffic conditions.

1. RTA traffic counts from RTA Count site 05037
2. Traffic counts undertaken in 2003
3. Putty Road is located between the Warkworth Mine and Mount Thorley Operations and is not displayed on *Figure 15.1*.

General:

- High level of service = free flowing traffic and spare capacity
- Good level of service = minimal delays and spare capacity

15.2.2 *Product Coal Transport*

Product coal from HVO is transported to the Port of Newcastle by rail. The main load points for HVO are the HVLP and the MTCL (located in HVO North). In addition, Wambo Mining Corporation has constructed the Wambo rail spur and loop which is planned to be used to capacity by the Wambo and United Mines. Product coal from HVO South is currently processed at the HVCPP and transported to the Port of Newcastle via the HVLP or the NLP. In addition, approval exists for the transport by road of 4.4 Mtpa of product coal from the LCPP to the MTCL. This approval will no longer be required if Project Approval is obtained.

15.3 *IMPACT ASSESSMENT*

15.3.1 *Road Impacts*

Additional Employees

An additional 50 workers are proposed to be employed at HVO over the life of the project. An additional 100 workers will be required during the construction phase to upgrade the LCPP and develop the associated coal transport infrastructure.

Employees can travel to HVO via a number of routes. A survey of existing employee residential locations undertaken for the West Pit EIS (ERM 2003) suggests that the majority of employees access HVO from the east (80%), mainly from major urban centres such as Singleton, Cessnock, Maitland and Newcastle and a smaller percentage access the site from the north west (20%) from centres such as Muswellbrook and Scone. *Table 15.3* contains a breakdown of the different routes taken to HVO from both the east and the north west.

Table 15.3 Employee Road Usage to Access HVO

Main Road	Sub Road	Direction Travelled From	% of Employee Vehicles Using Main Road	% of Employee Vehicles Using Sub Road
New England Highway	Lemington Road	East	30	30
Jerrys Plains Road	Lemington Road	East	50	10
Jerrys Plains Road	Comleroi Road	East	-	40
New England Highway	Lemington Road	North west	10	5
Jerrys Plains Road	Lemington Road	North west	10	5
Jerrys Plains Road	Comleroi Road	North west	-	10
		Totals	**100**	**100**

For this proposal it is assumed that up to 25 of the new employees will be entering the site from Jerrys Plains Road and the other 25 from Lemington Road. This assumption takes into account the 80/20 east west split and accounts for employees entering the site at locations appropriate to where they work, ie the LCPP or the HVO South pits.

The change in traffic as a result of the proposed increase in employees is provided in *Table 15.4*. The traffic volumes were based on the West Pit assessment and include traffic generated as a result of construction phases of Warkworth and Wambo and additional traffic generated by HVO North. The employee movements have been calculated on the basis of 1.5 employees per vehicle making two vehicle movements per day.

Table 15.4 Change in Traffic Volumes Due to the Proposal

Road	Traffic Count Location	Daily Traffic Volume	Traffic from Other Mining Proposals	Baseline Traffic Volumes	Additional Employee Movements	% Change
New England Highway	East of Lemington Road	11,611	106	11,717	20	0.17
Jerrys Plains Road	West of Lemington Road	2,207	118	2,325	3	0.13
	North of the Putty Road	3,824	595	4,419	27	0.6
Lemington Road	Near intersection with New England Highway	1,134	192	1,326	23	1.7
	Near intersection with the Jerrys Plains Road	395	103	498	3	0.6

The proposed increase in employee numbers will have little impact on current traffic volumes on any of the roads leading to HVO. The biggest change in traffic volume will be on Lemington Road at the intersection with the New England Highway. This road already operates at a high level of service and is expected to continue to operate at this level of service as a result of the proposal.

Temporary Road Impacts Due to the Proposal

It is proposed that up to 100 employees will be required during the construction phase of the project. The impact on traffic volumes as a result of construction employees is provided in *Table 15.5* and is based on 80% of traffic traveling from the east, predominantly via Jerrys Plains Road and the balance traveling from the west (20%).

The greatest increase in traffic volume will be on Jerrys Plains Road during the construction phase of the works due to the proposal. Jerrys Plains Road currently operates at a good level of service and the proposed increase in employee movements will not have a significant impact on this level of service. In addition, this increase will be temporary and short in duration.

Table 15.5 Temporary Road Impacts Due to the Proposal

Road	Traffic Count Location	Daily Traffic Volume	Traffic from Other Mining Proposals	Baseline Traffic Volumes	Additional Employee Movements	% Change
Jerrys Plains Road	West of Lemington Road	2,207	118	2,325	13	0.6
	North of the Putty Road	3,824	595	4,419	106	2.3
Lemington Road	Near intersection with New England Highway	1,134	192	1,326	13	1.0
	Near intersection with the Jerrys Plains Road	395	103	498	13	0.5

- New England Highway data has been omitted from the table as the traffic count location is east of Lemington Road and does not account for traffic travelling from the west along the New England Highway and turning onto Lemington Road.

Product Coal Transport Impacts

Consultation with government and community stakeholders indicated that the transport of product coal along Jerrys Plains Road was a major issue. DA 215/97 allows for the transport of up to 4.4 Mtpa of product coal from the LCPP to the MTCL via Jerrys Plains Road. In line with NSW Government policy to limit road transport of coal, alternative options are proposed for the transport of coal from the LCPP to the Wambo rail spur. These options are detailed in *Section 5.5*. Approval of this Project Application will allow for the surrender of the aforementioned consent condition. No other transport of product coal along Jerrys Plains Road is proposed. Any road haulage of product coal to either the Wambo rail spur or to a rail loop located adjacent to the LCPP, will occur on private land, to the east of Jerrys Plains Road. No interaction with Jerrys Plains Road is required for any of the proposed product coal transport options.

Relocation of Comleroi Road

The proposal seeks approval to relocate Comleroi Road to accommodate changes to the mine layout, as described in *Table 5.1* and shown in *Figure 5.8*. The proposed relocation will not result in permanent traffic disruption. Temporary traffic disruptions will occur throughout construction, however, these disruptions will be short in duration and access to properties and facilities along this road will be maintained throughout the construction phase through the use of alternative routes. Consultation will be undertaken with road users as listed in *Table 15.1*, as well as SSC. Road closures and diversions will be managed in accordance with procedures which will be developed for the project. The proposed modifications will occur to the east of the intersection of Comleroi Road and Jerrys Plains Road, therefore no changes to the current intersection will be required.

Heavy Equipment Access Track

Heavy equipment movements across Jerrys Plains Road between HVO South and MTW will result in temporary road closures on an as required basis, as described in *Table 4.1*. These events will be infrequent and of a short duration, similar to those already experienced during blasting. RTA approval will be obtained as required and road closures will be undertaken in accordance with the HVO Road Closure Management Plan – Jerrys Plains Road. This management plan is reviewed annually and approval obtained from SSC and RTA.

15.3.2 Rail Impacts

Proposed Rail Spur and Loop

Options for the transport of coal from the LCPP to the Wambo rail spur have been presented in *Chapter 5*. A rail spur and loop will be constructed to enable the transport of product coal to the Port of Newcastle via the proposed LLP and the Whittingham line. This loop will have capacity for one empty and one full train to be stacked onto the loop and will have a design capacity of two trains which will each be approximately 1600 m long. *Figure 5.7* shows the location of the proposed rail spur and loop.

The operation of the rail spur and loop will not impact users of Jerrys Plains Road as the spur will be constructed on the northern side of the road and no road crossings will be required.

Transport Impacts due to the Rail Spur and Loop

This proposal covers the construction and operation of the rail spur and loop to the LCPP; however access to the Whittingham line is subject to negotiations with ARTC and impacts will be assessed in accordance with the relevant regulatory requirements.

Potential transport impacts associated with the rail spur and loop include:

- the transport of material to the site to construct the spur and loop; and
- the reduction in coal truck haulage required once the rail spur and loop are constructed and approval for the increase in the number of trains on the Whittingham line is obtained.

The operation of the rail spur and loop is likely to have a positive impact on Jerrys Plains Road as it will result in the permanent removal of coal trucks from HVO South once it is constructed. Traffic impacts from the transport of construction material to the site are likely to be minor and of short duration. An assessment of the potential noise impacts resulting from the construction and operation of the rail spur and loop are presented in *Chapter 7 – Noise and Vibration*.

15.4 MANAGEMENT MEASURES

The management of traffic and transport at HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The key objective for management of traffic and transport is to safely mange impacts to road users that may occur as a result of mining or construction related activities.

Many control measures to minimise traffic and transport impacts are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

The impacts to traffic and transport which require mitigation primarily relate to temporary road closures due to blasting. This will be managed in accordance with CNA's Road Closure Management Plan for Jerrys Plains Road.

Commitments Specific to the Proposal

In addition to standard site controls, CNA will ensure that the relocation of Comleroi Road and construction of the rail spur and loop are undertaken in accordance with the relevant regulatory requirements. The appropriate approvals will be obtained, including those required for heavy equipment transfer, and relevant stakeholders will be consulted.

15.5 CONCLUSIONS

The impacts to traffic and transport as a result of the proposal are likely to be minor in nature and in general require no specific management measures as there will be a small increase in the number of permanent personnel (50 personnel) and a small increase in the number of temporary employees (100) during the construction phase. These increases will not result in a decrease in the level of service currently experienced on Lemington Road or Jerrys Plains Road.

Temporary road closures will also occur as a result of the proposal; however, these closures will be managed through the HVO Road Closure Management Plan.

16 WASTE

This chapter identifies waste streams that are produced at HVO South, describes current waste management practices, outlines potential increases in waste production resulting from the proposal and provides details of procedures that are currently utilised to manage these waste streams.

16.1 INTRODUCTION

A number of wastes are produced as part of the mining process and as a result of the supporting activities across HVO. These wastes are generally categorised as:

- non-mineral waste including:
  - general waste;
  - recyclable waste; and
  - regulated and hazardous waste.
- wastewater; and
- mineral waste (coarse and fine rejects and overburden).

Details of recycled mine water management are provided in *Chapter 9 – Groundwater* and *Chapter 10 – Surface Water*. Details of management of mineral waste are provided in *Chapter 2* and changes resulting from this proposal are in *Chapter 5*.

Existing management measures were reviewed to identify additional measures required as a result of this proposal.

16.2 EXISTING ENVIRONMENT

16.2.1 Current Waste Management Practices

CNA's waste management strategy is in accordance with the principles of the waste management hierarchy and the provisions of the *POEO Act 1997*. The aims are to reduce wastes at source, re-use materials where possible, recycle wastes where practicable, and dispose of wastes appropriately and responsibly. Waste reduction is considered for all activities within HVO including the design and purchase of equipment and development of new or alternative processes. Purchasing guidelines encourage the selection of recyclable or reusable products where practical. This includes consideration of the nature and amount of packaging so that products which have a minimum of packaging or recyclable or reusable packaging are selected.

CNA's Total Waste Management System (TWMS) is recognised as best practice in non-mineral waste management within the coal industry and since its inception the TWMS (or derivatives thereof) have been adopted across Australasia both within mining and other industries as the preferred system for non-mineral waste management.

Non-Mineral Waste Management

Non-mineral waste is generated throughout HVO mining, maintenance and administrative areas. In particular non-mineral waste is generated at the Cheshunt maintenance workshops, administrative offices and bathhouse.

Management of non-mineral waste is detailed in CNA EMS Waste Management procedure. This procedure describes CNA's requirements for the management of general, recyclable, regulated and hazardous wastes. In addition the procedure outlines the waste tracking and recording measures. This waste tracking and recording system ensures all waste is managed in accordance with regulatory and CNA requirements. Waste tracking is provided by the nominated contractor who supplies the site supply department with waste transport certificates. These certificates detail the waste producer, type of waste, physical nature of the waste (liquid and solid), collection time and date, transporter details, proposed destination for the waste and evidence that the waste was received at the disposal or recycling facility.

Table 16.1 identifies current non-mineral wastes generated and the disposal and waste tracking methodology.

Table 16.1 Non-Mineral Waste Management

Waste Type	Waste Categories	Disposal Method
General Waste	• Food scraps (putrescible waste) • Food wrappers • Non-recyclable plastics (packaging) • Rope • Rubber (hydraulic) hoses • Polystyrene cups • Damaged pallets or wooden products • Rubber bands, metal clip binders, pens • Damaged air filters • Light hydrocarbon soiled rags	Collected by licenced contractor and disposed offsite
Recyclable Waste	• Paper (copy paper, newspaper, hand towels, phone books, envelopes) • Magazines • Aluminium cans • Glass bottles • Cardboard • Plastics • Wooden pallets • Toner cartridges • Conveyor belting • Light and heavy vehicle tyres • Scrap metal (heavy metal scrap, light gauge scrap, aluminium, brass, lead copper, 205 L and 20 L drums), dragline cable	Collected by licenced contractor and removed from site for recycling or reused on site. In addition, heavy earthmoving tyres re-used on site as markers or for other delineating purposes. The location and depth of disposed tyres are recorded.
Regulated Waste	• Oils • Grease • Lubricants • Oily rags • Contaminated soils • Oily contaminated absorbents • Oil Filters • Oily water • Coolant	Collected and stored prior to removal from site by an EPA approved contractor. Disposal is tracked in accordance with regulatory and CNA requirements.
Hazardous Waste	• Lead acid batteries • Non-hydrocarbon • Solvents • Sharps • Medical waste	Disposed offsite by licenced contractor. Disposal is tracked in accordance with regulatory and CNA requirements.

Wastewater Management

Wastewater is generated from the site sewage treatment plants and equipment washpads. At HVO South there is a sewage treatment plant which supports the Cheshunt bathhouse and equipment washpads to support the maintenance workshops. The sewage wastewater is treated to an acceptable level and reused in the mining process and oily water is stored for collection and treatment by a licenced contractor.

In addition, amenity facilities within mobile crib huts contain sewage storage tanks. Theses are pumped out be a licenced waste contractor as required.

Activities occur in accordance with the *Environmental Guidelines: Assessment, Classification & Management of Liquid and Non-Liquid Wastes (NSW EPA 1999)* and the *Environmental Guidelines for the Utilisation of Treated Effluent*.

16.3 IMPACT ASSESSMENT

There is potential for an increase to the volume of waste produced at HVO due to the HVO South project. The main increases will occur due to the recommissioning, reconstruction or upgrade of the LCPP and construction activities associated with the mine extension areas and possible rail spur and loop.

16.3.1 Non-Mineral Waste

If market conditions are favourable, there is the potential for an increase of 150 people over current employment levels (this number includes those employed during construction and operation). The additional employment and new or expanded administration offices may result in minor increases to non-mineral waste generation. Recyclable waste will also be produced during construction works at the LCPP and from infrastructure associated with the LCPP.

The demolition of the Cheshunt Bathhouse and relocation or reconfiguration of the HVGC will produce recyclable materials. The proposal may result in a minor increase in operational equipment at HVO South. In turn, volumes of regulated waste would increase. The proposal may result in an increase in personnel and a minor increase in operational equipment, and consequently a minor increase in the volume of hazardous waste produced at HVO South.

16.3.2 Wastewater

Specific consented activities to be maintained include the expansion of Cheshunt Bathhouse and workshop and possible relocation as mining in the Cheshunt Pit progresses. There is an enclosed sewage treatment facility associated with the bathhouse. The proposal will also allow for the expansion of the heavy vehicle wash pad. This will result in a greater volume of wastewater to be produced.

16.4 MANAGEMENT MEASURES

Waste management at HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle. The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for management of waste are to:

- minimise the generation of wastes including hazardous waste and maximise the opportunities for reuse and recycling; and
- ensure that appropriate segregation, collection, handling, transport and disposal of waste is undertaken to minimise impacts on the environment and to ensure that any contamination is remediated.

Many control measures to minimise waste management impacts are already in place as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

Regular controls include:

- awareness through environmental inductions to ensure that relevant employees are aware of waste management initiatives;
- monitoring results included in the AEMR;
- planning when purchasing items to avoid or minimise waste;
- segregation of waste;
- disposal of waste by a licenced contractor;
- a waste tracking system;
- a spill response process; and
- remediation of hydrocarbon contaminated soils.

Commitments Specific to the Proposal

There are no suggested commitments specific to the proposal. It is anticipated the mitigation measures currently implemented at HVO will be sufficient to manage the increase in waste resulting from the proposal, including measures to ensure a reduction in the volume of general waste disposed to landfill.

16.5 CONCLUSIONS

Volumes of wastes produced across HVO South may increase marginally as a result of the proposal. However, comprehensive waste management procedures are in place and will continue to be implemented to manage any waste generated from the proposed application.

CNA's waste management procedures have been developed in accordance with the principles of key waste legislation and the waste management hierarchy. The implementation of these management procedures and additional management measures outlined in *Section 16.4* will ensure that wastes will continue to be reduced at source, reused where possible, recycled where practicable, and disposed appropriately and responsibly.

17 ENERGY USE AND GREENHOUSE GASES

This chapter provides an overview of current and projected energy use and greenhouse gas emissions from HVO. It outlines energy efficiency and greenhouse gas reduction initiatives currently undertaken by CNA and RTCA. Sections of this chapter have been adapted from the HVO South Coal Project Greenhouse and Energy Assessment (Rio Tinto, 2007), presented as Annex O.

17.1 INTRODUCTION

This chapter addresses the current and projected energy use for the HVO site as a whole. This approach has been taken because the division of HVO into North and South is impractical for this exercise, and would be significantly less precise than the data presented here. The activities within this proposal will be incorporated in the improved integrated management of energy currently under development and consistent with the objectives of RTCA's Climate Change Action Plan (CCAP). This improved management is also identified in the HVO Energy Savings Action Plan, (ESAP) which was submitted to DEUS in July 2006.

The efficient use of energy during operations is pertinent to CNA for a number of reasons. Firstly, a large amount of energy is consumed during the extraction and processing of coal resources. The efficient use of energy for these processes equates to economic benefits. Secondly, greenhouse gas emissions are related to energy use. An increase in the energy efficiency of operations will lead to a reduction in greenhouse gas emissions per tonne of product coal produced.

17.2 METHODOLOGY

The following process has been used to report on the current and projected energy usage, efficiency and greenhouse gas emissions at HVO:

- a statement of the most current complete year of energy usage and greenhouse gas emissions for the entire HVO site;

- a projection of the energy use and emissions for the years 2006 - 2028 in terms of gigajoules consumed, based upon activities described in the mine planning process. Current and predicted emissions have been calculated based on emission factors published in the National Greenhouse Gas Inventory Workbooks (NGGI, 2006) and Australian Greenhouse Office (AGO) Factors and Methods Workbook 2006 (AGO, 2006);

- a comparison of the energy projections with the amounts of coal to be extracted, including an evaluation of the efficiency of operations in terms of energy produced versus energy used; and

- a brief description of future energy and greenhouse gas emission management activities.

In addition, existing management measures were reviewed to identify additional measures required as a result of this proposal.

This assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. Therefore the existing and potential environmental impacts are already approved and management measures have been developed and implemented. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. The assessment results are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been approved.

17.3 *EXISTING ENVIRONMENT*

17.3.1 *Current Operations Energy Use and Greenhouse Gas Emissions*

Current Energy Usage

Table 17.1 outlines energy used by HVO for 2005. Energy is consumed in two forms at HVO: electricity and diesel fuel. Electricity usage is divided into mining (electricity expended on the extraction of resources) and processing (electricity expended on the preparation of coal for sale). Diesel is used in equipment across HVO, and in association with the preparation and detonation of explosives.

Table 17.1 Indicative Energy Usage for HVO

	Electricity			
Energy Usage	Mining (MWh)	Processing (MWh)	Total (MWh)	Total (GJ)[1]
	63,000 (50.4%)	62,000 (49.6%)	125,000	450,000
	Diesel			
Energy Usage	Equipment (tonnes)	Explosives (tonnes)	Total (tonnes)	Total (GJ)[2]
	49,000 (97.9%)	1,000 (2.1%)	50,000	2,290,000
			Total of Electricity and Diesel:	2,740,000

1. This calculation assumes that 1 kWh is equivalent to 0.0036 GJ.
2. This calculation assumes that the calorific value of 1 tonne of diesel is equal to 45.8 GJ.

General:

- 1 GJ is enough energy to power a refrigerator (600w) for approximately 1.5 years.
- 2005 data was adopted for this assessment as at the time of reporting, this was the latest full year of data available.
- Figures have been rounded.

Current Greenhouse Gas Emissions

The World Business Council for Sustainable Development / World Resources Institute (*Greenhouse Gas Protocol*, 2004) and other international bodies such as the United Nations Framework Convention on Climate Change and the Intergovernmental Panel on Climate Change recognise six main greenhouse gases:

- Carbon dioxide (CO2);
- Methane (CH4);
- Nitrous oxide (N2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF6).

Different gases have different greenhouse warming effects (potentials) and emission factors take into account the global warming potentials of the gases created during combustion. The global warming potentials of the greenhouse gases (Appendix 3, AGO 2006) are as follows:

- CO_2 = 1;
- CH_4 = 21; and
- N_2O = 310.

When the global warming potentials are applied to the estimated emissions then the resulting estimate is referred to as CO_2-equivalent emissions (CO_2-e). This approach has been adopted for this assessment.

The current greenhouse gas emissions for HVO have been calculated using the classification systems in the World Business Council for Sustainable Development /World Resources Institute *Greenhouse Gas Protocol*. The classification system uses three scopes:

Scope 1 – direct greenhouse gas emissions from sources that are owned or controlled by the company and include for example, fuel use, onsite electricity generation, anode and reductant use, process emissions and land management. In the case of the Project, this includes use of diesel fuel from mining equipment, coal seam gas and explosives used within the boundary of the site;

Scope 2 – emissions from the imports of electricity, heat or steam from third parties (energy related indirect emissions); and

Scope 3 – other indirect greenhouse gas emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation. Third party transport and the combustion of coal by customers are examples of Scope 3 emissions.

The greenhouse gas emissions produced by operations at HVO in 2006 are provided in *Table 17.2*.

Table 17.2 Indicative Greenhouse Gas Emissions for HVO

Source	Unit	Amount	Scope 1 emissions (kt CO_2 –e)	Scope 2 emissions (kt CO_2 –e)	Scope 3 emissions (kt CO_2 –e)
B2 Biodiesel	kL	15,900	42	-	4.78
Diesel	kL	46,700	126	-	14
Petrol	kL	146	0.337		0.044
Purchased electricity	MWh	124,000	-	111	21.9
Anfo	kt	10	1.65	-	-
Heavy Anfo	kt	17.2	2.86	-	-
Emulsion	kt	11	1.96	-	-
Coal seam methane	kt CH_4	33.3	699	-	-
Land clearance	ha	149	14.5	-	-
Land revegetation	ha	573	-3.56	-	-
Third party transport	-	-	-	-	251
Combustion from saleable coal	kt	12,000	-	-	30,900
Total		**-**	**885**	**111**	**31,191**

- A negative indicates amount sequestered.
- Figures have been rounded to three significant figures, totals are based on rounded numbers.

HVO emitted 885 kt of CO_2-e during 2006 and were indirectly responsible for a further 111 kt CO_2-e. Greenhouse gas emissions at the site are related to purchased electricity and fuel, the preparation and detonation of explosives, gases liberated from disturbed coal seams and net vegetation lost during land clearance activities. Third party emissions have also been included in the table and relate to transport and combustion of saleable coal.

17.3.2 Projected Energy Use and Emissions

Projected Energy Use

Mine plans are used as the basis for reporting on projected resource recovery and energy consumption during operation. It should be noted that years presented are indicative only and results may vary depending on the rate of mining.

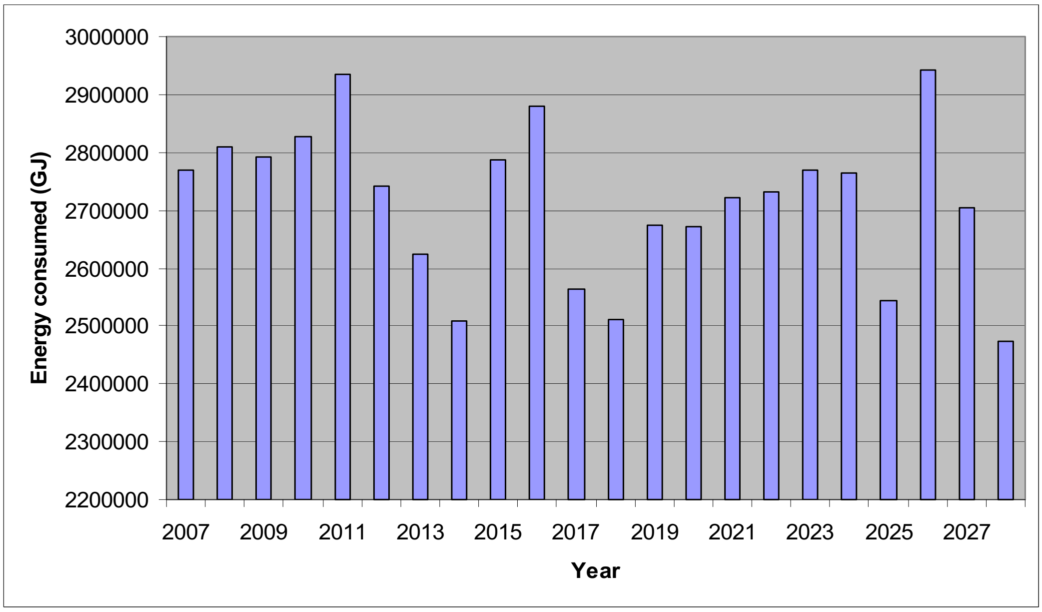
The amount of electricity and diesel fuel (for both equipment and explosives) used each year by HVO is predicted based on:

- equipment movements;
- amount of explosives used; and
- the use of plant such as pit lighting.

For each year of the mine plan this information is collated and the appropriate energy values applied to each activity/item. These values are totalled and a prediction of the energy consumed for each year of the mining scenario is produced. *Figure 17.1* shows the amount of energy predicted to be consumed each year at HVO until 2028 as per mine plans as at September 2006 (*Section 5.3* describes the base case scenario). The amounts are a composite of electricity and diesel values. While the total amount of energy used over the life of the operation will remain the same, the amount of energy consumed per year may vary and is an approximation.

The variation in energy used is related to a number of factors. For years in which haul routes are long, or a large number of vehicles or explosives are used, (ie for blasting and overburden removal) much higher energy consumption will be seen. Years in which haul distances are relatively short and a relatively small amount of vehicle movements occur will experience a lower energy consumption.

Figure 17.1 Projected Energy Usage Based Upon the Base Case Scenario



Projected Emissions

The projected greenhouse gas emissions (Scope 1, 2 and 3) from the existing operation and the project maximum are presented in *Figure 17.2*. This figure highlights the decrease in emissions as the mine approaches closure.

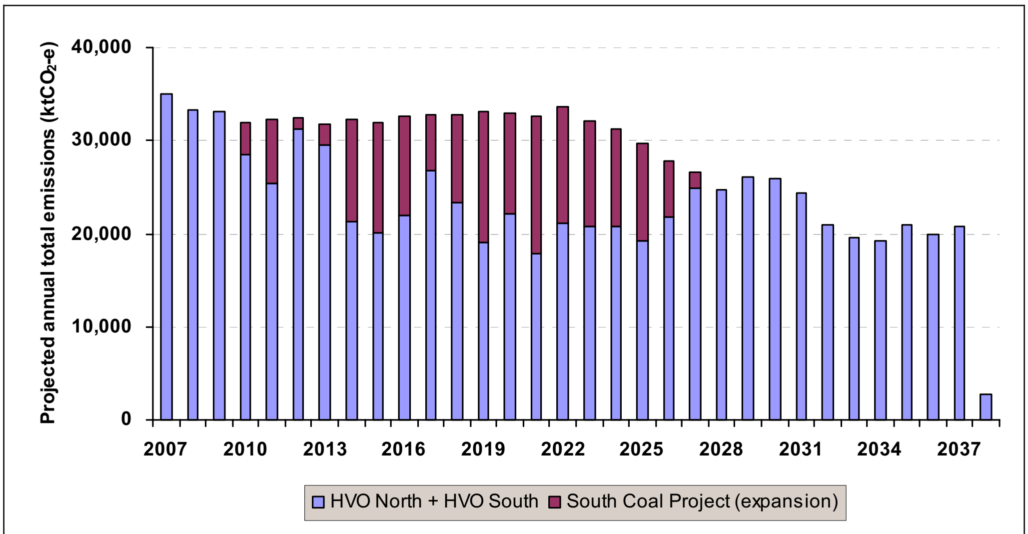
If the project is approved, an additional 155 Mt CO_2-e of greenhouse gases will be emitted over the life of the mine. This equates to a 21% increase in greenhouse gas emissions compared to a business as usual scenario over the same period.

Globally the potential impact of the proposal has been assessed using internationally recognised data and methodologies as discussed in *Section 3.4.1 of Annex O*. Between project inception to peak-production the impact of the proposal will range from 0.01% (2010), to 0.04% (2020) of global energy related emissions. An assessment was also carried out to determine the potential impact on global surface temperatures resulting from the additional emissions. It was determined that over the life of mine, the emissions resulting from the project as distinct from currently approved mining at HVO, will raise the global surface temperature by 0.000078ºC.

On a global scale the greenhouse impact of the proposal is minimal and is unlikely to have any significant influence on global temperatures. Further the additional coal that is produced is to meet customer demand for coal. It is a reasonable assumption that if the coal wasn't produced at HVO then it would be produced at an alternative mine somewhere in the world. Therefore the equivalent emissions of greenhouse gas from coal to the global atmosphere would occur.

Nevertheless, Rio Tinto does recognise the IPCC findings that there is a cumulative effect of greenhouse emissions that does impact global warming and climate change. In this context, RTCA and CNA will continue to focus on improving energy efficiency and reducing the greenhouse gas emissions associated with mining, processing and using its coal product. The assessment of the construction options for the LCPP have included sustainability initiatives. CNA remains committed to reducing the impact of onsite activities and will continue to implement energy efficiency improvement projects, while RTCA will continue to seek global solutions through adoption of new technologies and continued support of greenhouse abatement solutions such as clean coal technologies. These initiatives are discussed further in *Chapter 21 – Company Performance*.

Figure 17.2 Projected Greenhouse Gas Emissions for Existing Mining Operations and the Addition of the Project Maximum



17.3.3 *Efficiency of Operations*

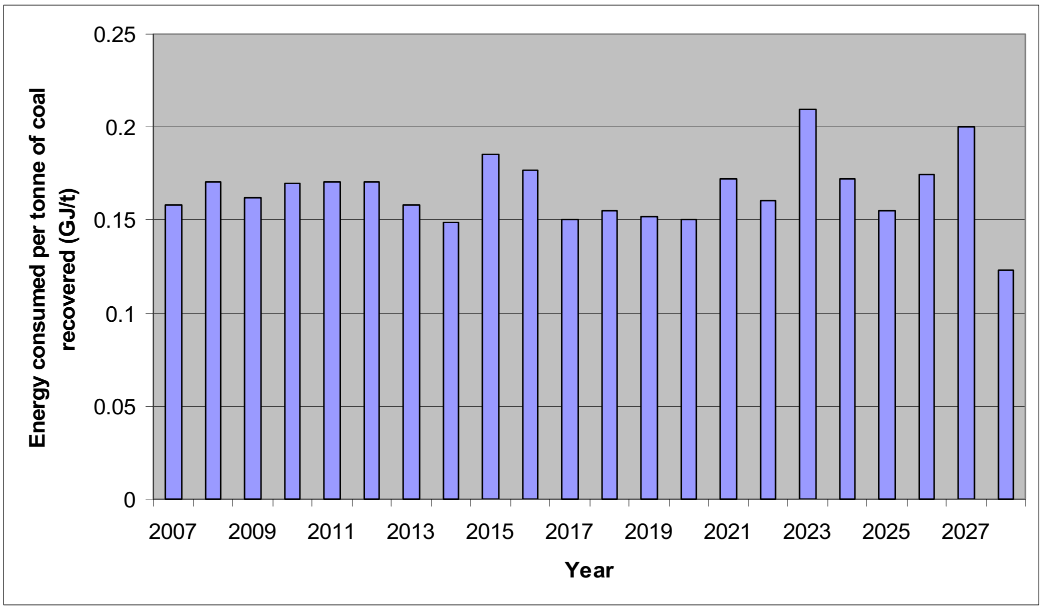
The energy efficiency of coal mining can be assessed by comparing the energy expended in extraction with the amount of coal extracted. *Figure 17.3* shows how many gigajoules of energy are used to extract one tonne of coal for each year of the mines operation. It is important to note that these years are indicative only and that some variation in the rate at which the resource is extracted is expected.

Fluctuations in this efficiency can be the result of a number of factors including:

- depth of the pit;
- distance of the resource from the processing plant;
- rehabilitation works;
- amount of resource extracted; and
- depth and thickness of the overburden.

The lower the value shown on *Figure 17.3*, the lower the amount of energy consumed per tonne of coal extracted. High values represent years in which a relatively high amount of energy was consumed extracting each tonne of coal. Higher values expected in 2023 and 2026 relate to an increased rehabilitation effort and a lower extraction rate.

Figure 17.3 Energy Efficiency of Extraction at HVO



17.4 ENERGY MANAGEMENT

17.4.1 Energy Saving Activities

There are a number of energy management initiatives undertaken at HVO. As a designated energy user under the *Energy Savings Order 2005*, HVO is required to submit an Energy Savings Action Plan (ESAP) to DEUS. The most recent plan lists a number of energy saving activities as shown in *Table 17.3* including:

- cost effective projects being undertaken at HVO;
- potential cost effective projects that will continue to be reviewed by HVO during project pre-feasibility and feasibility to determine if cost effective energy savings can be obtained from implementation of these projects; and
- cost effective projects being undertaken by RTCA Corporate with an intention to implement these projects across all RTCA operations including HVO.

Table 17.3 ***Energy Saving Activities***

Activity	Energy Savings (GJ)	Indicative Project Start Date
HVO – Cost Effective		
Haul truck engine replacement / repower with higher efficiency engines	14,800	1 January 2008
Improve control of lighting plants	3,860	1 July 2006
Reduce idle load on conveyors and plant	9,010	1 October 2006
High efficiency motors	2,700	1 July 2006
HVO – Potential Cost Effective		
Dragline digital drive and Titronics installation and optimisation of operating efficiency	4,510	1 July 2006
Variable speed drives for process pumps	2,880	1 July 2006
Spiral upgrade[1]	-	1 July 2006
Develop truck replacement strategy, incorporating energy efficiency potential[1]	-	31 December 2007
In-pit fuel tankers	1,270	1 January 2006
Hydrocarbon cleanliness	22,840	1 January 2006
Total HVO Savings	**61,870**	
RTCA Corporate – Cost Effective		
Electricity monitoring and management	9,010	1 October 2006
Diesel fuel management	44,710	1 July 2006
Investigate use of diesel fuel additives	111,780	1 July 2006
Total RTCA Corporate Savings	**165,500**	
TOTAL SAVINGS	**227,370**	

1. Energy savings to be determined as project enters pre-feasibility stage
- Energy savings figures based on 2005 actual energy use data

CNA will continue to investigate opportunities to ensure that energy is efficiently used at HVO.

Examples of the cost effective activities to be implemented at HVO as listed in *Table 17.3* are detailed as follows:

Haul Truck Engine Replacement / Repower

This project involves eight haul trucks being repowered with alternative engines that are estimated to provide 6% fuel savings compared to current engines. Actual fuel burn rates of the engines will be recorded to obtain energy savings in litres of fuel.

Improve Control of Lighting Plants

Automatic switches (on and off) are to be installed on all lighting plants across site (approximately 50 plants). Observations will be made during project implementation to ensure that the switches are effective. The fuel usage for each lighting plant will be recorded prior to and after project implementation to determine savings in litres of fuel.

Reduce Idle Load on Conveyors and Plant

The ROM conveyors and associated equipment at HVCPP will be automated to stop when operating idle. Energy savings will be determined by measuring the hours that relevant plant is stopped with the new automated system rather than operating idle as would be the case prior to project implementation.

In-Pit Fuelling

In the first quarter of 2007, HVO will implement in-pit fuelling. A mobile fuel tanker will be stationed in-pit so additional fuel is not needed to travel to re-fuel.

Detailed below are descriptions two example RTCA Corporate energy savings activities listed in *Table 17.3*.

Diesel Fuel Management

HVO currently uses implied burn rates and run hours from the 'Modular' system to allocate diesel fuel usage. This system is not currently utilised by HVO to measure efficiency or highlight individual users. HVO also issues diesel from a number of points and the potential exists for significant spillage and errors in allocation. RTCA Corporate is currently undertaking a review of the potential inefficiencies listed above and is using this to develop a best practice diesel metering, monitoring and reporting system. This will be used at HVO with the aim to use this data to drive efficiency of diesel use and to assess a number of projects that have the potential to save significant amounts of diesel.

Electricity Monitoring and Management

Data from electricity meters will be monitored and reported to mine and processing plant operators. The data will be used for calculation and tracking of efficiency indicators for major electricity-consuming plant. The aim of this project (together with other online systems) is to develop a best practice electricity metering, monitoring and reporting system to provide operators with electricity indicators to facilitate timely intervention to correct variances in efficiency.

As each project listed above will be implemented at different times, savings from these projects will begin to be realised at different times as well. The annual savings realised for each project by the end of 2008 can be factored into the 2005 projection of energy use in 2008. These projects and additional projects identified following the implementation of the ESAP should result in an improvement (ie reduction) of 5.5% of HVO's 2008 energy use compared to business as usual without the projects implemented. These energy savings will contribute to HVO's target of 3% reduction in energy use from 2003 to 2008.

17.4.2 Rio Tinto Reporting

Internal Rio Tinto reports are generated on a bi-annual basis to summarise energy use at HVO, and the corresponding CO_2-e emissions associated with each energy type. Emissions from other sources such as coal seam methane, land management, road, rail and ship transport of product coal, and the carbon content of the coal which can be used to determine the emissions from burning (assuming 100% of product coal is burnt) are also reported.

17.4.3 Rio Tinto Greenhouse Gas Management Initiatives

Rio Tinto has standards for greenhouse gas emissions to ensure the minimisation of greenhouse gas emissions in Rio Tinto, including HVO. This will be accomplished by identifying greenhouse gas emissions sources, evaluating and prioritising them according to significance, then designing and implementing appropriate control, reduction and mitigation measures of greenhouse gas emissions to the environment.

One medium which will be used to achieve these tasks is the RTCA CCAP. This plan has been developed to help meet commitments and to manage the risks and opportunities that arise in relation to climate change. RTCA's CCAP has four key objectives and areas of work:

- Clean Coal: Actively researching and promoting technologies that reduce CO_2 emissions from the use of coal. Programmes include COAL21, an initiative of the Australian Coal Association aimed at reducing greenhouse gas emissions arising from the use of coal in electricity generation in Australia;

- Energy Management: Improving energy use at operations, projects and in the supply chain. The first step was undertaking energy audits at each operation and identifying a range of energy projects for further development and implementation;

- Designing for the Future: Designing projects, recognising risks from a changing climate and opportunities in a changing policy environment. Programmes in this area include investigating new options to capture coal seam methane from underground and opencut mines; and

- Raising Awareness: Raising awareness with employees, the communities where we operate, our customers, governments, suppliers and industry that this is an issue that requires us all to change how we currently operate.

Current actions include payment of a levy per tonne of coal to fund clean coal demonstration projects ($12-15 million per year based on 2005 production rates), inclusion of a minimum of five energy improvement projects per site in the 2007 plan, and measurement and reporting to capture energy use and savings.

During 2007 Rio Tinto announced a new Hydrogen Energy company in partnership with BP. The company will develop alternative energy solutions in the form of decarbonised energy projects. A number of existing technologies will be combined in a unique way to reduce carbon dioxide emissions from fossil fuel power generation when compared with existing plants.

17.4.4 Management Measures

The management of energy use and GHG emissions at HVO are undertaken with reference to the corresponding action plan that details the key objectives and control measures.

The ESAP for HVO outlines site energy use and greenhouse gas emissions, key performance indicators and recommended actions.

The key objectives for energy management are to:

- manage the operations in a way that maximises energy use efficiency and minimises GHG emissions;
- review emissions from operations and modify activities to ensure compliance with relevant criteria; and
- identifying opportunities for improvement in energy efficiency.

Many control measures are already in place as part of existing controls for the HVO South activities to minimise impacts resulting from energy use and greenhouse gas emissions. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

Regular controls include:

- awareness through environmental inductions to ensure that relevant employees are aware of potential impacts from equipment and its operation;
- internal bi-annual reporting of energy consumption and greenhouse gas emissions; and
- reporting of energy use and greenhouse gas emissions in the RTCA Annual Sustainability Report.

Commitments Specific to the Proposal

In addition to the mitigation measures the mine plan will be regularly reviewed with a view to keeping emissions to the lowest levels practicable. Haul roads will be kept to the shortest routes practicable and material rehandling will be kept to the minimum levels practicable. Most of these measures are routinely applied as part of the efficient design of the mine.

17.5 CONCLUSIONS

The efficient use of energy during operations is significant to CNA as it results in economic benefits and will result in a reduction of greenhouse gas emissions. The proposal will result in a 21% increase in greenhouse gas emissions over the life of the mine compared to the business as usual scenario over the same period. Globally, between project inception to peak-production the impact of the proposal will range from 0.01% to 0.04% of global energy related emissions (as distinct from the currently consented operations). It is considered a reasonable assumption that if the coal was not produced at HVO, an alternative mine would increase production to meet demand, therefore equivalent emissions would occur.

Energy efficiency and greenhouse gas reduction initiatives are currently being implemented at HVO, and will continue to be developed, by CNA and RTCA. These will aid in the minimisation of greenhouse gas emissions and add to the industry knowledge base on greenhouse gas reduction initiatives.

18 LAND USE AND MANAGEMENT

This chapter provides an overview of the pre-mining and existing HVO South key land resources and outlines management plans that will be implemented to ensure these resources are effectively managed throughout the Project Approval period and beyond. This chapter is supported by the Soil Survey and Land Resource Assessment Report by GSS Environmental, 2007 presented as Annex P.

18.1 INTRODUCTION

A holistic approach to land management is critical to provide the best closure outcomes for HVO South. The object of this assessment was to review current land uses across the local landscape and determine the additional impacts that may result from the proposal. The specific aspects that are assessed include soil types, land capability and agricultural suitability.

18.2 METHODOLOGY

This chapter has adapted information presented in the *Soil Survey and Land Resource Assessment (GSSE, 2007).* The methodology for this assessment included study of existing mapping information, soil profiling, field surveys, laboratory assessment and land capability and agricultural land suitability assessment for the mining extension areas. Details are provided in *Annex P*. In addition, relevant sections of past assessments focussing on land resources have been considered, and existing management measures were reviewed to identify additional measures required as a result of this proposal.

18.3 PRE-MINING AND EXISTING LAND RESOURCES

18.3.1 Topography

Regional Topography

There are four landform units within the Hunter Valley which include:

- the Liverpool and Mount Royal Ranges to the north west and north east respectively;
- the Merriwa Plateau (weathered basalt) and Goulburn Valley (softer sandstones) define the south western part of the Upper Hunter;
- north eastern foothills extend from the Mount Royal Ranges to the central part of the Valley; and
- central lowlands from Murrurundi to Branxton formed from relatively weak Permian sediments.

HVO South is located in the central lowlands.

Local Topography

The local topography around HVO South is characterised by gentle to undulating slopes with first, second and third order drainage lines forming part of Hobden Gully and draining to the Hunter River. These drainage lines are located in the north west section of HVO South. Typical elevations in this area range from 70 to 130 m AHD. Other topographical features include the Wollombi Brook which flows from the south west to the north east to join the Hunter River. The bed of the Brook is up to 100 m wide and is contained within sandy banks that can reach a height of 8 to 10 m. The area surrounding the Brook comprises low undulating hills which rise from alluvial flats. Elevations increase to 110 m at a hill in the southern portion of the Project Application area. Topography in HVO South also includes a flat area used as a landing strip for the HVGC located in the south west of the site.

18.3.2 Soil

Soil surveys have previously been undertaken over all mining areas for previous development applications. A soil survey covering the proposed extension areas which have not been previously assessed has also been prepared. *Table 18.1* summarises the soil groups identified in past assessments together with a description of erosion potential and topsoil stripping depth.

Table 18.1 Summary of Soil Characteristics (Past Assessments)

Survey Area	Soil Type	Location	Description	Erosion potential	Top soil stripping depth (cm)
Cheshunt/ Riverview	Clay soils	1103 ha covering most of the Cheshunt and Riverview Pit areas	Moderately structured thin, porous, acid topsoils Tough, dense, alkaline subsoils	Stable Moderate to high dispersive rating	0-10
	Gravelly soils	Two small pockets (5 ha) in the Cheshunt Pit and north east of the WOOP	Very stony, acid, crumby porous topsoils Less stony, tough, dense subsoils	Stable Stable	0-10
	Alluvial soils	61 ha within Cheshunt Pit	Weakly to strongly structured friable clay loam topsoil. Crumbly, porous, sandy clay or light clay	Moderately dispersive Material at depth has a moderate to high dispersive rating	0-50
	Sandy soils	111 ha adjacent to the Hunter River	Weakly structured, acid, brittle to crumbly, porous, sandy topsoils. Light medium clay or sandy clay subsoils	Stable Stable	0-10

Survey Area	Soil Type	Location	Description	Erosion potential	Top soil stripping depth (cm)
South Lemington	Duplex soils	All other areas of south Lemington lease area	Sand to clay loam topsoils Red clayey subsoils	Stable Slightly dispersible	0-10
	Siliceous sands	Under Wollombi Brook	Acidic sand topsoil Hard sandy clay subsoils	Stable Slightly dispersible	0-10
Source – Adapted from ERM 1998 and SKM 1997.					

The soil survey conducted by GSS Environmental (GSSE) for the proposed extension areas identified six soil units which are described in detail in *Annex P* and listed below:

- Yellow Duplex;
- Red Duplex;
- Siliceous Sands;
- Alluvial Soils;
- Lithosols; and
- disturbed land.

Table 18.2 summarises the distribution of each soil group. A substantial proportion of the survey areas were classified as 'disturbed' land, especially the Deep Cheshunt extension area, which has been heavily impacted by opencut mining in the Cheshunt Pit. The suitability of these soils for use as top dressing and the stripping depth is summarised in *Table 18.3*. Full descriptions of each soil type are provided in *Annex P*.

Table 18.2 Summary of Soil Types in Proposed Extension Areas

Soil Types	Extension Areas			
	Deep Cheshunt	**Riverview Pit South West**	**Riverview Pit South East**	**South Lemington Pit 1**
Yellow Duplex	Dominant	Identified	Dominant	Dominant
Red Duplex	-	Identified	-	-
Siliceous Sands	Minor areas	-	-	Minor areas
Alluvial Soils	Minor area in northern margins	-	-	-
Shallow Rocky Lithosols	-	Identified	-	-
Source – adapted from GSSE 2006				

Table 18.3 Summary of Soil Suitability for use in Rehabilitation

Soil Unit Type	Suitable Stripping Depth (cm)
Yellow Duplex	10
Red Duplex	10
Lithosols	Not suitable for top dressing
Siliceous Sands	Not suitable for top dressing[1]
Alluvial soils	50
Disturbed land	Not suitable for top dressing

Source – GSSE 2007
1. Unless mixed with clay material

18.3.3 Land Capability

Land capability is the ability of land to accept a type and intensity of use permanently, or for specified periods under specific management, without permanent damage (Houghton and Charman, 1986). There are eight land capability classes; I through to VIII and along with classes U and M for disturbed land. Class I land has the greatest potential for agricultural or pastoral uses and Class VIII is considered unsuitable for either. The pre-mining land capability for HVO South was dominated by Classes IV and V. The definition of the land capability classes is provided in *Table 18.4*.

Table 18.4 Rural Land Capability

Land Class	Land Suitability	Land Definition
Class I	Regular Cultivation	No erosion control requirements.
Class II	Regular Cultivation	Simple requirements such as crop rotation and minor strategic works.
Class III	Regular Cultivation	Intensive soil conservation measures required such as contour banks and waterways.
Class IV	Grazing, occasional cultivation	Simple practices such as stock control and fertiliser application.
Class V	Grazing, occasional cultivation	Intensive soil conservation measures required such as contour ripping and banks.
Class VI	Grazing only	Managed to ensure ground cover is maintained.
Class VII	Unsuitable for rural production	Green timber maintained to control erosion.
Class VIII	Unsuitable for rural production	Should not be cleared, logged or grazed.
U	Urban areas	Unsuitable for rural production.
M	Mining and quarrying areas	Unsuitable for rural production.

Source - Soil Conservation Service of NSW (1986).

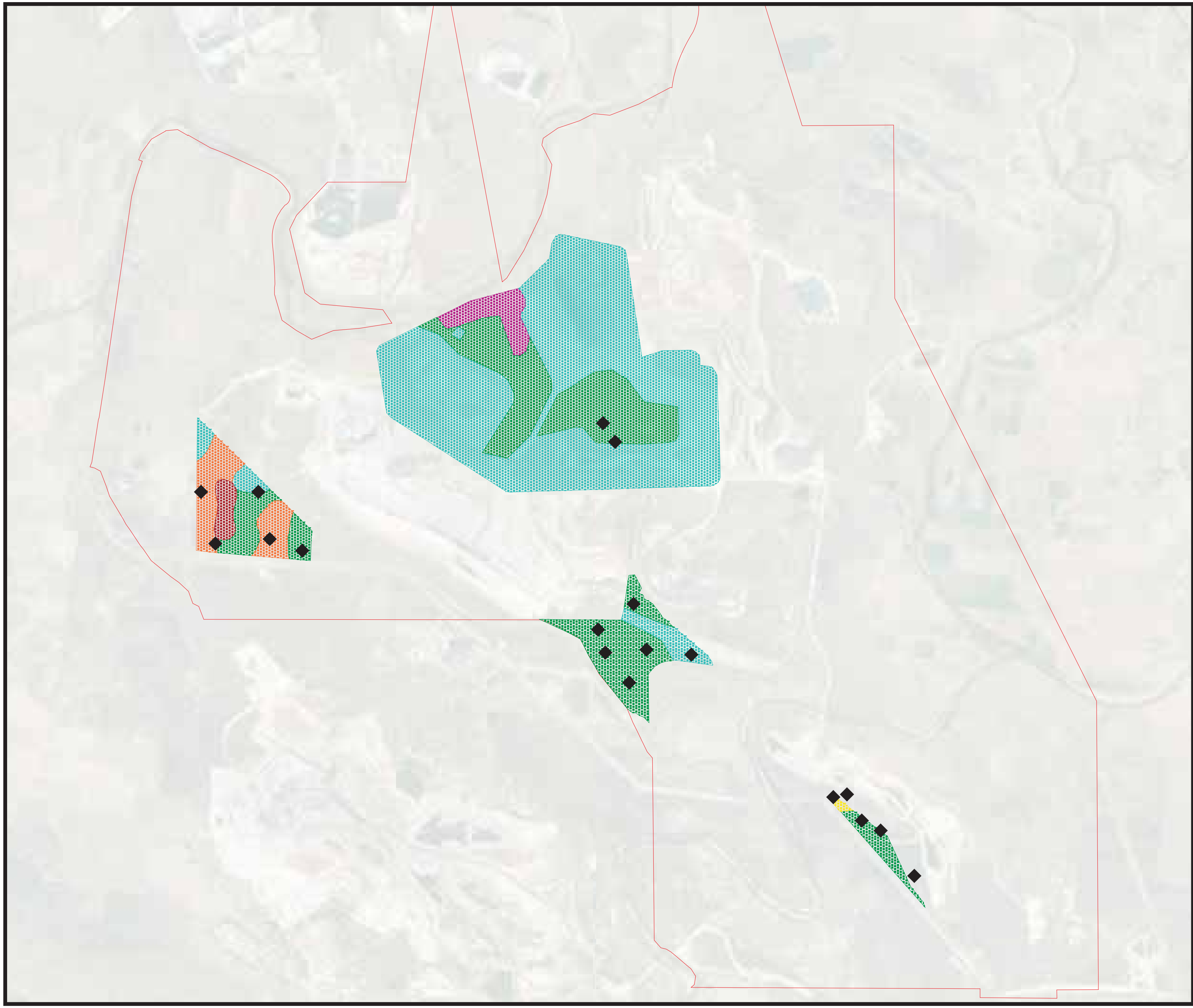
GSSE classed the four extension areas that are the subject of the proposal as follows (refer to *Figure 18.1*):

- the remaining undisturbed land in the Deep Cheshunt extension area is limited to Class VI – suitable for grazing only. The flat land adjacent to the Hunter River is not suitable for cultivation due to the presence of Yellow Duplex soils and the fragmented nature of the landscape caused by drainage depressions, dams and drains. The remainder of the Deep Cheshunt extension area is limited to Class VI, due to the subsoil properties of Yellow Duplex soils and the slope gradient;

- Riverview Pit south west extension area is generally limited to Class VI due to slope gradient and soil type (Yellow and Red Duplex). The western third of the Riverview Pit south west extension area is limited to Class VII, due to slope steepness, soil type (Duplex soils) and surface rockiness (Lithosols and outcropping on upper slopes and crests);

- Riverview Pit south east extension area and South Lemington Pit 1 extension area are limited to Class VI due to the high erosion potential of the subsoils associated with the Yellow Duplex soils. The Siliceous Sands at the north western end of the South Lemington Pit 1 extension area are Class VII due to the high potential for erosion associated with the Siliceous Sands; and

- land within all areas that has been disturbed by mining is considered to be Class M, unsuitable for agricultural production due to mining or quarrying activities. The steeper slopes of the hill and spurline on dark clays are limited to Class VI.



Legend
- Disturbed
- Yellow Duplex
- Alluvial Soils
- Siliceous Sands
- Red Duplex
- Lithosoils
- Application Area
- Sample Sites

Figure 18.1

HVO South Soil Types and Profile Sites

Client:	Coal & Allied Operations Pty Ltd		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_EAR_G_13_R0		
Date:	04/10/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	-
Source:	GSS Environmental		
Scale:	Refer to Scale Bar		

N

0 0.75 1.5km

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ERM

18.3.4 Agricultural Land Suitability

Agricultural land suitability is an alternative land classification system used to assess land suitability, relative to a specific type of agricultural production. The system consists of five classes, which assess land on the basis of suitability and agricultural production potential. As well as assessing land capability (soils, geology, soil erosion, topography and climate), agricultural suitability considers industry specific factors that may influence potential production. The same piece of land may be classed differently, depending on selected land use.

The system allows for land to be allocated into five possible classes (with suitability decreasing progressively from Class 1 to Class 5). The classes are described in *Table 18.5*.

Table 18.5 Agricultural Land Suitability Classes

Class	Description
1	Arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent.
2	Arable land suitable for regular cultivation for crops but not suited to continuous cultivation. It has a moderate to high suitability for agriculture but edaphic (soil factors) or environmental constraints reduce the overall level of production and may reduce the cropping phase to a rotation with sown pastures.
3	Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with pasture. The overall production level is moderate because of edaphic or environmental constraints. Erosion hazard, soil structural breakdown or other factors including climate may limit the capacity for cultivation and soil conservation or drainage works may be required.
4	Land suitable for grazing but not cultivation. This includes native pastures or improved pastures based on minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.
5	Land unsuitable for agriculture or at best only to light grazing. Agricultural production is low or zero as a result of severe constraints, including economic factors, which preclude land improvement.

Source - GSSE 2007

The current, or most recent, agricultural land use within the survey areas is cattle grazing.

As reported by GSSE 2006, the majority of the undisturbed land within the four extension areas is Class 4; suitable for grazing with significant limitations. This is due to soil characteristics for the Yellow Duplex subsoils within the areas. Slope gradient is also a limiting factor in the eastern half of the Deep Cheshunt extension area and Riverview Pit south west extension area. The western half of the Riverview Pit south west extension area is limited to Class 5; unsuitable for agricultural production or light grazing. This is due to soil type, slope gradient and surface rockiness within the area. The northern end of South Lemington Pit 1 extension area is also limited to Class 5, due to the poor soil characteristics of the Siliceous Sands. Mining impacted land within the survey areas is limited to Class 5; unsuitable for agriculture, or at best light grazing; due to mining disturbance. Assessment of any changes to agricultural land suitability resulting from mining operations is part of the MOP process.

18.3.5 Pre–Mining Land Uses

Opencut mining at HVO commenced in the early 1950's. Prior to this the key land uses included:

- cultivation;
- improved pastures;
- selectively cleared land for grazing;
- remnant native vegetation; and
- riparian corridors (Hunter River and Wollombi Brook).

The pre-mining (1960's) land use in the HVO South Project Application area and surroundings was grazing, with some areas of cropping and remnant vegetation. Cleared land dominated the area as shown in *Table 18.6* and in *Figure 18.2.*

Table 18.6 Pre-Mining Project Application Area Land Type

Description	Area (ha)	Area (%)
Cultivation/Cropping	741	11
Remnant Vegetation	500	8
Cleared	5293	81
Total	6534	100

The landscape and rehabilitation objectives developed as part of the Life of Mine planning process (refer to *Chapter 19*) have considered the pre-mining land uses across the Project Application area and surroundings.

Legend

Project Application Area

Figure 18.2

HVO 1963-1967 Aerial Mosaic

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_21 Suffix No: R1
Date:	27.09.2007 Drawing Size: A4
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

N

0 1 2km

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ERM

18.4 *MANAGEMENT MEASURES*

The management of land and specifically land use at HVO is undertaken with reference to the corresponding management plans that detail the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle. The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for the various aspects of land use management are included in five specific management plans and summarised in *Table 18.7*. Draft Management Plans that apply to land use for the proposal are included as *Annex Q.*

Table 18.7 Land Management Objectives

Land Management Component	Objectives
Erosion and Sediment Control Management Plan	• manage the activities in a way that minimises erosion and sedimentation impacts to environment and neighbours, and limits interference to mining production; • protect natural and rehabilitated landforms and minimise erosion; and • minimise sedimentation of natural waterbodies and watercourses.
Topsoil Stripping and Stockpiling Management Plan	• manage the activities in a way that minimises groundwater impacts to environment and neighbours, and limits interference to mining production; • understand topsoil quality and quantity; • plan and manage topsoil stockpiles to maintain soil viability; • achieve direct placement of topsoil from disturbed areas for rehabilitation purposes wherever possible; and • protect stockpiles from erosion and weed infestation.

Land Management Component	Objectives
Subsidence Management Plan	• manage the operations in a way that minimises highwall mining subsidence impacts to environment and neighbours, and limits interference to mining production; and • optimise resource extraction while managing subsidence impacts.
Weeds and Feral Animals Management Plan	• work with neighbours in the management of weeds and feral animals; • prevent the introduction and spread of noxious weed species and feral animals; and • implement the Weed and Feral Animal Control Programme to minimise impacts to the environment.
Bushfire Management Plan	• work with neighbours to minimise the risk of bushfires and rapidly control outbreaks should they occur; • protect people, property and assets; • protect areas of heritage value; and • protect areas of threatened flora and/or fauna.

Many control measures are already in place to minimise impacts to land as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

Regular controls for management of land are implemented through the five specific management plans. Draft Land Management Plans are included as *Annex Q*.

Controls for erosion and sediment control are detailed in *Chapter 10: Surface Water*.

Controls for management of topsoil stripping and stockpiling include:

- stripping as per topsoil stripping plans described in the relevant MOP;
- completion of a GDP prior to topsoil stripping;
- minimisation of mechanical breakdown of soil structure;
- stockpile register maintained for topsoil stockpiles; and
- weed management for topsoil stockpiles.

Controls for management of highwall mining subsidence include:

- subsidence assessment to determine preferred mine design to minimise potential impacts;
- strengthening of support structures prior to mining;
- rehabilitation work following mining; and
- monitoring of impacts.

Controls for management of weeds and feral animals include:

- weed inspections and identification;
- weed spraying including record keeping;
- inspection and washing of earthmoving machinery; and
- feral animal eradication programmes.

Controls for management of bushfire include:

- grazing and slashing to minimise fuel build-up;
- maintenance of fire breaks;
- ongoing communication with the NSW Rural Fire Service;
- GDP process to minimise impacts to flora and fauna; and
- site fire fighting equipment and emergency response procedures.

Commitments Specific to the Proposal

There are no suggested controls specific to the proposal that are required for land management. The current standard control measures implemented at HVO are anticipated to be sufficient to manage any potential impacts form the proposal on land use.

18.5 CONCLUSIONS

This chapter provides an overview of the pre-mining and existing land resources including soils, land capability and agricultural suitability. This includes an assessment of soil and land capability for the extension areas within HVO South. Most soil in the extension areas is suitable for use as topsoil for rehabilitation. Land capability assessments show that the extension areas are predominantly class VI (grazing only) or below and have an agricultural suitability of Class 4 – suitable for grazing with significant limitations.

CNA currently implement land resource management procedures and plans as part of ongoing mining operations. These plans have been modified concurrently to the preparation of the Environmental Assessment Report to reflect changes resulting from the proposal and to enable increased ease of implementation. These plans will form part of the mine landscape strategy that will provide for enhanced final landscape outcomes as discussed in *Chapter 19*.

19 MINE LANDSCAPE PLANNING

This chapter provides an overview of the mine landscape planning process that will be followed for HVO South and an indicative final landform design. It presents the objectives in place for mine closure and final void management and sustainability initiatives.

19.1 INTRODUCTION

Existing opencut mining at HVO is already resulting in alterations to the local landform. The currently approved mining includes overburden emplacements, two final voids, 16 tailings storage facilities, roads and infrastructure. Some of the overburden emplacement areas have already been rehabilitated (North Lemington and the WOOP overburden emplacements).

The proposed extension of mining at HVO South will result in modifications to previously planned and approved final landforms described in earlier Environmental Assessment Reports and MOPs. Following approval, a consolidated MOP will be lodged in recognition of this proposal and will replace the current MOPs for HVO South.

The proposal has allowed for a formal review of previous landform designs and has taken the opportunity to consider previous and surrounding land use; external and internal planning requirements; existing rehabilitated landforms and ecological and sustainability values.

The pre-mining (pre-1960) environment was heavily cleared (approximately 90% of Project Application area). The cumulative effects of agriculture along with more recent mining activities have resulted in a significant reduction of native vegetation and the removal of habitat for native fauna.

The pre-mining agricultural and natural land uses included cultivation, improved pastures, selectively cleared land for grazing, remnant native vegetation and riparian vegetation. Agricultural activities that now occur in the Hunter Valley area include dairies, cultivation (lucerne), grazing cattle, horse studs, vineyards, orchards and forestry.

The current land uses include ongoing agricultural activities and neighbouring mining operations. CNA acknowledges that final land uses need to integrate with the rehabilitation undertaken by the surrounding mining operations and existing agricultural land and provide for both sustainable agricultural production and enhanced biodiversity.

Existing management measures were reviewed to identify additional measures required as a result of this proposal.

19.2 REGIONAL VISION

The *Synoptic Plan - Integrated Landscapes for Coal Mine Rehabilitation for the Hunter Valley of NSW (DMR, 1999)* was developed with a particular focus on minimising the cumulative environmental impacts of mining in the Hunter Valley.

The Synoptic Plan contains five vision statements to guide mine rehabilitation.

1. By application of the Synoptic Plan, the mining industry, together with local and state governments, will demonstrate an integrated approach to natural resource management of lasting benefit to the region.

2. Rehabilitation and land management practices in relation to coal mining can provide significant regional contributions to the Government biodiversity initiatives and greenhouse emission reduction targets.

3. By integrated planning, mine site rehabilitation can realise a diversity of post mining landscapes based on sustainable land use including commercial timber plantations and management of biodiversity and visual amenity.

4. Given fundamental criteria of stability, safety and sustainability, rehabilitated mine sites and their surrounding mine holdings can provide alternative land uses integrating with and contributing to regional economies.

5. A coordinated approach amongst stakeholders to the monitoring of vegetation management will provide the necessary evaluation of vegetation reforms generally in the Hunter Region, and particularly in the coalfield.

To achieve this regional planning vision, the landscape and rehabilitation planning process must actively link with neighbouring mine plans and consider surrounding and regional land uses and ecosystems for sustainability and compatibility of final land uses. Vegetation corridors are an important component to ensure enhanced biodiversity values and improve ecological sustainability.

The intent of the Synoptic Plan will continue to be integrated into future landscape and rehabilitation planning for HVO while acknowledging the changes that may result from neighbouring mining operations and their rehabilitation, surrounding agricultural activities and changes to existing remnant vegetation.

19.3 LANDSCAPE AND REHABILITATION GOALS AND OBJECTIVES

The conceptual final landscape across HVO South is planned to be an undulating, free-draining landform with a post mining land capability which supports agricultural land for predominately cattle grazing and native habitat. This landform will reflect the natural features and complement the previously created landforms.

By using an integrated approach including regular review of mine plans, progressive rehabilitation and monitoring; potential environmental or community impacts may be reduced, hence improving outcomes for the final landform.

The draft *HVO Conceptual Landscape and Rehabilitation Management Strategy* (CNA 2007) (the Strategy) was recently prepared to provide an overview of how strategic landscape and rehabilitation planning and management is developed, implemented and maintained at HVO. The Strategy was developed in consultation with relevant government agencies and submitted in June 2007. The Strategy describes the process for designing the landforms across HVO and undertaking progressive rehabilitation with the aim of achieving a final landscape vision, and aligns with the concepts of the Synoptic Plan. This Strategy has been considered in the development of the final landscape for HVO South.

The key outcomes of the Strategy included:

- landscape and rehabilitation goals and objectives;
- a process for incorporation of the regional vision;
- landform design criteria considerations;
- rehabilitation success indicators;
- a process for developing draft completion criteria for the landscape; and
- assessment and review processes.

The Strategy provides more detail on proposals to enhance biodiversity and an outline of how the Strategy will integrate with existing and planned corridors of native vegetation in areas surrounding HVO. The objectives of the Strategy are reflected in the indicative final landscape proposed for HVO South in *Table 19.1.* The Strategy will be refined following consultation with key government agencies and relevant stakeholders, and will be implemented by the site MOPs.

Table 19.1 Landscape and Rehabilitation Goals and Objectives

Goal	Objective	Considerations
Successful design and rehabilitation of landforms to ensure structural stability, revegetation success and containment of wastes.	Maximise likelihood of long term landform stability and minimise erosion.	Slope angles and lengths compatible with regulatory requirements or better.
	Ensure final landform is compatible with surrounding landforms.	Consistency of final landform with surrounding landforms.
	Optimise final void dimensions and rehabilitation of tailings storage facilities.	Safe and stable rehabilitation of final voids and tailings storage facilities.
	Ensure removal and/or containment of hazardous or contaminated material.	Licenced hazardous materials managed in accordance with regulatory requirements.
	Determine suitable vegetation for re-establishment (pasture, agroforestry, shelter belts, cropping, native woodland, riparian corridors).	• Sustainability of vegetation type and suitability to final landform type. • Size of stands and corridor length and design. • Native vegetation establishment should consider local species and sourcing seed of local provenance as well as control of threatening processes, such as weeds, overgrazing, uncontrolled fire and pests. • Functional ecosystem groups. • Faunal colonisation. • Soil formation and conservation. • Riparian zones, drainage lines, water bodies and general hydrology. • Cultivation species and target yield. • Plant growth characteristics.

Goal	Objective	Considerations
Post-mining land use compatible with surrounding land uses and provides environmental and community benefits.	Return appropriate areas of land to a sustainable and productive grazing use.	• Cultivation species • Erosion control
	Ensure final land use is compatible with surrounding land use.	Consistency of final land use with surrounding land uses.
	Encourage sustainability and diversity of land use.	• Consideration of vegetation type and land use type and suitability to final landform. • Ongoing management requirements. • Control of threatening process including feral animals, weeds, bushfire and overgrazing. • Post mining land ownership in relation to most suitable post mining land use.
	Minimise weeds and pests.	Compliance with legislation for the region at the time of relinquishment.

19.4 PROPOSED HVO SOUTH FINAL LANDFORM

The final landform at HVO South will be developed with recognition of the pre-mining landform features and will incorporate the existing rehabilitated landforms to ultimately be consistent with the surrounding landscape features.

The final landform will be undulating, with slopes of generally 10 degrees for overburden emplacements and up to 18 degrees for internally draining subdomains such as lowwalls and ramps as approved in previous MOPs. This will be achieved by creating gradients for the Cheshunt and Riverview overburden emplacements similar to the adjoining natural slopes and cognizant of existing rehabilitation completed for the WOOP and North Lemington emplacements. The intent is to increase the flat terrain available and reduce the void dimensions to promote the best use of overburden material and optimise topography. This may result in areas of steeper but stable slopes, but will ultimately increase areas suitable for agricultural purposes.

Surface water catchments assessed in *Chapter 10* have identified sediment control structures that will be retained. Future structures for erosion and sediment control and water management will be incorporated into the landform as rehabilitation progresses. Heights of the Cheshunt and Riverview overburden emplacements will not exceed the maximum height of existing rehabilitated landforms. *Table 5.1* provides details on currently approved and proposed relative levels of the emplacements.

The proposed tailings storage facilities located in the eastern and southern eastern sections of Riverview and South Lemington Pit 1 (*Figure 5.7*) are planned to be capped with overburden and rehabilitated after consolidation of tailings as has successfully occurred elsewhere in HVO.

A single final void at Deep Cheshunt is now planned to remain in place at completion of mining (See *Section 19.4.1*). Consultation will be undertaken with regulatory authorities and the community to communicate final landform options through the development of the HVO Landscape and Rehabilitation Management Strategy (CNA 2007) and the Mine Life Planning process.

The proposed landform is shown in *Figure 19.2*.

19.4.1 Final Void

The final void formation resulting from the mine plan at September 2006 will now differ to that proposed in the Hunter Valley No. 1 South Pit EIS 1998. The two final voids proposed for Cheshunt and Riverview will now be backfilled and a single void will result from mining in Deep Cheshunt.

The location of the final Deep Cheshunt void is at the economic limit of opencut mining. The void will remain as an open water body as all available overburden will be used to create an undulating and free-draining overburden emplacement (due to mine design and operation constraints).

The void will be located south of the Hunter River, aligned generally east - west and will have a strike length of approximately 3700 m and top width of 1700 m. The void depth will be 200 m with the water level likely to oscillate around an elevation of 0 mAHD. This void will be designed to capture mine affected surface water runoff from the Cheshunt and Riverview overburden emplacements and allow for evaporation of accumulated water. Non mine affected water will be diverted away from mine disturbance areas.

Predictive groundwater modelling (*Chapter 9*) indicates that an equilibrium void lake water level is estimated to be reached after 250 years. At this level the inflows to the void from groundwater and surface water runoff are balanced by evaporation from the surface of the void water storage.

The equilibrium void water level is approximately 50 - 60 m below the ground surface, therefore the risk that the void would overtop even during an extreme rainfall event is very low. The location of the final void is well above the 1:100 Hunter River flood level. The equilibrium void water level is also well below the pre-mining groundwater levels, hence the open void will act as a groundwater sink. An option exists, that has not been assessed in detail, for the Deep Cheshunt Pit final void to be used as a buffer for floods in the Hunter River by acting as an off-line storage. These issues are addressed further in *Chapters 9* and *10*.

A Final Void Management Plan will be prepared for each of the HVO voids north and south of the Hunter River at least five years prior to completion of mining in the specific opencut pit and will include:

- identification of possible beneficial uses for the void;
- consideration of technologies which will assist to enhance the range of possible uses;
- review of modelling and predictions of long term hydrological behaviour and water quality responses, including final void water quality and level;
- long term integrity of void slopes;
- waste characterisation and containment as pertains to runoff into final voids;
- coal seam capping; and
- long term management, monitoring and mitigation measures.

The key management requirements are to ensure the ongoing stability of the void and safety for the community.

19.5 PROPOSED HVO SOUTH FINAL LAND USE

CNA recognises the importance of the local agricultural industry and seeks to integrate biodiversity enhancement with sustainable agricultural practices. This can be achieved by returning mined land to agricultural productivity, complemented by the establishment of native biodiversity. The term 'eco-agriculture' can be used to describe this concept of ecosystem management, which also includes enhancing wildlife habitat in non-farmed patches within agricultural landscapes, and improving the habitat quality of productive farmlands.

In recognition of the previous agricultural practices in the area, an increase in areas available for sustainable agriculture compared to previous plans has been proposed.

While the intentions of the Synoptic Plan will be considered in the rehabilitation design of the HVO South area, the primary driver of final land use will be land suitability. This is defined by mine design constraints and topsoil quality and availability. Where possible post-mining land uses will complement those that exist on adjoining land.

The landform will be predominately revegetated to improved pastures with vegetation for stock shelter belts. Existing areas of established cultivation will be retained. Native vegetation corridors will also be created and where possible will connect to remnant areas of forest or woodland to provide opportunities for wildlife habitat and migration. As described in *Chapter 14*, final landforms strongly influence visual amenity both during operations and following closure. Therefore, in some areas visual corridors may be established where existing vegetation is assessed as deficient. In addition, agroforestry plots may be established as appropriate.

The aim is to provide ongoing agricultural benefits whilst creating complementary areas of biodiversity. This should enhance agricultural productivity, increase habitat and biodiversity values and establish vegetation cover that creates corridors to link surrounding native vegetation and enhance local and regional ecological linkages to provide for a sustainable final land use.

The final landscape has been designed to enhance the biodiversity potential through the creation of vegetation corridors and incorporating the management of surrounding remnant vegetation. This management will include habitat maintenance and augmentation, and restoration of vegetation.

Figure 19.1 illustrates the slope categories of the current final landform and conceptual rehabilitation based on this landform, and *Figure 19.2* shows the conceptual final landscape with proposed vegetation corridors and linkage to remnant vegetation.

Table 19.2 describes the components of the pre-mining environment compared to the proposed post-mining environment and the Synoptic Plan. In recognition of the previous agricultural practices in the area and commitments made in previous Environmental Assessment Reports and MOPs, an increase in areas available for sustainable agriculture has been proposed. The existing Cheshunt-Riverview MOP (2002) proposes that of rehabilitated land, 30-40% is established as native flora (habitat) and 60-70% of rehabilitated land is grazing.

Table 19.2 Land Use within Project Application Area

Project Application Area	Pre-mining (ha)[1]	Proposed Post-mining (ha)[1]	Synoptic Plan (ha)[1]
Trees	500	2000	2568
Grazing	5293	4260	2210
Final Void	N/A	275	234

1. Areas are approximate

Figure 19.1

Slope Analysis and Proposed Tree Corridors

Client:	Coal & Allied Operations Pty Ltd
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_EAR_G_11
Date:	29/08/2007 Drawing size: A4
Drawn by:	GC Reviewed by: LS
Source:	Coal & Allied Operations Pty Ltd
Scale:	Not to Scale

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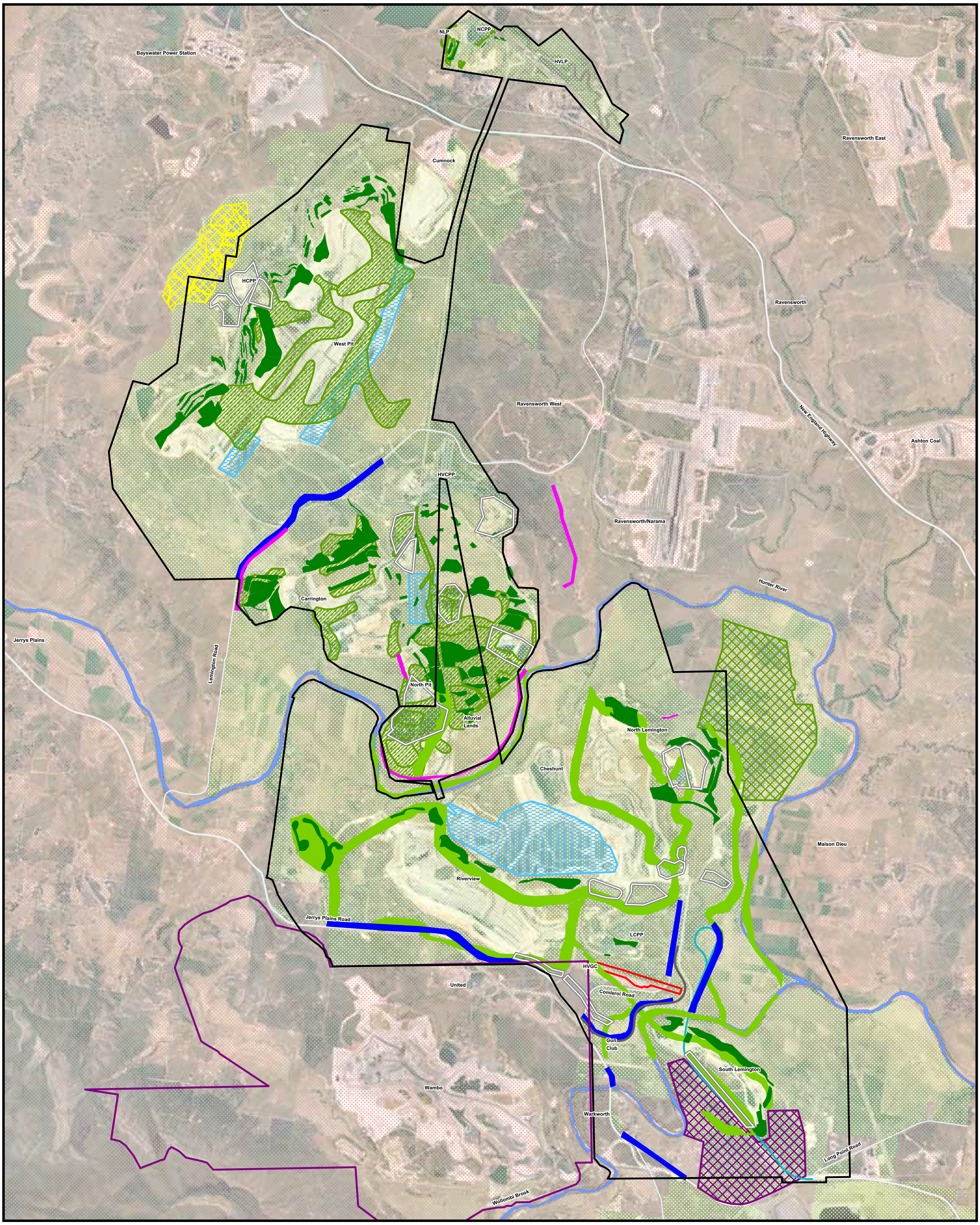

Legend

- HVO North Development Consent Boundary and HVO South Project Application Area
- United Development Consent and Wambo Surface Disturbance Boundary
- Existing Visual Screen
- Potential Visual Screen
- Existing Rehabilitation - Trees
- Proposed Native Vegetation - Strategy
- Proposed Vegetation Enhancement Area
- Proposed Native Vegetation MOP
- Proposed Agro Forestry
- Habitat Management Area
- Water Filled Void
- Rehabilitated Tailings
- Proposed Gliding Strip
- Local Roads and Proposed Comleroi Road
- Proposed Rail Spur and Loop
- Proposed Pasture
- Private Land Ownership

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_GIS20
Date:	04.10.07 Drawing Size: A3
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

N

0 1 2km

Figure 19.2

Conceptual Final Landscape

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19.6 REHABILITATION TECHNIQUES

Rehabilitation includes the progressive reshaping of mined landforms (waste dumps and pits) and drainage channels, topsoil haulage and placement, ripping, erosion control, weed control, seeding and fencing to obtain the final landform design outcome.

The rehabilitation of HVO South will be carried out throughout the life of the mine and will be undertaken once mining activities in an area have ceased. Standard and well recognised rehabilitation procedures are utilised and described below.

In general, rehabilitation involves shaping of the overburden according to the final landform design. Topsoil is re-spread on the shaped areas to a minimum depth of 100 mm. Contour banks may be constructed at regular intervals down the slope of the rehabilitation area. If required the area is rock-raked to generally remove rocks greater than 200 mm in diameter. Areas to be planted to pasture are then scarified along the contour to assist in seed germination and water infiltration.

Revegetation is undertaken progressively and as soon as practicable after the completion of surface preparation. Seeding of a rehabilitation area is undertaken using either a tractor mounted seed spreader or direct hand seeding. Generally, pasture areas and trees and shrub areas will be sown separately. Where utilised, tube stock may be planted in rip lines at approximately 5 m spacing and in an irregular pattern along the contour to achieve as natural a result as possible.

For each possible post mining land use, the rehabilitation techniques utilised will have different indicators and success criteria:

- pasture – productive, stable, low levels of erosion, resilient pastures;
- cultivation – productive, low level of erosion;
- trees for shelter – specific species and growth habit (height and canopy cover);
- trees for agroforestry – productive (growth rates) and resilient to pests, appropriate soil fauna to complement nutrient acquisition;
- trees for visual screening – reduce visual impact of operations; and
- native vegetation for corridors and biodiversity – reproducing and sustainable, dimensions able to support ecosystem biodiversity (habitat) and provide transport corridor for fauna, appropriate functions consistent with neighbouring remnant ecosystems.

19.6.1 Rehabilitation Schedule

Detailed rehabilitation plans are submitted to the DPI-MR as part of the MOP, and include progressive rehabilitation as areas become available. An indicative mine rehabilitation schedule according to the mine plan at September 2006 is shown in *Figure 19.3*.

Mining at South Lemington Pit 1 was temporarily suspended in 2001. Recommencement of mining in South Lemington Pit 1 forms part of this proposal, and will be incorporated into a revised MOP for HVO South, which will supersede all previous MOPs for this area. The management commitments for South Lemington Pit 1 will be addressed in this updated MOP in consultation with the DPI-MR, and will include highwall stability monitoring, water storage management, minimisation of visual impacts and management of dust emissions and erosion.

While it is acknowledged that the preferred ratio of disturbance to rehabilitation is constant (DPI-MR assessment requirements), the proposed increase in production for the extensions to mining in HVO South means an initial increase in area of disturbance relative to rehabilitation. The indicative areas of disturbed and rehabilitated land within HVO South over the life of the mine according to the mine plan at September 2006 are provided in *Table 19.3.*

The proposed mine plan for HVO South will result in an unavoidable increase in disturbance. The waste material from the mining of the boxcut (initial mining pit) for Riverview south east and South Lemington Pit 2, and sequential strips (to advance mining in all pits down dip) is necessarily placed in out of pit emplacements. This allows the establishment of working room for the deeper mining operation to the Bayswater seam. During this development stage, the surface area of the active overburden emplacement exceeds that which is available for rehabilitation. Only after the overburden emplacement approaches final landform levels, does the area available for rehabilitation relative to the area being disturbed (comprising active pit and active overburden stockpile) achieve a closer balance.

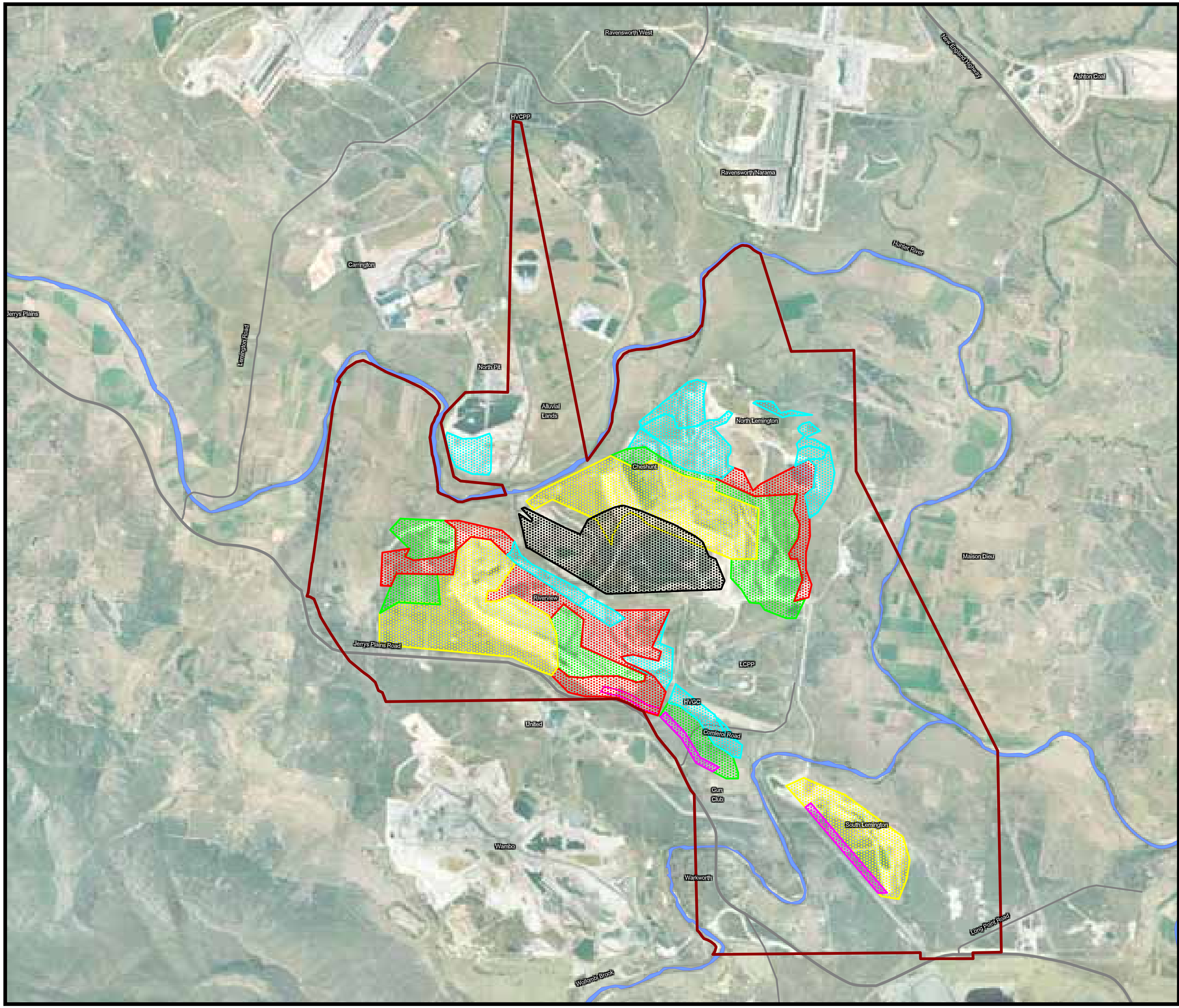
The disturbance area of the active pit increases as a result of the additional working room required for mining depth. This is due to the additional benches and batters needed for both highwalls and lowwalls, and extensions of road and ramp systems. Areas of disturbance such as infrastructure, dams and rejects disposal areas also remain for the duration of active mining. These areas which are essential for efficient mining operations, contribute to an accumulating rehabilitation deficit during the life of the mine.

It is the intention to rehabilitate all areas outside immediate active mining and associated infrastructure as soon as they become available. It is not until active mining is complete that these areas will become available for rehabilitation. At this point, an intensive reshaping programme will be undertaken to form a stable landform.

Table 19.3 HVO South Disturbance and Final Spoil Placement

Mine Plan Year	Disturbance (ha)[1]	Final Spoil Placement (ha)[1]	Disturbance to Final Spoil Placement Ratio[1]
1-9	561	499	1.1: 1
10-14	208	386	0.5: 1
15-19	61	357	0.2 : 1
20-21	0.7	110	0.006 : 1

1. Approximate, based on mine plan as at September 2006.



Legend

Project Application Area

Rehabilitation Scheule

- Proposed Tailings Disposal
- Final Void
- Year 1-9
- Year 10-14
- Year 15-19
- Year 20

Figure 19.3

Approximate Rehabilitation Schedule

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_22	Suffix No:	-
Date:	27.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

N

0 1 2km

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ERM

19.7 SUSTAINABILITY AND BIODIVERSITY INITIATIVES

19.7.1 *Biodiversity Enhancement*

Of the 250 ha required for the extension of mining, only 48 ha supports remnant vegetation and 92 ha supports regenerated vegetation (approximately). An additional area of 35 ha has previously been approved to be cleared as part of the Riverview Pit Extension (ERM 2005), of which around seven ha is remnant vegetation and six ha is regenerated vegetation.

The environmental assessment process has involved detailed ecological investigations which have identified the ecosystems and threatened flora and fauna species within the Project Application area that may be impacted by the operations *(Chapter 11)*. The ecological value of the area of all of this remnant vegetation has been assessed and was determined to be of moderate significance. (*Annex L* and ERM 2005).

The Synoptic Plan identified areas of remnant vegetation that could be linked to rehabilitation areas. In addition, recent projects across CNA operations have included assessment of retained remnant vegetation outside of the Project Application area.

This information will improve the ability to design and regenerate vegetation corridors. These linkages will ultimately allow for improvement in biodiversity by:

- promoting a net improvement in ecological value and connectivity;
- increasing the area of woodland and potentially regeneration of threatened flora species;
- increasing habitat and ecosystems for threatened fauna species; and
- contributing to the development of a regional corridor consistent with the principles and strategies outlined in the Synoptic Plan.

Some of these existing areas have previously been developed as offsets. In particular, the Warkworth Mine Green Offsets and Wambo Mine Remnant Vegetation Enhancement Areas contribute to the development of the regional corridor.

Vegetation corridors are important to ensure continued biodiversity and improve ecological sustainability. Yet with this it is acknowledged that agricultural activities continue to be undertaken in the Hunter Valley area, including dairying, cultivation (Lucerne), grazing cattle, equine industry, viticulture, orchards and forestry. Vegetation corridors will therefore be planned cognizant of existing and proposed agricultural activities (*Section 19.5*).

The intent is to develop functional corridors to support and enhance biodiversity of threatened and common flora and fauna species. The final landforms will be established to support a variety of sustainable activities, which include both agriculture and native ecosystems. Natural ecosystems provide opportunities for fauna habitat, foraging and migration. Within the Project Application area, this will increase the long-term ratio of retained or rehabilitated vegetation to vegetation that occurred in the pre-mining environment area to 4:1.

To further mitigate the impacts of this proposal, the final landscape planning has reviewed areas of remnant vegetation to determine which are most suitable for biodiversity enhancement.

It was identified in the ecological assessment that the Archerfield Property has high potential biodiversity value (*Annex L*). This property is owned by CNA and currently leased as a dairy farming operation comprising cultivated farm land and grazing land. Within the grazing land approximately 140 ha of existing vegetation has been identified as containing high biodiversity values including a diversity of vegetation communities and native flora species, as well as habitat opportunities for threatened fauna species. This area is highly suitable for enhancement to improve its current biodiversity values and provide compensatory habitat for the areas to be cleared as part of the proposal.

To complement the planned rehabilitated woodland corridors it is proposed to actively enhance the Archerfield Property to increase the vegetation cover and habitat value of the area, utilising techniques determined by the Warkworth Green Offsets research programme.

Of the remaining cleared area within the property, approximately 200 ha is also available for natural regeneration. The soil profile of this area has been identified as potentially suitable for establishment of the endangered ecological community Warkworth Sands Woodland. In recognition of this, the research programme being developed for the Warkworth Green Offsets is assessing this opportunity along with natural regeneration of endemic species.

The area of the remnant vegetation within the Archerfield Property is equivalent to the area of remnant vegetation to be cleared as a result of the proposal however has a much higher biodiversity value.

Other activities undertaken or supported by CNA have also been identified as potentially contributing to biodiversity and cultural value including:

- Lower Hunter Land – permanent protection of large areas of high biodiversity value;
- Warkworth Green Offsets – linkage to create larger corridors;
- Rivercare Project – improvement of riparian vegetation; and
- Aboriginal ‘keeping places’ – protection of existing Aboriginal cultural heritage.

19.8 MANAGEMENT MEASURES

Landscape planning and rehabilitation at HVO is undertaken with reference to strategies and management plans that detail the key objectives and control measures.

The draft *HVO Conceptual Landscape and Rehabilitation Management Strategy* has been developed to assist final landform and landscape planning at HVO.

In addition the management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle. The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for the various aspects of landscape planning and rehabilitation are to:

- ensure that disturbed areas are rehabilitated progressively and are managed to ensure their success;
- ensure that impacts on the landscape are minimised during and post mining operations;
- aim for rehabilitation that supports both agricultural practices and enhances biodiversity; and
- return post mining land to at least equivalent to pre-mining land capability.

Many control measures are already in place to minimise landscape impacts as part of existing controls for the HVO South activities. As a result the recommended measures have been separated into those mitigation measures that are applied to the operation and those that are specific to the proposal.

Mitigation Measures

Specific controls have been developed and are detailed in the HVO EMS procedures and management plans. These controls apply to the following activities:

- planning and undertaking disturbance;
- seed collection and habitat creation;
- final landform design;
- landscape planning;
- preparation for rehabilitation including surface preparation and planting;
- reporting on rehabilitation planning in the HVO AEMR;
- planning for mine closure; and
- development of final void and tailings management plans.

Commitments Specific to the Proposal

1. General environmental land management practices implemented on all CNA owned land will be applied to the Archerfield Property along with planned rehabilitation areas.

2. Remnant vegetation located within the Project Application area and outside proposed disturbance areas will be protected and enhanced to improve the ecological value and biodiversity. In particular, the specific management practices will include:

   - monitoring of remnant vegetation areas in accordance with existing procedures to provide evidence of success of management practices;
   - undertaking bushfire management, weed and pest control in accordance with recommended practices;
   - utilising local native species for seed stock where practical;
   - utilising existing farm dams and retention or establishment of native vegetation around dams to provide habitat; and
   - habitat creation and enhancement for common and threatened species.

3. The vegetation on the Archerfield Property will require specific management practices to protect and enhance the ecological value and improve the biodiversity. In particular, the specific management practices will include:

   - monitoring of remnant vegetation areas in accordance with existing procedures to provide evidence of success of management practices;
   - undertaking bushfire management, weed and pest control in accordance with recommended practices;
   - maintenance and enhancement of native grasses, wherever possible;
   - utilising local native species for seed stock where practical;
   - utilising existing farm dams and retention or establishment of native vegetation around dams to provide habitat;
   - habitat creation and enhancement for common and threatened species; and
   - fencing of remnant vegetation to restrict stock access where practical.

4. Options for securing the 140 ha of vegetation on the Archerfield Property will be investigated and a suitable mechanism will be implemented to ensure protection and enhancement of the biodiversity during the life of the project. Due to proximity of the Archerfield Property to coal resources and operations, it is considered inappropriate as a biobank site under the draft NSW Threatened Species Conservation (Biodiversity Banking) Regulation 2007 (DECC). An alternative measure will need to be identified to secure the site for the duration of the development.

5. A Final Void Management Plan will be prepared for the Deep Cheshunt Pit final void at least five years prior to completion of mining and will include:
   - identification of possible beneficial uses for the void;
   - consideration of technologies which will assist to enhance the range of possible uses;
   - review of modelling and predictions of long term hydrological behaviour and water quality responses, including final void water quality and level;
   - long term integrity of void slopes;
   - waste characterisation and containment as pertains to runoff into final voids;
   - coal seam capping; and
   - long term management, monitoring and mitigation measures.
6. Mining in South Lemington Pits will be incorporated into a revised MOP for HVO South, which will supersede all previous MOPs for this area. The management commitments for South Lemington Pit 1 will include highwall stability monitoring, water storage management, minimisation of visual impacts and management of dust emissions and erosion.

The process for designing the landforms across HVO and undertaking progressive rehabilitation with the aim of achieving a final landscape vision will be undertaken in accordance with the *HVO Conceptual Landscape and Rehabilitation Management Strategy*.

19.9 CONCLUSIONS

Landscape planning is undertaken recognising the intent of the Synoptic Plan and stakeholder expectations along with mine planning constraints and pre-mining land resources.

The cumulative effects of agriculture and mining have resulted in significant clearing of native vegetation and removal of habitat for native fauna. The planning process for final landform and land use also acknowledges the importance of providing land for sustainable agriculture in the future, therefore a balanced approach for rehabilitation has been proposed.

Of the additional 250 ha to be cleared, only 48 ha contains remnant vegetation. The rehabilitation planned will create native vegetation corridors that will be of greater value due to the increased regional vegetation connectivity.

In addition, 140 ha of existing remnant vegetation within the Archerfield Property will be made available to complement the proposed native vegetation corridors. These areas will be enhanced utilising recognised management practices.

20 SOCIO-ECONOMICS

The following chapter outlines the relevant socio-economic baseline characteristics for the Project Application area, identifies any potential changes to the social and economic environment resulting from the proposal.

20.1 INTRODUCTION

The existing social and economic impacts of HVO are relatively well understood. CNA's proposal will involve continued interaction with the local social and economic environment. The purpose of this assessment is to identify and assess the potential socio-economic impacts of the proposal in accordance with DGRs.

20.2 METHODOLOGY

The socio-economic assessment includes the review of the relevant baseline information for the local and regional communities, prediction and assessment of the likely effects of the proposal and identification of appropriate management strategies and programmes.

This chapter has been prepared using publicly available information sourced from SSC, CNA (*Annual Report* and *Social and Environment Report*), Australian Bureau of Statistics (ABS), various government agencies, research bodies and community representatives.

Previous studies and planning documents relating to community services, facilities, and employment in the area have been reviewed and referenced as appropriate. In particular, comprehensive socio-economic assessments have previously been prepared for the *CNA West Pit Extensions and Minor Modifications EIS (ERM, 2003)* and *Extension to Warkworth Mine (ERM, 2002)* providing detailed information on the impacts and benefits of mining on the local and regional community.

CNA has provided additional data on current and future proposed mine operations and employment levels.

The study area extends to the localities of Maison Dieu, Warkworth and Jerrys Plains. Information is also provided on the wider Singleton LGA and the Hunter Valley region (which equates to the Hunter Statistical Division (SD)).

Consultation with key stakeholders has been undertaken during the preparation of this Environmental Assessment Report and the process and issues raised are summarised in *Chapter 6*. In addition, existing management measures were reviewed to identify additional measures required as a result of this proposal.

This assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. Therefore the existing and potential environmental impacts are already approved and management measures have been developed and implemented. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. The assessment results are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been approved.

20.3 EXISTING ENVIRONMENT

To assess the potential direct and indirect impacts of this proposal a baseline is required by which future impacts can be measured. This section presents information on the existing social and economic characteristics of the area surrounding HVO South. The demographic and economic data that is considered to be relevant to this proposal includes:

- the population characteristics, including population growth trends;
- an economic profile of the region's main industries and markets;
- the employment baseline, including sectors, income and unemployment rates;
- community services and recreation; and
- community development.

20.3.1 Population Characteristics

The Singleton LGA, comprising Singleton, the larger villages of Broke, Bulga, Jerrys Plains and smaller communities of Warkworth and Maison Dieu, had a population of 20,384 people at the *2001 Census* and an estimated population of 21,193 in 2004 (ABS 2004). A minor increase in Singleton's population (1.2%) occurred between 1996 and 2001. This was several percent lower than the Hunter SD and the NSW average. The estimated population in Singleton increased by 4.5% between 1999 and 2004. Similar estimated population increases occurred across the Hunter SD and NSW. *Table 20.1* compares population growth in the Singleton LGA to the Hunter SD. It should be noted that at the time of this assessment, the 2006 census data was not available.

Table 20.1 ***Population Growth of the Singleton LGA Compared to Hunter Statistical Division and NSW 1996 to 2004***

	Persons 1996	Persons 1999 (ERP*)	Persons 2001	Persons 2004 (ERP*)	% Change 1996-2001	% Change 1999-2004
Singleton LGA	20,133	20,916	20,384	21,913	1.2	4.5
Hunter SD	540,491	574,141	563,587	604,240	4.1	5.0
NSW	6,038,696	6,411,370	6,371,745	6,731,295	5.6	4.8

Source - Singleton Demographic Profile 1998, ABS 2001 and ABS Estimated Resident Population (ERP) 2004*

(Note: it is not appropriate to calculate growth rates between census and ERP dates as data is not strictly comparable)

20.3.2 Economic Profile

The economy of Singleton LGA and the Hunter Valley is built around the mining, agriculture, power generation, tourism and defence industries.

Coal is the most common resource mined within the Hunter Valley. SSC identifies that 65% of the coal reserves that exist within the Upper Hunter are located within the LGA of Singleton. In the SSC 2006 draft strategic plan 'Singleton to 2030', 18 operational mines were identified, with an annual production of 75 Mt coal. SSC perceives that coal mining in the area will continue to have a strong presence beyond 2030, stating that "development consents have been granted for a new mine and several major mining extensions and it can be anticipated that further development applications shall be received for new mines and mining extension in the future" (SSC, 2006: 15). The plan states that "technological improvements in years to come may well mean that an opportunity will exist to mine over existing mining leases" and that the challenge for SSC and its community will be "to review these applications with the principles of sustainability in mind".

The public sector receives benefits from the coal industry through taxes, state owned enterprises and royalties. The Federal Government receives revenue in the form of taxes (company, sales and income tax from employees), and excise on fuel and imported equipment and goods.

The State Government holds an interest in rail freight and port charges and in some consumers of coal (electricity). The State Government collects payroll tax on the wages of employees and some royalties.

20.3.3 Employment Baseline

The mining industry is important to the local economy and employed 15.6% of Singleton LGA inhabitants in 2001. This proportion is significantly higher than across the Hunter SD where the sector employs 7.6% of inhabitants. Other areas of employment in the Singleton LGA include the retail sector (12.9%) and the manufacturing sector (8.0%). *Table 20.2* below details employment by industry sector for Singleton LGA compared against state averages.

Table 20.2 Employment by Industry Sector

Employment Sector	Percent of Workforce Employed Singleton LGA	Percent of Workforce Employed Hunter SD	Percent of Workforce Employed NSW
Agriculture, Forestry and Fishing	6.79%	3.01%	3.36%
Mining	15.56%	3.09%	0.54%
Manufacturing	8.02%	11.63%	11.50%
Electricity, Gas and Water Supply	2.81%	1.32%	0.74%
Construction	6.76%	7.48%	6.90%
Wholesale Trade	5.62%	4.69%	5.56%
Retail Trade	12.92%	16.61%	14.22%
Accommodation, Cafes and Restaurants	4.94%	5.50%	5.16%
Transport and Storage	3.31%	3.90%	4.58%
Communication Services	0.69%	1.19%	2.00%
Finance and Insurance	1.59%	2.52%	4.80%
Property and Business Services	6.97%	8.70%	12.16%
Government Administration and Defence	7.54%	4.47%	3.83%
Education	4.58%	7.29%	6.81%
Health and Community Services	5.98%	11.13%	9.41%
Cultural and Recreational Services	1.31%	1.81%	2.46%
Personal and Other Services	2.39%	3.52%	3.58%
Non-classifiable Economic Units	0.45%	0.39%	0.54%
Not Stated	1.77%	1.76%	1.84%

Source - ABS Census 2001.

The unemployment rate in Singleton (5.6%) at the time of the 2001 Census was lower than that of NSW (7.2%), and the Hunter SD (8.2%). The lower unemployment rate in Singleton may be accounted for by the prominence of mining and related businesses in the area.

According to the *2001 Census* (ABS 2001) 6,809 people were employed in mining in the Hunter, with the majority of this employment (4,099 persons, or 60%) occurring in the Lower Hunter, mainly in the Cessnock, Lake Macquarie, Muswellbrook and Singleton LGAs. Within the Hunter region's mining sector, 88% of employment in 2001 was in coal mining. In 2004, CNA directly employed approximately 2.7% of the Singleton population.

Presently, CNA's mining operations directly employ over 679 people at HVO. In addition to those personnel involved directly in the mining operations, more than 500 contract personnel are employed in the areas of electrical maintenance, mechanical maintenance, heritage, environmental, rehabilitation works, earthmoving, information technology support and cleaning. This supply chain spend is referred to as 'indirect' employment and encompasses contractors working for the mine and also those personnel working at firms supplying the mine and its contractors. The majority of these personnel are employed by local contractors from the surrounding townships.

Direct and indirect employees will spend a proportion of their wages in the local community on goods and services, including housing, food, clothes, leisure activities, transport and utilities. This spending in the Hunter Valley will support additional employment and is referred to as the 'income' or 'induced' employment effect.

From *Table 20.3* it can be seen that the majority of CNA employees (HVO, MTW and Bengalla operations) live in the Singleton, Cessnock, Maitland and Muswellbrook LGAs, reflecting the location of the mines and supporting the income profiles of these LGAs outlined above.

Table 20.3 CNA Workforce by Location

Local Government Area	Number of Employees	Percentage of Total Employees
Singleton	589	39
Muswellbrook	252	17
Scone, Murrurundi or Merriwa	38	2
Maitland and Dungog	268	18
Cessnock	241	16
Newcastle, Lake Macquarie or Port Stephens	84	6
• Based on CNA 2003 data.		

Income

Relatively high income earners were concentrated in Muswellbrook, Scone and Singleton in the Upper Hunter (2001 Census, ABS) and this finding is generally supported by income tax return data from the Australian Tax Office (www.ato.gov.au). In addition, in 2000-01, both average and median incomes in the Muswellbrook and Singleton LGAs were well above those for NSW as a whole despite annual wage and salary incomes being generally lower in the Hunter than in the State. Further, persons employed in the mining industry in the Hunter earned the second highest average weekly wage following persons employed in electricity, gas and water supply (ABS, unpublished data, 2004).

In the Hunter, the socio-economic index (indicating most advantaged areas with a relatively high proportion of people with high incomes or a skilled workforce) was determined by the ABS from data collected in the 2001 census, and was generally highest in Singleton. Singleton was the most advantaged of all LGAs in the Hunter in terms of economic resources.

20.3.4 Community Services and Recreation

Services are currently concentrated in the main centres of Muswellbrook and Singleton with no services available in Maison Dieu and Warkworth. There is a primary school, church, hotel, service station, community hall and café/bed and breakfast accommodation in Jerrys Plains.

Currently two recreation activities occur within the existing development consent boundary:

- the HVGC operates on privately owned land within the current development consent boundary. To enable mining to the south east of Riverview Pit, CNA must negotiate an acceptable proposition for the HVGC in order to acquire their land. These discussions have not concluded; and

- the Gun Club operates on CNA land located off Comleroi Rd within the current development consent boundary. The Gun Club is required to relocate. CNA have provided an alternative location and the Gun Club are currently relocating.

20.3.5 *Community Development*

CNA and other local mining companies have contributed significant funds to the local community through specific community development programmes, including the CNA Community Trust.

Since its establishment in 2000, the CNA Community Trust has made approximately $4.2 million in funding available to support a range of community projects to address challenges raised by the local community. Trust projects support initiatives in the areas of economic development, training, education, emergency services, employment, business development and environmental awareness and management across the shires of Cessnock, Maitland, Singleton, Muswellbrook and the Upper Hunter.

In mid-2005, the CNA Community Trust was extended for a three year period to mid-2008. The Community Trust projects are summarised in *Community Trust Annual Report*, CNA 2006.

In addition to the CNA Community Trust, CNA supports an extensive and diverse range of community programmes including:

- Hunter Valley Research Foundation; helping to sustain Australia's longest serving private, not-for-profit regional research centre to further increase knowledge and understanding of the Hunter region;

- Hunter Medical Research Institute; contributing to more than 350 researchers studying a range of health issues including cancer, cardiovascular health, pregnancy, asthma and mental health;

- Hunter Westpac Rescue Helicopter Service; helping to maintain a free 24 hour medical transport and search and rescue service for the Hunter region;

- site-based sponsorship and donations programmes, administered by employee representatives such as support for schools, events and fund-raising initiatives;

- naming-rights sponsorship of the CNA Newcastle Knights National Rugby League Football Club;

- the Aboriginal Development Consultative Committee (ADCC) was launched in 2006 to provide funding support of $500,000 per annum to support education; training and employment; Aboriginal business development; and heritage and culture preservation for the Aboriginal community of the Upper Hunter Valley; and

- Rivercare – including land management and stream improvement works from the Hunter River and Wollombi Brook confluence to the SSC's eastern boundary near Greta (a summary of works is provided in *Section 21.3.2*).

These and similar programmes will continue to be implemented throughout HVO.

20.4 IMPACT ASSESSMENT

The information provided in this chapter in relation to mining activities and economy is for HVO as a whole, including both HVO North data and HVO South, unless otherwise specified.

Potential changes that can result from new mining developments include:

- population increases resulting from construction and operations;
- modification to economic benefits to local and regional communities; and
- impacts on social amenity (social amenity issues such as noise and dust and potential changes resulting from the proposal are detailed in other chapters).

It is recognised that the highest proportion of coal mines in NSW occur in the Hunter Valley. The changes resulting from the proposal occur within an existing approved operation and, therefore, are not expected to dramatically change the existing socio-economic environment.

20.4.1 Population and Employment Implications

The approval of the extensions to HVO South will give the mine a 21 year time frame for mining activities from the date of approval, which will result in a further seven years production from the Cheshunt and Riverview Pits and nine years production from the South Lemington Pits. At the peak of operations, HVO is predicted to employ up to 829 people (including contractor equivalents), a possible increase of 150 people over current employment levels if market conditions are favourable (includes during construction and operation).

This increased operation will have further economic benefits to the local community through both ‘indirect’ and ‘induced’ employment by local procurement spend and the spending of employee salaries.

In the absence of consultation with local suppliers and detailed economic modelling it is difficult to be certain of the scale of supply chain and income employment effects. However, a 2001 World Bank study (*Large Mines and the Community)*, considering the indirect employment effects of mines, found that indirect employment ranged from 94% to 178% of direct employment. This study adopts a relatively conservative estimate of indirect employment at 100% of direct employment, ie a further 150 indirect employees. In line with the World Bank study an assumption has been made regarding the induced employment effect. Induced employment is estimated to be 165% of direct and indirect employment. This equates to 495 employees (165% of the additional 300 direct and indirect additional employees).

In total, therefore, given favourable market conditions, increased CNA operations in the Hunter Valley at HVO South are estimated to result in the employment of 795 individuals comprised of 150 through direct employment, 150 through indirect employment and 495 through induced employment. As detailed in *Chapter 15*, a survey of employees of HVO undertaken in 2003, found that approximately 80% travelled to work from major urban centres such as Singleton, Cessnock, Maitland and Newcastle and 20% from centres such as Muswellbrook and Scone. It is expected that additional jobs created would be filled by primarily residents within these localities. The creation of additional employment opportunities may also prevent people from leaving the region to look for opportunities elsewhere.

Population projections produced by SSC have suggested that the population of the Singleton LGA will grow by a further 23.7% between 2001 and 2021, to a total of 26,700 persons. This equates to an average growth rate of 1.1% per annum. The continuation of mining within the SSC is a contributing factor to this projected population growth.

As discussed, a large proportion of the jobs created are expected to be filled by people within the region. These residents may be currently unemployed, have an existing tenure that will be increased as a result of the project or working in other industries or for other companies. As such, the project is not expected to significantly impact on the long term population growth.

20.4.2 Economic Implications

Enhancing the economic position of HVO South and prolonging the life of the mine will result in continued economic benefits to the local and regional communities and State and Federal Governments, and extended employment for CNA employees.

The proposed mine extension will make a significant contribution to the economy at a local and national level. Approximately 21% of all revenue will be paid in the form of taxes and royalties.

Additional benefits to the government will result from a reduction in administration of multiple consents, reduced scope for future modification to the project approval and recovery of additional coal reserves.

Property Values

Another aspect of the economic impacts associated with the proposal is that ongoing mining operations may change the value of surrounding properties. This is an issue for all mining operations and may also result from changing local employment levels and population due to new mining projects or mine closures.

It should be noted that some neighbouring properties are located in the zone of affectation for HVO South (Wandewoi and Cheshunt) and this is predicted to continue under the proposed mine plan. However, in accordance with CNA's EMS, procedures have been developed to reduce potential impacts and address concerns raised by neighbours. If acquisition criteria are exceeded at residences within the zone of affectation and a written request for acquisition is received, CNA will enter discussions with the land holder in order to acquire the property.

Given the majority of the additional employment will be sourced from within the region, it is not expected that the availability of affordable housing will be significantly reduced or that there will be a significant impact on the availability of rental housing.

Given the long standing history of mining operations in the area the extension of mine life is not anticipated to significantly alter the existing structure of the economy. The distribution of economic activity in the study area is estimated to remain similar, with the mining sector providing the greatest proportion of employment and agriculture continuing to employ an above state average proportion of people, albeit less than the mining sector.

20.4.3 *Implications for Community Services and Development Programmes*

It is predicted that there will be sufficient capacity in the existing local services to accommodate the minor changes resulting from the proposal as most employees will be sourced/ commute from major urban centres including Singleton, Cessnock, Maitland and Newcastle.

CNA will work closely with the HVGC and to find an acceptable relocation option if agreed with the HVGC when discussions are concluded. CNA have provided an alternative location for the Gun Club.

Prolonging the life of the mine also means that CNA will have continued opportunity to identify and support suitable community development programmes.

20.5 MANAGEMENT MEASURES

CNA will continue to implement current management programmes that contribute to the social and economic aspects of the local community. These include community development and consultation programmes as described above and in particular the CNA Community Trust and ADCC.

20.6 CONCLUSIONS

The integration and extension of HVO South will ensure that mining operations will continue until at least 2028. This additional resource will ultimately provide a benefit to the local and regional community and economy by:

- ensuring ongoing employment in the mining sector across HVO;
- increasing employment by 795 individuals through direct, indirect and induced employment effects;
- additional sales revenue and royalties; and
- significant flow-on effects into the regional, state and national economy.

Throughout its operations CNA will continue to develop relationships with the local community, as seen through the HVO CCC and by proactive management of complaints. The involvement and consultation with the community has also been evident through the various information sessions, meetings with residents and school site tours (*Chapter 6*). Programmes such as the CNA Community Trust, sponsorships, donations and the ADCC have provided support to the local community. The proposal will ensure that these efforts continue, and that the community continue to benefit from the operations of the mine.

The direct economic benefits of HVO South and the flow on effects into the local, regional and national economies are significant. The continued operation of the mine is important to the ongoing economic development of the region.

Coal & Allied Operations Pty Ltd

Hunter Valley Operations South Coal Project

Environmental Assessment Report
Part D - Conclusions

21 COAL & ALLIED COMPANY PERFORMANCE

As the proposal involves extensions to mining within an existing operation, this chapter provides an overview of CNA's performance, in particular background information on CNA's commitment to continuous improvement along with information on environmental improvement and research programmes currently in place.

21.1 INTRODUCTION

CNA has a vision to create a safe, highly successful coal business that is valued by employees, the community, customers and shareholders. By working closely with community groups in the Hunter Valley, CNA hopes to understand the key values and interactions to promote a positive, sustainable future.

CNA has also made strategic commitments through its Health, Safety and Environment Policy. These commitments include setting high standards to continue to improve performance with goals to minimise injuries, occupational related diseases and environmental incidents.

In particular, the environmental objectives include working towards reducing the overall footprint of the operations, planning for closure, recognising biodiversity and understanding the community's environmental values.

A number of environmental improvement and research programmes are undertaken by the company to achieve these goals.

21.2 OPERATIONAL PERFORMANCE

The following section outlines CNA's operational performance in terms of compliance against relevant standards and regulatory requirements and EMS monitoring and management.

21.2.1 Compliance against Standards and Regulatory Requirements

CNA undertakes or is subject to a variety of audits where performance is measured against internal Rio Tinto Standards, ISO14001 (ISO14001 prescribes internationally recognised standards for environmental management) and regulatory requirements. These audits include:

- regular internal environmental audits which cover specific components of the operations;
- periodic external surveillance audits of the EMS to verify that it complies with ISO14001;
- internal compliance reviews; and
- regulatory audits as specified in various regulations, consents and licences.

21.2.2 EMS, MONITORING AND MANAGEMENT

For RTCA, environmental management starts with the RTCA Health, Safety and Environment Policy. This policy statement commits to using resources efficiently and minimising impacts on the environment in all stages of the mining process. The practical implementation of this policy is achieved by environmental management systems.

CNA have developed an EMS in accordance with ISO14001 for all CNA's operational mine sites. The EMS is designed to cover all of CNA's existing operations, new projects, closed sites and surrounding properties and allows CNA to:

- efficiently manage its environmental issues;
- ensure compliance with regulatory requirements;
- continually improve its environmental performance; and
- satisfy the expectations of stakeholders and the local community.

Sound environmental management ensures appropriate systems, processes and procedures are in place to protect the natural environment.

The EMS includes procedures (listed in *Table 21.1*) that must be implemented where relevant for all CNA activities. These procedures are discussed in the relevant chapters.

Table 21.1 CNA EMS Procedures

Procedure Name
Environmental Management System
Environmental, Social and Cultural Impact Management
Property Management
Closure Planning
Rehabilitation
Waste Management
Water Management
Air Quality Management
Noise and Vibration Control
Land Management
Greenhouse Minimisation
Acid Mine Drainage
Site Contamination Prevention and Control
• Procedure sub topics not shown.

Environmental management and monitoring measures are outlined in environmental assessments undertaken for previous activities and consent conditions relating to these assessments. As required by development consent conditions, management plans have been prepared for certain environmental aspects taking into account potential impacts previously identified in environmental assessments and incorporating relevant legislation, policies and standards. These plans are reviewed and updated every five years or more frequently as required. *Table 21.2* lists current management plans.

Table 21.2 Current Management Plans

Management Plan	**Area where Applicable**
Archaeology and Cultural Heritage	HVO
Blast and Vibration	HVO
Bushfire	All CNA operations
Dust/ Air Quality	HVO
Erosion and Sediment Control	All CNA operations
Land	HVO
Landscape	HVO
Water and/or Mine Dewatering	HVO
Noise	HVO
Soil Stripping	HVO
Road Closure	HVO
Alluvial Lands	HVO
Non-mine Waste	All CNA operations

This environmental assessment has provided the opportunity to modify and update management plans to reflect changes resulting from the proposal and provide for a more ‘user friendly’ format that will aid implementation.

Table 21.3 lists proposed management plans and associated CNA procedures. Management plans have been split into categories. Categories are generally comprised of management plans relating to a specific environmental aspect. These plans are in various stages of preparation.

Where applicable, management plans have been referred to throughout this Environmental Assessment Report.

Table 21.3 Proposed Management Plans and Associated CNA Procedures

Management Aspect (or Management Categories)	Management Documents	CNA Procedures
Land Management	Aboriginal Heritage Management Plan (site specific)	Cultural Heritage Management
	Historic Heritage Management Plan	
	HVO Landscape and Rehabilitation Management Strategy (including visual screening)	Rehabilitation
	Final Void Management Plan	Closure Planning Guidelines
	Flora and Fauna Management Plan	Flora and Fauna
	Weeds and Feral Animals Management Plan	
	Mineral Waste Management Plan (overburden, coarse and fine rejects)	Coarse Rejects and Tailings Disposal
	Acid Rock Drainage Management Plan	Acid Mine Drainage Prevention and Control
	Hazardous Materials Management Plan	Site Contamination Prevention and Control
	Bushfire Management Plan	
	Erosion and Sediment Control Management Plan	
	Subsidence Management Plan	
	Topsoil Stripping and Stockpiling Management Plan	
Water Management	Water Management Manual including: • Surface Water Management Plan (including levee plan) • Groundwater Management Plan • Rivercare Management Plan	Water Management Water Discharge

Management Aspect (or Management Categories)	Management Documents	CNA Procedures
Social Amenity Management	Noise Management Plan	Noise
	Blast and Vibration Management Plan;	Blasting
	Non-mineral Waste Management Plan	Waste Management
	Air Quality Management Plan;	Dust Management
		Spontaneous Combustion
	Greenhouse Gas and Energy Management Plan	Visual Management
	Road Closure Management Plan	

Monitoring programmes have been developed for each of CNA's operations where required by consent conditions for specific environmental impacts. Each programme has been developed in consultation with relevant stakeholders to achieve compliance with the relevant consent criteria in a way that prevents and/or minimises the environmental impact generated by the development.

HVO has an extensive network of monitoring instruments and weather stations which test and record parameters including current air temperature, rainfall, wind speed and direction, dust, ground vibration and noise levels. In addition, specialist personnel conduct a regular schedule of water quality testing, inspecting infrastructure and equipment for leaks or spills, monitoring earthworks, conducting flora and fauna surveys and assessing rehabilitation work.

The environmental management and monitoring programmes and a concerted effort to continually improve performance are essential to ensure noise, vibration and dust are minimised, comply with regulatory limits and are acceptable to the surrounding communities.

21.3 ENVIRONMENTAL IMPROVEMENT

The following section provides an overview of current CNA research and development, Climate Change and Rivercare programmes, and outlines CNA's approach to recycling and waste management.

21.3.1 RESEARCH AND DEVELOPMENT

RTCA, as part of Rio Tinto Energy, is supporting the research and development of new technologies through direct spending and within the Australian Coal Association Research Programme (ACARP), and the Australian Coal Association's COAL21 programme. The COAL21 programme promises to align efforts of coal producers, generators, and researchers in an Australian national programme for zero emissions from electricity generation.

CNA facilitates a number of research initiatives across its business. The research activity is coordinated at a corporate level by the Environmental Services Department. Current research programmes are listed in *Table 21.4*.

Table 21.4 CNA Research Initiatives

Research Programme	Overview
Commercial Forestry Trials	In 2001, CNA and NSW State Forests received ACARP funding to research the viability of commercial forestry on mine rehabilitated land and low quality buffer lands adjoining the mines. Timber production is being closely monitored over a five-year period.
Native Grass, Tree Seed and Fertilizer Substitute Trial	Native seed trials were separately established in October 2003 at CNA's Riverview Pit and Warkworth Mine. Results of the study will provide specific guidance on the practical use of native grasses, the use of an alternative native tree seed mix and the effect of a fertilizer substitute on weed and tree establishment. This study is ongoing.
Hydrocarbon Degradation – Phytoremediation Trial	Phytoremediation is currently being explored as a treatment method for small volumes of petroleum contaminated soil. Phytoremediation raises no significant risks to human health, groundwater or the surrounding environment.
Meteorological Data Measurement and Assessment	CNA is supporting an ACARP research project studying the use of acoustic sounding equipment and modelling techniques to predict airblast overpressure prior to blasting. This study will run over a two year period and will involve joint funding from a large number of mines in the Hunter Valley. The system became operational in Q3 2006 and is ongoing.
Blast Vibration Studies	CNA operates its opencut mines close to residential areas at Bulga Village, Warkworth Village and a number of rural residences adjacent to its Mining Leases. The community has raised concerns over the effects of ground vibration from large production blasts and CNA has responded to these concerns by carrying out a range of blasting trials over the last few years.

Research Programme	Overview
Contribution of Mining Emissions to NO_2 and PM_{10} in the Upper Hunter	CNA directly supported ACARP Project C12027, *Contribution of Mining Emissions to NO_2 and PM_{10} in the Upper Hunter Region*. The fieldwork for this project was based at a CNA study site adjacent to HVO in an area where mining is a major land use. The field studies collected data on atmospheric structure using LIDAR (Light Detection and Ranging) techniques and additional detailed data was collected to establish the characteristics of particulate matter emitted from opencut mining operations. Sections 1, 2 and 3 of the report were published by ACARP during 2005. Section 4, which covers modelling of PM_{10} and NO_x dispersion, was published in 2006. In addition to research activity carried out directly on CNA sites, CNA actively supports the supervision and administration of other ACARP research carried out on behalf of the coal sector. Currently, CNA acts as industry monitor for a further three air quality projects in the Hunter Valley: • C13036 Characterising Fine Particle Concentrations in the Hunter Valley; • C15042 Assessing Fine Particle Concentrations in the Hunter Valley; and • C14054 NO_x Emissions from Blasting in Opencut Operations.
Development of Meteorological Prediction System	CNA is a sponsor, with other companies, of a research programme to develop a meteorological prediction system that will provide detailed weather forecasts for the Hunter Valley. The research is being undertaken within the ACARP with special funds being provided by a consortium of coal mining companies in the Hunter Valley to purchase an acoustic sounder and radio acoustic sounding system (RASS). The acoustic sounder and RASS will provide detailed temperature and wind profiles in the vertical up to a height of approximately 1 km at a site located on CNA land near the Carrington Pit (within HVO North). Data from this system and from the other network of meteorological monitors in the Hunter Valley will be used with the MM5 medium scale meteorological model to refine standard Bureau of Meteorology forecasts to take account of detailed terrain, land use and particular conditions that apply in the Hunter Valley. The objective of the system is to provide mining companies with detailed information on wind and temperature conditions, as they are likely to develop in the short-term, over a six to 12-hour time frame. The forecast data will extend to heights of up to 1 km (approximately) and will provide mine operators with valuable data on the likely transport of dust from blasting and surface sources. It will also assist in the better management of blast overpressure and noise because it will provide information on inversion strengths and the expected break up times of inversions.

21.3.2 *RIVERCARE*

CNA own a total of approximately 37 km of Hunter River frontage in the mid to upper Hunter Region (comprising 9 km double river frontage and 19 km single river frontage). A further 11 km of major tributary frontage is owned by CNA along the Wollombi Brook in the mid to upper Hunter Region (comprising 5 km double brook frontage and 700 m single brook frontage).

A Community Enhancement Contribution was required as a condition of the West Pit consent. This condition required $30,000 to be paid to Council for stream and water quality improvement works in the Hunter River or its tributaries.

In 2005 following the CNA fund contribution, the SSC engaged a land management group to develop a Rivercare Plan from the Hunter River and Wollombi Brook confluence to Council's Eastern boundary near Greta. The plan aims to identify issues related to the River including erosion, native vegetation and weeds. The plan will be able to be used by landholders to obtain substantial funding through the Australian Government Envirofund and Hunter-Central Rivers Catchment Management Authority (CMA) for on ground works such as the removal of rubbish, fencing, removal of environmental weeds and native tree planting.

Additionally, CNA provided funds of $302,904 in 2003 to establish a three year River Paramedics Programme in conjunction with Conservation Volunteers Australia (CVA), Landcare, CMA, DWE, DoP and local landholders. The programme aims to help restore the degraded Hunter River System by planting native trees, eradicating weeds and fencing areas to manage stock.

Another three year term of the River Paramedics Programme commenced in 2006. The programme includes conservation work, workshops for community groups and training of community volunteers. The value of this programme is approximately $316,000.

A project involving the Australian Museum will support research being undertaken on riverbank restoration and rehabilitation across the Upper Hunter. 'Bugwise: Biodiversity Extension in the Hunter Valley' aims to establish new methods and tools to help non-scientists measure invertebrate biodiversity. Ecologists at the Museum are establishing a Bugwise Resource Kit, to include hard copy manuals, a web site and interactive guides that will allow easy identification of insects and other invertebrates. A total of $88,000 has been dedicated to this project from the CNA Community Trust.

Since 2003, a total of $736,904 has been dedicated to the Rivercare works, implementation of Rivercare Plans and 'Bugwise' biodiversity project.

21.3.3 *RECYCLING AND WASTE MANAGEMENT*

As discussed in *Chapter 16*, CNA's MTW and HVO have created the Total Waste Management System for recycling and waste management which includes reporting and tracking of waste products, as well as committing to improve practices for recycling and collection.

In 2005, over 75% of waste was recycled and in the two year period to 2005 the amount of waste directed to land fill was almost halved.

Several other mining companies and large organisations within the Hunter Valley region have implemented waste management systems based on the CNA system and have experienced similar positive results.

The system was entered in the 2005 Hunter Central Rivers Coal Industry Environmental Awards where it received a Highly Commended award.

21.4 COMMUNITY RELATIONS

CNA's community relations programme involves:

- communicating information about operational activities, future developments and mine life planning;
- consulting, so as to understand community issues and expectations and avoid, manage or mitigate negative impacts;
- supporting community development programmes which address community needs and leave a sustainable social legacy; and
- building relationships with stakeholders based on mutual respect, active partnership and long term commitment.

Chapters 6 and *20* provide more detail on the stakeholder consultation process and socio-economic outcomes.

Since being established, the CNA Community Trust has provided funding to support environmental, employment, training and business development initiatives. Further details on the community trust are provided in *Section 20.3.5*.

RTCA also makes donations corporately, and supports diverse projects such as Opera Queensland's Young Artist programme and the OPTI-Minds Challenge workshop. In 2005, RTCA donated $15,000 to the Salvation Army in lieu of sending Christmas cards. Presentations were made to Salvation Army representatives at Singleton, Mackay, the Central Highlands, Kingaroy and Brisbane during December, 2006.

21.5 REPORTING

CNA prepare an AEMR for each of its operations (as required by development consent conditions and under the *Mining Act 1992*). The AEMR compiles monitoring results and discusses trends, system changes and responses to any potential issues identified throughout monitoring. Targets for future initiatives are also identified.

The AEMR is distributed to the DPI-MR, DoP, DWE, DECC, SSC, MSC, HVO CCC, and the NSW Rural Fire Service.

The CNA website and Annual Sustainability Report describes in detail the social and economic initiatives undertaken by the company. The annual reports are made publicly available following publication either directly from CNA or on the CNA website.

Other reporting requirements include contribution to the Rio Tinto Annual Social and Environmental Report and quarterly reporting of monitoring results (via the CNA near neighbour Environmental Newsletter distributed to the local community).

Mine personnel report on mine operations to the CCC quarterly (see *Section 6.5.2*).

21.6 CONCLUSIONS

CNA is committed to sustainable development and improving company performance. This is evident by the internal policies and procedures to which all business units must comply. CNA is subject to a rigorous auditing process which measures compliance against Rio Tinto Standards, operational components, CNA EMS procedures and regulatory requirements. This ensures full transparency and provides a means of quantifying environmental improvement. In addition, the company proactively seeks opportunities for environmental improvement through research and development.

22 STATEMENT OF COMMITMENTS

The following Statement of Commitments has been prepared in accordance with the DGRs and Part 3A of the *EP&A Act.* These commitments outline the management, mitigation and monitoring measures to be adhered to by CNA throughout the development and operation of the proposed HVO South Coal Project to manage potential environmental impacts arising from the proposal.

Management of activities occurring at HVO is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle. The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The recommended management measures from each of the technical reports include a number of control measures to minimise the potential impacts resulting from the proposal. These measures have been considered in the context of the existing HVO activities and the CNA EMS. Many of these measures are already in place as part of existing controls for the HVO South activities, and will continue to be implemented across HVO South to minimise the potential impacts resulting from the proposal.

This Statement of Commitments details those controls that are considered specific to the proposal.

22.1 GENERAL

CNA will:

- carry out the proposal generally in accordance with the systems, plans and mitigation measures identified throughout this Environmental Assessment Report;

- bring any matters that arise and require further assessment by the Director General to the Director General's attention and will comply with all requirements received; and

- obtain and maintain all permits, licences and approvals required throughout the life of the project that are not incorporated into the Part 3A Project Approval. This Statement of Commitments does not replace any obligations CNA has under these statutory requirements.

All works will be undertaken in accordance with the relevant Australian Standards where these standards do not conflict with specific legislative or safety requirements.

Standards may include but not be restricted to the latest versions of:

- *AS 2601-2001: The Demolition of Structures; and*

- *AS1940 - The Storage and Handling of Flammable and Combustible Liquids.*

22.2 ENVIRONMENTAL MANAGEMENT SYSTEMS

The CNA EMS has been developed and implemented in accordance with ISO14001.

This EMS will continue to be applied to the activities undertaken as part of the HVO South Coal Project.

22.3 MANAGEMENT MEASURES

22.3.1 Community Consultation

The existing consultation programmes will continue to be undertaken to ensure any specific outcomes from the environmental assessment are included into the relevant programmes as required.

The community consultation specific to the proposal will continue throughout the project, from submission through to government decision and implementation of commitments. Ongoing communication techniques utilised by CNA (*Table 6.1*) will be implemented as appropriate.

22.3.2 Noise

In addition to the mitigation measures undertaken at HVO for noise, the following controls specific to the proposal will be implemented:

- equipment operation within South Lemington Pit 1 and associated truck movements will cease during night time operations if monitoring identifies unacceptable noise impacts will result from south westerly winds (occurring at or above 2.1 m/s). At lower wind speeds, real-time noise and/or weather monitoring will be used to guide modifications to operations as required.

- noise limits that will apply to the proposal are detailed in *Table 22.1*.

Table 22.1 Noise Limits Applicable to Proposal, dB(A)

No.	Location	Day Limits	Evening Limits	Night Limits	
		$L_{Aeq(15 min)}$	$L_{Aeq(15 min)}$	$L_{Aeq (15 min)}$	$L_{1(1 min)}$
3	Elisnore	38	38	38	45
4	Muller	38	38	38	45
5	Bowman	39	39	41	46
7	Stapleton[1]	N/A	N/A	N/A	45
8	Holz (Oaklands)[2]	N/A	N/A	N/A	45
10	Moses (Wandewoi)[1]	N/A	N/A	N/A	45
13	Jerrys Plains Centre	38	38	38	45
16	Algie	39	39	42	46
17	Algie	39	39	40	46
19	Birralee Feeds Pty Ltd	38	38	38	45
23	Hawkes [1] (Springwood)	N/A	N/A	N/A	46
24	Clifton & Edwards	39	39	39	46
31	Cooper (Kilburnie)	39	39	39	49
32	Algie (Curlewis)	39	39	42	46
33	Edward & Haynes[2]	N/A	N/A	N/A	46
34	Ernst	39	39	40	46
36	Garland	38	38	38	45
38	Henderson[1]	N/A	N/A	N/A	46
43	Kannar[2]	N/A	N/A	N/A	46
45	Kelly[1]	N/A	N/A	N/A	46
47	Moxey	39	39	41	46
61	Shearer	39	39	41	46

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General:

- Daytime (between 7am and 6pm); evening (between 6pm and 10pm); and night time (between 10pm and 7am).
- The noise emission limits above apply for winds up to 3 m/s (at a height of 10 m) and temperature gradients up to 4 degrees Celsius per 100 m.
- If there is a valid private amenity agreement with any property owners these criteria may be exceeded.
- Maison Dieu assessment locations are No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village assessment locations are No's 23, 33, 38, 43 and 45 and Jerrys Plains assessment locations are No's 3, 4, 13, 19, 31 and 36. Isolated assessment locations are No's 7, 8 and 10.
- Location No. is consistent with the HVO West Pit consent (DA 450-10-2003).

22.3.3 *Blast and Vibration*

In addition to the mitigation measures undertaken at HVO for blast and vibration management, blasts will be designed to minimise impacts on neighbouring mine ventilation structures and minimise the potential for fracture development along pit walls to assist with pit wall stability:

- blast vibration will be managed through design and modelling;
- bench heights will be managed to not significantly exceed 15 m;
- no throw blasts will take place adjacent to final walls;
- high density explosives will be toe loaded;
- blast monitoring and post blast analysis will be undertaken where required;
- presplit blasting will be implemented on final walls where this indicates improved wall conditions; and
- visual monitoring by way of regular highwall and pit inspections will be undertaken.

22.3.4 *Air Quality*

In addition to the mitigation measures undertaken at HVO for air quality management, efficient mine planning and operations will ensure:

- the mine plan is regularly reviewed with a view to controlling dust emissions and keeping emissions to the lowest levels practicable;
- exposed areas are kept to the minimum practicable; and
- haul roads are kept to the shortest routes practicable and material handling is kept to the minimum levels practicable.

22.3.5 *Groundwater*

In addition to the mitigation measures undertaken at HVO for groundwater management, the following controls specific to the proposal will be implemented:

Groundwater Flow To and From Rivers:

- development of protocols for monitoring and reporting of DWE stream gauge results to clearly record any reductions in flows that are attributed to mining. This will include monitoring Hunter River flows immediately up gradient and down gradient of the site. In addition, consideration will be given to tying in specific CNA water level recordings with current DWE gauging locations;
- monitoring of groundwater elevations within alluvium between the Hunter River and the Cheshunt Pit; and
- measured groundwater elevations and river flow will be assessed against predictions to determine whether application of additional management measures is required; and
- offset seepage to pits in accordance with regulatory requirements.

Regional Groundwater Drawdown:

- the HVO *River Red Gum Rehabilitation and Restoration Strategy* and CNA EMS procedure for Flora and Fauna will be updated to reflect changes resulting from the proposal. This will include monitoring the health of the River Red Gums located on the Hunter River and Wollombi Brook alluvium as identified in *Chapter 11* (*Figure 11.2*). The monitoring programme will include details on frequency of monitoring, reporting and corrective actions; and

- up to three monitoring wells will be installed in the proximity of the cluster of registered DWE bores located to the east of the LCPP (*Figure 25 Annex J*). Data will be used to compare actual versus predicted impacts. Deviations away from predicted impacts will be assessed, and if predictions are exceeded, management measures will be implemented.

Alluvial Buffer Zone:

- a buffer zone of 100 m will be retained from the Cheshunt Pit highwall to the edge of alluvium of the Hunter River;

- a buffer zone of 150 m will be retained from the South Lemington Pit 2 highwall to the edge of alluvium of the Wollombi Brook;

- bores will be installed to further delineate the saturated zone between the Hunter River and the Cheshunt Pit before mining commences within this area; and
- the groundwater component of the HVO Water Management Manual will include procedures for monitoring potential impacts, including accurately measuring seepage to pits throughout mining and assessment of proximity to alluvials as mining approaches.

Deep Cheshunt Pit Final Void:

- the Deep Cheshunt Pit final void will be designed to intercept leachate from overburden emplacements and minimise discharge of saline groundwater. Deep Cheshunt Pit final void design will be reviewed at least three years prior to anticipated mine closure;
- the Deep Cheshunt Pit Final Void Management Plan will include future use options including investigation of feasibility to use the Deep Cheshunt Pit final void as a water storage that could be used as a buffer in times of flood flows in the Hunter River and as a supplementary water supply at times of scarce water supply. This would include additional investigations to refine predictions of final void water chemistry;
- a post closure monitoring programme will be developed as part of the Deep Cheshunt Pit Final Void Management Plan for water quality monitoring of the final void; and
- the mine plan will be further reviewed with a view to minimise the area of the Deep Cheshunt Pit final void as much as practicable.

22.3.6 *Surface Water*

In addition to the mitigation measures undertaken at HVO for surface water management, the following controls specific to the proposal will be implemented.

Water Supply:

- modify Water Access Licences, review conditions and report on water use in the AEMR;

- monitor and record abstraction quantities; and

- increase pump capacity from Dam 20S (or alternative storage) to the LCPP and undertake minor improvements to the existing HVO South water system in conjunction with the design of the LCPP to minimise need to pump from Hunter *River Water Discharge:*

- review current discharge conditions in respect of the proposal and incorporate where applicable into the Water Management Manual.

Flood Mitigation:

- construct South Lemington Pit 2 Levee SLL2 as a permanent levee and ensure the outer face of the levee will withstand 100-year ARI flood flow velocities; and
- assess Hobden Gully levee (CL1) prior to mine closure to determine if protection of the Deep Cheshunt Pit final void is required.

Erosion and Sediment Control:

- erosion and sediment control structures will remain in place to divert water away from the Deep Cheshunt Pit final void unless required for use as flood flow storage.

Monitoring and Inspections:

- prior to LCPP and infrastructure construction works review the Surface Water Monitoring Programme, establish additional representative monitoring sites where required and undertake monitoring; and
- annual monitoring of water level and water quality in the Deep Cheshunt Pit final void after mining operations have ceased as part of the post closure monitoring programme. Monitoring will continue in accordance with regulatory requirements.

22.3.7 *Ecology*

In addition to the mitigation measures undertaken at HVO for management of flora and fauna, the following controls specific to the proposal will be implemented:

- the River Red Gum Rehabilitation and Restoration Strategy prepared by CNA will be updated to include the stands along the Hunter River and Wollombi Brook, will include collection and storage of seed from existing stands, and will ensure the health of these River Red Gums is periodically monitored;

- studies will be undertaken to investigate the preferred water source of River Red Gums and develop appropriate management measures;

- areas identified with sand profile will be included in the Warkworth Green Offsets research programme;

- the Coast Banksias will be assessed and fenced to exclude stock and provide for enhancement opportunities;

- rehabilitation planning will identify opportunities to create similar ecological characteristics (such as habitat types) of proposed extension areas;

- remnant vegetation areas not required to be disturbed by the proposal will be managed to ensure security of flora and fauna habitat in the future; and

- the Warkworth and Wambo Green Offset areas and the Hunter Valley Synoptic Plan will be considered with rehabilitation planning to enhance linkage where practical.

22.3.8 Aboriginal Heritage

In addition to the mitigation measures undertaken at HVO for management of Aboriginal heritage, the following controls specific to the proposal will be implemented as agreed with the Aboriginal Working Group.

Management Measures for ACHMP HVO South Stage 1 include:

- all management measures will be undertaken in accordance with the Aboriginal Heritage Assessment as outlined in the ACHMP;

- if at a later date it is found necessary to undertake an action that would impact sites described within the Aboriginal cultural heritage assessment, additional and specific management recommendations may be implemented in consultation with the Working Group;

- provision is to be made for the management of collected cultural heritage material;

- provision will be made in the ACHMP for the Working Group to undertake an independent compliance audit of the management programme on a six monthly basis. In the event that any non-compliant activities are identified at any time, an additional compliance audit may be undertaken as part of the investigation process;

- where any mitigation is required it will be undertaken by representatives of the Working Group and suitably qualified technical advisers;

- implement a management programme providing for the controlled collection of the following sites where site avoidance is not possible. Until management measures (which may involve the collection of cultural material) have been implemented, mine-related impacts to the sites will be prevented:

  - Riverview South West Mining Extension Area Sites 1-24

  - South Lemington Pit 1 Mining Extension Area Sites 59-79

  - Proposed rail spur and loop easement Sites 80-83

  - LCPP Sites 101 and 105-106

- the alignment of the proposed rail spur and loop have been amended to avoid impacts to Sites 26-44, 47-58 and 107-109;

- restricted access zones will be defined for Sites 26-44, 47-58, 84-100, 102-104 and 107-109. The boundaries (*Figure 12.3*) are indicative only; and

- land management activities on the Archerfield property will avoid any impacts to Site 25.

Management measures to be implemented in accordance with the agreed ACHMP for HVO South Stage 2.

22.3.9 Historic Heritage

In addition to the mitigation measures undertaken at HVO for management of historic heritage, the following action specific to the proposal will be implemented:

- a targeted field assessment will be undertaken by an historic heritage professional where required to supplement existing information to report on the relative significance of the additional sites identified on CNA land including a derelict bridge structure over an unnamed ephemeral creek and the cockatoo fence and recommend additional management measures.

22.3.10 Visual

In addition to the mitigation measures undertaken at HVO for management of visual amenity, the following action specific to the proposal will be implemented:

- a review of the extension areas that adjoin Jerrys Plains Road and the proposed rail spur and loop easement will be undertaken prior to construction of the rail spur and loop, to determine if additional screening is required.

22.3.11 Traffic and Transport

In addition to the mitigation measures undertaken at HVO for management of traffic and transport, the following action specific to the proposal will be implemented:

- ensure the relocation of Comleroi Road and construction of the rail loop are undertaken in accordance with the relevant regulatory requirements; and

- obtain the appropriate approvals, including those required for heavy equipment transfer; and

- ensure relevant stakeholders are consulted as required.

22.3.12 Waste Management

There are no suggested controls for waste management specific to the proposal. It is anticipated the mitigation measures currently implemented at HVO will be sufficient to manage the increase in waste resulting from the proposal.

22.3.13 *Energy Management Activities*

In addition to the mitigation measures currently implemented the mine plan will be regularly reviewed with a view to keeping emissions to the lowest levels practicable. Haul roads will be kept to the shortest routes practicable and material rehandling will be kept to the minimum levels practicable. Most of these measures are routinely applied as part of the efficient design of the mine.

22.3.14 *Land Management*

There are no suggested controls for land management that are specific to the proposal. The current mitigation measures implemented at HVO are anticipated to be sufficient to manage any potential impacts from the proposal on land use.

22.3.15 *Mine Landscape Planning*

In addition to the mitigation measures undertaken at HVO for management of landscape planning, the following actions specific to the proposal will be implemented:

- General environmental land management practices implemented on all CNA owned land will be applied to the Archerfield Property along with planned rehabilitation areas.

- Remnant vegetation located within the Project Application area and outside proposed disturbance areas will be protected and enhanced to improve the ecological value and biodiversity. In particular, the specific management practices will include:

  - monitoring of remnant vegetation areas in accordance with existing procedures to provide evidence of success of management practices;

  - undertaking bushfire management, weed and pest control in accordance with recommended practices;

  - utilising local native species for seed stock where practical;

  - utilising existing farm dams and retention or establishment of native vegetation around dams to provide habitat; and

  - habitat creation and enhancement for common and threatened species.

- The vegetation on the Archerfield Property will require specific management practices to protect and enhance the ecological value and improve the biodiversity. In particular, the specific management practices will include:
  - monitoring of remnant vegetation areas in accordance with existing procedures to provide evidence of success of management practices;
  - undertaking bushfire management, weed and pest control in accordance with recommended practices
  - maintenance and enhancement of native grasses, wherever possible;
  - utilising local native species for seed stock where practical;
  - utilising existing farm dams and retention or establishment of native vegetation around dams to provide habitat;
  - habitat creation and enhancement for common and threatened species; and
  - fencing of remnant vegetation to restrict stock access where practical.
- Options for securing the 140 ha of vegetation on the Archerfield Property will be investigated and a suitable mechanism will be implemented to ensure protection and enhancement of the biodiversity during the life of the project. Due to proximity of the Archerfield Property to coal resources and operations, it is considered inappropriate as a biobank site under the draft NSW Threatened Species Conservation (Biodiversity Banking) Regulation 2007 (DECC). An alternative measure will need to be identified to secure the site for the duration of the development.
- A Final Void Management Plan will be prepared for the Deep Cheshunt Pit final void at least five years prior to completion of mining and will include:
  - identification of possible beneficial uses for the void;
  - consideration of technologies which will assist to enhance the range of possible uses;
  - review of modelling and predictions of long term hydrological behaviour and water quality responses, including final void water quality and level;
  - long term integrity of void slopes;
  - waste characterisation and containment as pertains to runoff into final voids;
  - coal seam capping; and
  - long term management, monitoring and mitigation measures.
- Mining in South Lemington Pits will be incorporated into a revised MOP for HVO South, which will supersede all previous MOPs for this area. The management commitments for South Lemington Pit 1 will include highwall stability monitoring, water storage management, minimisation of visual impacts and management of dust emissions and erosion.

The process for designing the landforms across HVO and undertaking progressive rehabilitation with the aim of achieving a final landscape vision will be undertaken in accordance with the *HVO Conceptual Landscape and Rehabilitation Management Strategy*.

23 ECOLOGICALLY SUSTAINABLE DEVELOPMENT AND CONCLUSIONS

This chapter provides a conclusion justifying the project, taking into consideration the environmental impacts of the project, the suitability of the site, and the benefits of the project. It also assesses the preferred proposal against the principles of ecologically sustainable development.

23.1 INTRODUCTION

Rio Tinto has made a strategic commitment to sustainable development with a policy that states "Rio Tinto's businesses, projects, operations and products should contribute constructively to the global transition to sustainable development". Supporting this is a set of internal policies to which all businesses must conform even if local requirements are less exacting. These policies are part of the corporate governance machinery and are therefore subject to a rigorous assurance process. Independently verified external reporting at both site and corporate levels aims to ensure that performance is understood and continually improved.

Examples of how CNA is contributing to each of the three 'pillars' of sustainable development include:

- People – the CNA Community Trust was relaunched in 2005, offering $3 million for the next three years to projects in the Upper Hunter aimed at enhancing the economic base of the region, creating social and educational opportunities and increasing the quality of the environment;

- Planet – all CNA operations have an EMS developed in accordance with ISO14001. CNA has an excellent record in the development and implementation of sound environmental management practices across HVO, operating in an environmentally responsible and transparent manner. These practices are inherent across all aspects of CNA's business; and

- Prosperity – In many ways CNA's reputation and ability to access future resources is dependant on what remains after a mine closes, both in the environment as well as in the community and economy where it operated. As a result all CNA operations are required to prepare a Mine Life Plan. This was completed for HVO in 2005.

23.2 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Ecologically sustainable development (ESD) embraces the multiple objectives of social well being, environmental sustainability, and economic prosperity. The National Strategy for Ecologically Sustainable Development is governed by the Commonwealth DEW and provides broad strategic directions and framework for governments to direct policy and decision-making. The strategy defines ESD 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*".

This proposal addresses meeting society's needs through the provision of a valuable resource, while considering the potential impacts on the physical and social environment of not only the local and regional areas but also the national and global implications associated with greenhouse gas emissions.

Rio Tinto (the parent company of CNA) has made a strategic commitment to sustainable development with a policy that states "Rio Tinto's businesses, projects, operations and products should contribute constructively to the global transition to sustainable development". Supporting this is a set of internal policies to which all businesses must conform even if local requirements are less exacting. These policies are part of the corporate governance machinery and are therefore subject to a rigorous assurance process. Independently verified external reporting at both site and corporate levels aims to ensure that performance is understood and continually improved. Examples of this commitment are provided in *Chapter 21 – Company Performance*.

It is expected that environmental outcomes across HVO South will ultimately be improved as a result of the proposal. This will be achieved by a consolidated approach to rehabilitation, final landforms and increased operational flexibility and efficiency allowing the increased ability of operations to adapt to adverse environmental conditions. For example, the increased flexibility will allow operations to better adapt to adverse wind conditions enabling the improved management of potential dust impacts.

The principles of ESD are considered in the following sections in the context of the proposal.

23.2.1 Precautionary Principle

Interpretation

According to the *Protection of the Environment Administration Act 1991*, the precautionary principle 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.

This principle was developed in response to one of the great difficulties of interpreting scientific data. The scientific method produces results based on confidence limits. These are controlled by the scope of data acquisition, interpretation methods and general understanding within a particular scientific discipline of a particular phenomenon. This has been used as a way of validating a lack of response to a potential threat of serious or irreversible environmental degradation.

In the application of this principle:

- careful application should always be undertaken to avoid serious or irreversible environmental damage; and
- an assessment of consequences of various options should be undertaken in formulating a proposal.

ESD requires that uncertainty and the associated risk level be considered in decision making.

Justification

The environmental consequences of the proposal have been assessed as accurately as possible using appropriate specialists in relevant disciplines where required. Assessments were undertaken in accordance with the relevant State Government Technical and Policy Guidelines listed in the proposed project DGRs. The assessment process involved computer modelling, field validation, scientific analysis and interpretation of the individual and cumulative environmental impacts of the proposed development. This process has enabled the impacts of the proposed operations to be predicted with a reasonable degree of certainty. All predictions, however, contain a degree of uncertainty, which reflects the variable nature of the environment. Where there has been uncertainty in the prediction of impacts throughout the assessment process, a conservative approach was adopted to ensure the worst case scenario was used in the assessment of impacts.

The proposal is consistent with the precautionary principle to the extent that all potential threats to the environment have been identified and appropriate mitigation measures have been developed to reduce such impacts. All management procedures form part of the statement of commitments as outlined in *Chapter 22* and will form part of the approval conditions for this project.

The environmental investigations undertaken during the preparation of this Environmental Assessment Report have identified potential impacts with adequate scientific certainty to justify proceeding with the proposed development. The proposal therefore meets the objectives of the precautionary principle of ESD.

23.2.2 Social Equity Including Intergenerational Equity

Interpretation

Social equity involves value concepts of justice and fairness so that the basic needs of all sectors of society are met and there is a fair distribution of costs and benefits to improve the well-being and welfare of the community, population or society. Social equity does not imply equality but that there should be equal access to opportunities for improved welfare, with a bias towards advantaging the least well-off sectors of society.

Social equity includes intergenerational equity, which requires that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

Justification

It is acknowledged that coal is a finite reserve, however the proposal will ensure that the reserve is utilised in an efficient and sustainable manner and that the existing benefits afforded to the community are maintained or enhanced through the 21 year consent period. The proposal will provide access to approximately 224 Mt additional ROM coal that will supply the ongoing market demand for energy generation in the local and the Sydney metropolitan areas and international markets with the majority sold to Japan.

Social and economic benefits to the local community are expected through the production of local employment opportunities, the transfer of technical and commercial skills to local industry, positive multiplier effects in the region and ongoing sponsorship and funding for environmental enhancement programmes (see *Chapter 21*).

A holistic approach to land management is critical to provide the best closure outcomes for HVO South. The proposal provides the opportunity to bring together soil, land capability and agricultural suitability information, flora and fauna and Aboriginal heritage information and final void and other rehabilitation related information across all of HVO South. In addition, the plan is integrated with the HVO North rehabilitation plan. This will ensure that final landform is as good as or improved from its pre-mining state. This is in accordance with the concept of intergenerational equity.

23.2.3 Conservation of Biological Diversity and Maintenance of Ecological Integrity

Interpretation

Biological diversity refers to the diversity of genes, species, populations, communities and ecosystems, and the linkages between them. Biological resources provide food, medicines, fibres and industrial products. They also provide for vital ecological services such as maintaining soil fertility and the supply of clean and fresh water. Maintaining biological diversity safeguards life support functions and can be considered a minimal requirement for intergenerational equity.

Justification

A comprehensive assessment of the likely impacts of the proposal on flora and fauna is detailed in *Chapter 11* and *Annex L*.

One species listed as threatened under the *TSC Act*, the Grey-crowned Babbler, and one population listed as endangered under the *TSC Act*, River Red Gum population were identified during field work conducted in May 2006. This assessment concluded no River Red Gums will be removed as a result of this proposal and past assessments have concluded no significant impacts to Grey-crowned Babblers.

Previous and proposed approvals to clear vegetation may result in cumulative impacts to flora and fauna within the locality. However, this proposal has provided an opportunity to holistically assess potential opportunities to enhance biodiversity across HVO South. The *HVO Conceptual Landscape and Rehabilitation Management Strategy* will support the intent to improve ecological value, connectivity and enhancement of biodiversity of the area. Mitigation measures aim to conserve, enhance and manage habitat within the Project Application area, so that local populations can be maintained ensuring adherence to the principles of conservation of biological diversity and ecological integrity.

23.2.4 Improved Valuation and Pricing of Environmental Resources

Interpretation

This principle is a component of intergenerational equity. The principle relates to the need to determine proper values for services provided by the natural environment, such as the atmosphere's ability to receive gaseous emissions, cultural values and visual amenity.

Applying standard methods of valuation and pricing to environmental resources is a difficult process. This is largely due to the intangible nature of much of the natural environment. The environment has conventionally been considered a free resource, with the true cost to the environment not factored into cost of production or use of that resource.

This principle involves placing a monetary or social value on the environment that ultimately increases its value so as to decrease future exploitation.

Pollution and future exploitation can be controlled under the polluter pays principle, whereby polluters who degrade the natural environment are responsible and accountable for returning it to its previous condition.

Justification

This environmental assessment examined the environmental consequences of the proposal and has identified a number of management measures for the potential adverse impacts associated with the proposal that have been included in the statement of commitments. The management measures have been developed concurrently with the environmental assessment and have been incorporated directly into the mine design. As such, components of the proposal have been modified to minimise adverse impacts (ie construction of rail facilities, excluding road haulage). The proposal has therefore been refined and involves a higher initial capital expenditure to ensure a sustainable outcome. The cost of these measures can be used as an indirect indication of the value of environmental resources.

RTCA, as part of Rio Tinto Energy, is supporting the research and development of new technologies through direct spending and within the Australian Coal Association Research Programme (ACARP), and the Australian Coal Association's COAL21 programme. The COAL21 programme promises to align efforts of coal producers, generators, and researchers in an Australian national programme for zero emissions from electricity generation. This is another example of the company's commitment to improved valuation and pricing of environmental resources.

23.3 CONCLUSIONS

This report has presented the findings of an environmental assessment for the HVO South Coal Project.

The DGRs require a final justification for the project and its benefits with consideration of the site and the potential environmental impacts.

The site that the proposal applies to is a brownfields operation and the Project Application is for the activities proposed to be undertaken at HVO South, an existing mine that currently operates under 25 separate development consents and 10 associated modifications. Operations are currently consented to occur until approximately 2021.

The existing equipment, infrastructure and transport facilities will continue to be utilised for the ongoing mining operations. Project Approval will provide for a 21 year time frame for mining activities from the date of approval. At the peak of operations, HVO is predicted to employ up to 829 people (including contractor equivalents), a possible increase of 150 people over current employment levels if market conditions are favourable (including during construction and operation).

The ongoing use of this land for coal mining purposes is by far the highest value use of land on the total project lifecycle.

This proposal will allow for the replacement of all of the current consents and associated modifications with a single Project Approval. Therefore the proposal seeks approval for all current operational and environmental activities to continue. It will also provide for the extension of mining within HVO south of the Hunter River and will assist with improvements in operational efficiencies (in relation to mining and processing rates, equipment use and relocation, rejects and tailings disposal and coal transport and handling), infrastructure upgrades and modifications, and operational integration within HVO as a whole.

The environmental assessment was undertaken with the knowledge that the existing HVO South activities are already approved. In addition, further developments that have been approved are yet to occur. However, to adequately assess the potential impacts resulting from the proposal, the assessment methodology incorporated all of the existing HVO South activities, including those yet to occur. Furthermore, the environmental assessment has been prepared under conservative worst case scenarios for all technical assessments to develop a range of environmental and social parameters against which the proposal can be assessed. The worst case scenarios have been used to generate an environmental envelope to provide maximum flexibility for mining operations within acceptable environmental parameters. The mining operations can therefore retain some flexibility within the constraints of the identified environmental envelope. The results from the assessments are therefore the potential impacts resulting from the whole of HVO South including the changes resulting from the proposal. Consequently, it must be recognised that some of these potential impacts have previously been assessed and approved.

Issues with a greater potential to impact the environment were confirmed through liaison with relevant government agencies (and formalised in the DGRs), the local community and through the risk assessment process undertaken by the environmental assessment team. Identification of key issues has allowed for a focussed assessment of those issues. Higher risk category issues include noise and vibration, air quality, groundwater and landscape management. In addition surface water, ecology, greenhouse gas and energy, subsidence, heritage, traffic and transport, visual, waste, land use and socio-economic assessments were undertaken.

The results of these assessments have been presented throughout this report and where key issues have been identified, measures have been proposed to negate or mitigate the potential impact.

Any results obtained during the assessment process that indicated a potentially unacceptable impact to the environment necessitated a modification of the proposal. Key changes occurred to highwall mining areas and the location of the rail spur. In addition, modifications to operations will be undertaken to minimise potential impacts to noise, air quality and groundwater.

As a consequence the proposal has been developed such that there are no resulting significant environmental impacts that cannot be mitigated by appropriate safeguards and management measures. Recommended management measures have been incorporated into the statement of commitments for the proposal. These will support the Project Approval conditions that will be a result of the Part 3A government assessment and approval process.

Environmental benefits will be realised through better assessment and understanding of cumulative issues: cumulative assessments of HVO South as a whole; reduction in energy use per tonne of ROM coal processed due to reduction in transport distances; and continued assurance of 'best practice' final landscape design.

Social benefits will include security of employment: improved amenity outcomes for the local community; and a consolidated approach to mine closure. Current and future planning will continue to consider the expectations and preferences of local community, to ensure acceptance of a practical post-mining land use.

Operational and economic benefits have also been identified through cost savings and access to additional coal reserves.

This proposal addresses meeting society's needs through the provision of a valuable resource, with consideration given to the potential impacts on the physical and social environment of not only the local and regional areas but also the national and global implications associated with greenhouse gas emissions; and provides justification for the proposed HVO South Coal Project.

If Project Approval is not obtained the current HVO South activities can continue in their current form, however operations will be restricted in the ability to improve environmental, social and operational efficiencies and will not be able to maximise the recovery of the coal resource within the Project Application area.

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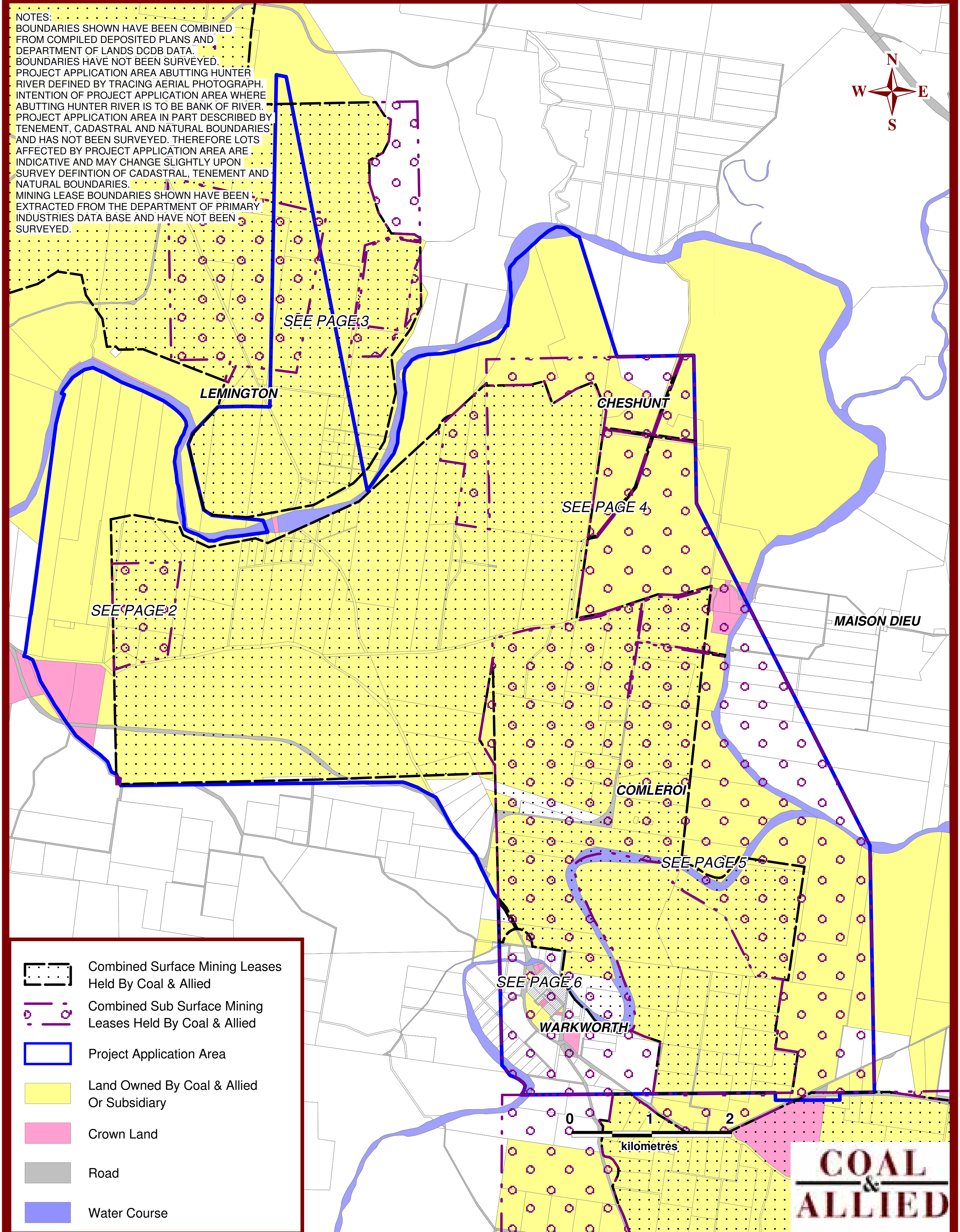
Annex A

Land Ownership Details

Properties Affected By Project Application Area

Location: Lemington
LGA: Singleton

Projection:	MGA Z56	Date:	19/09/07	Project:	HVO South
Contour Interval:	N/A	Plan By:	SC	Layout:	A4
Page:	1 of 10	Version:	01	Our Ref:	P_HVO_Sth EIS Properties_070918.wor



Properties Affected By Project Application Area

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LGA: Singleton

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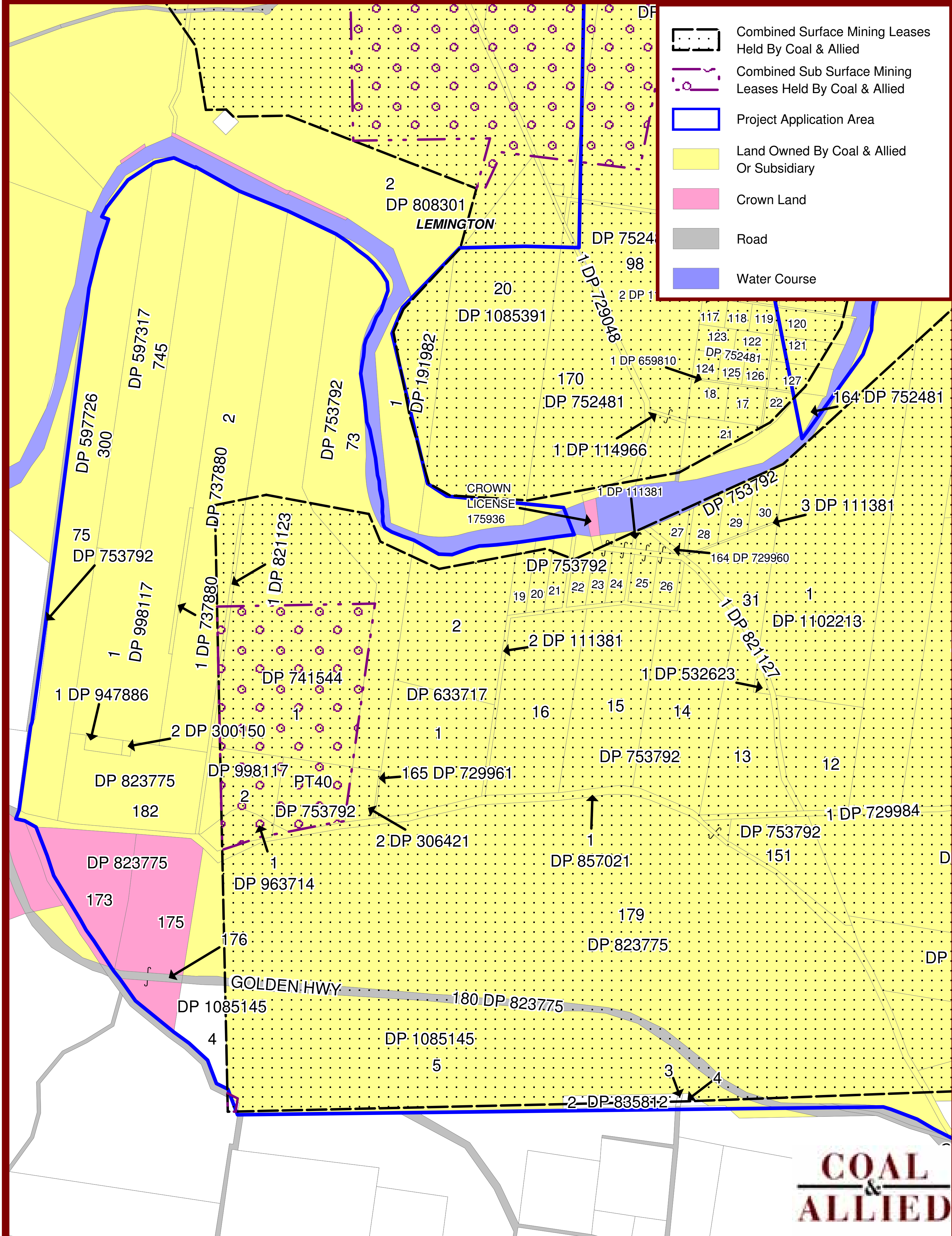

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LGA: Singleton

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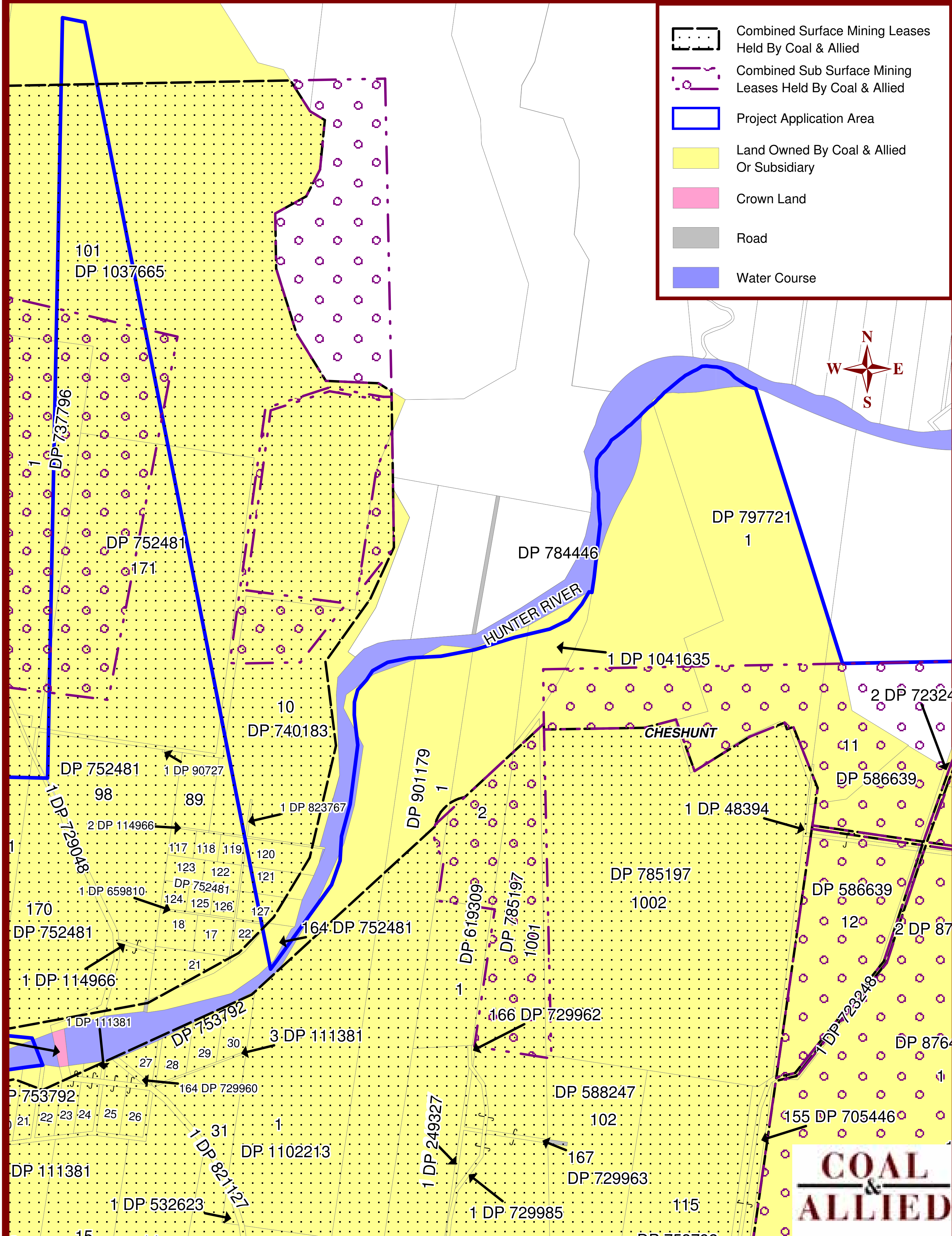

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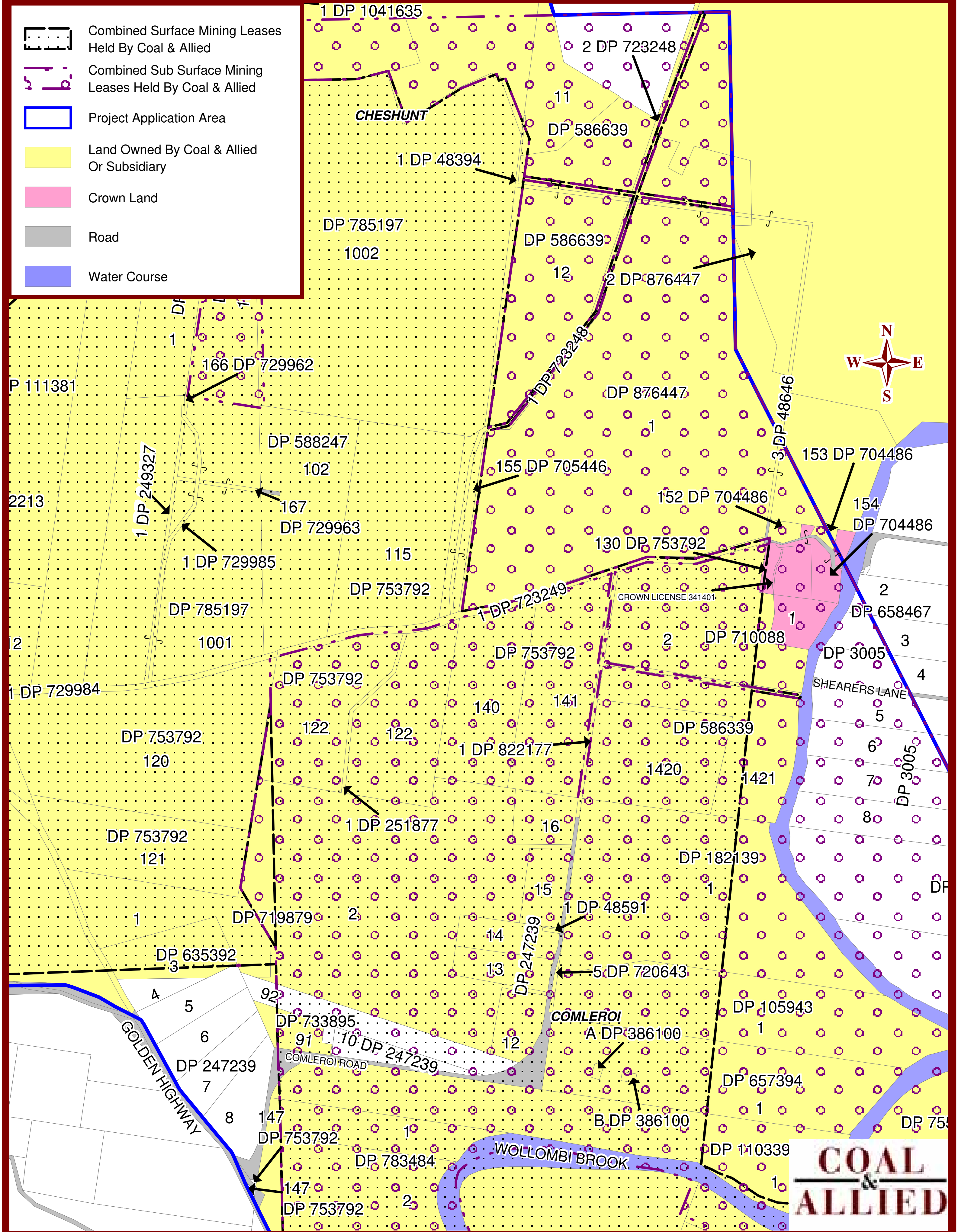

Properties Affected By Project Application Area

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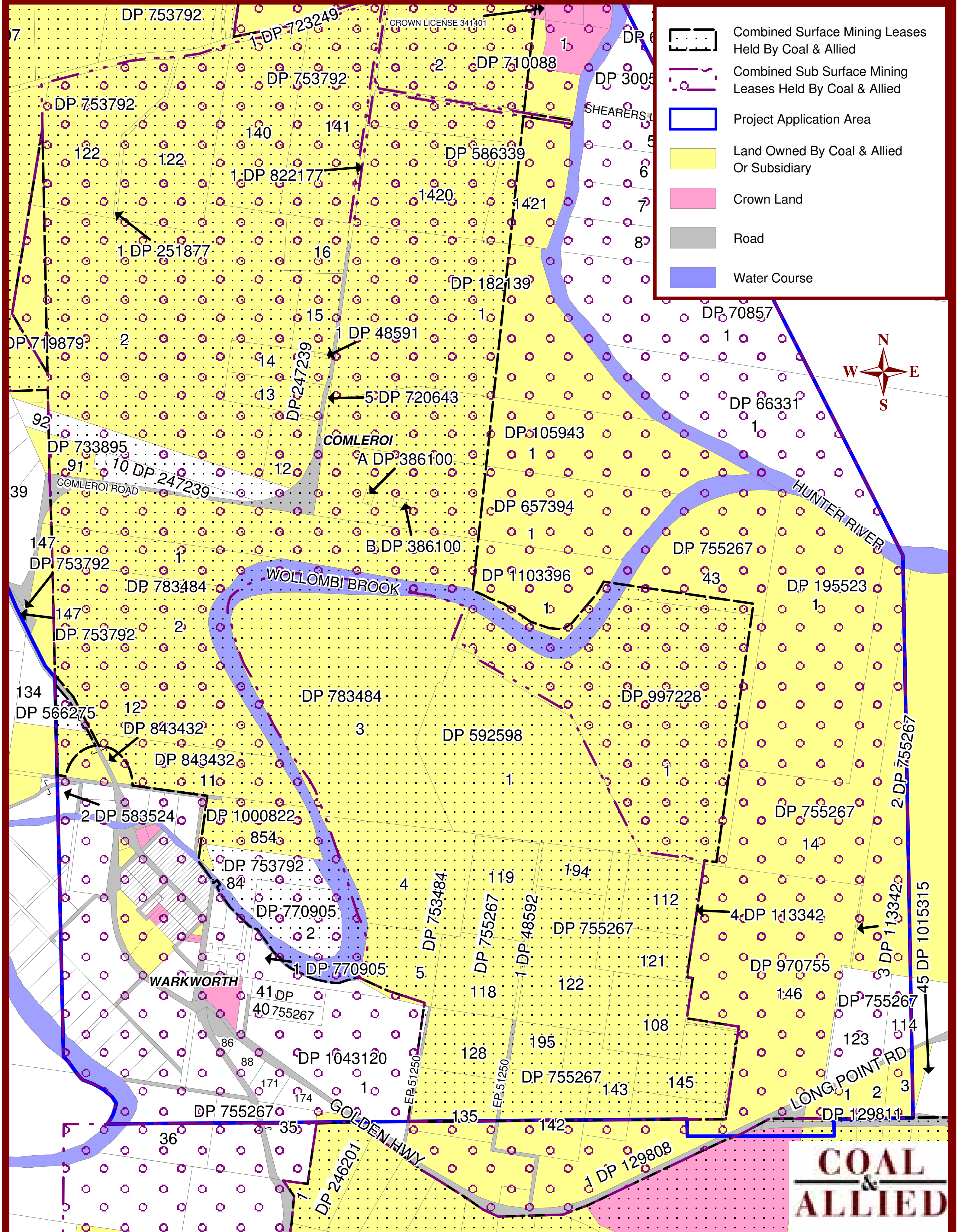

Properties Affected By Project Application Area

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LGA: Singleton

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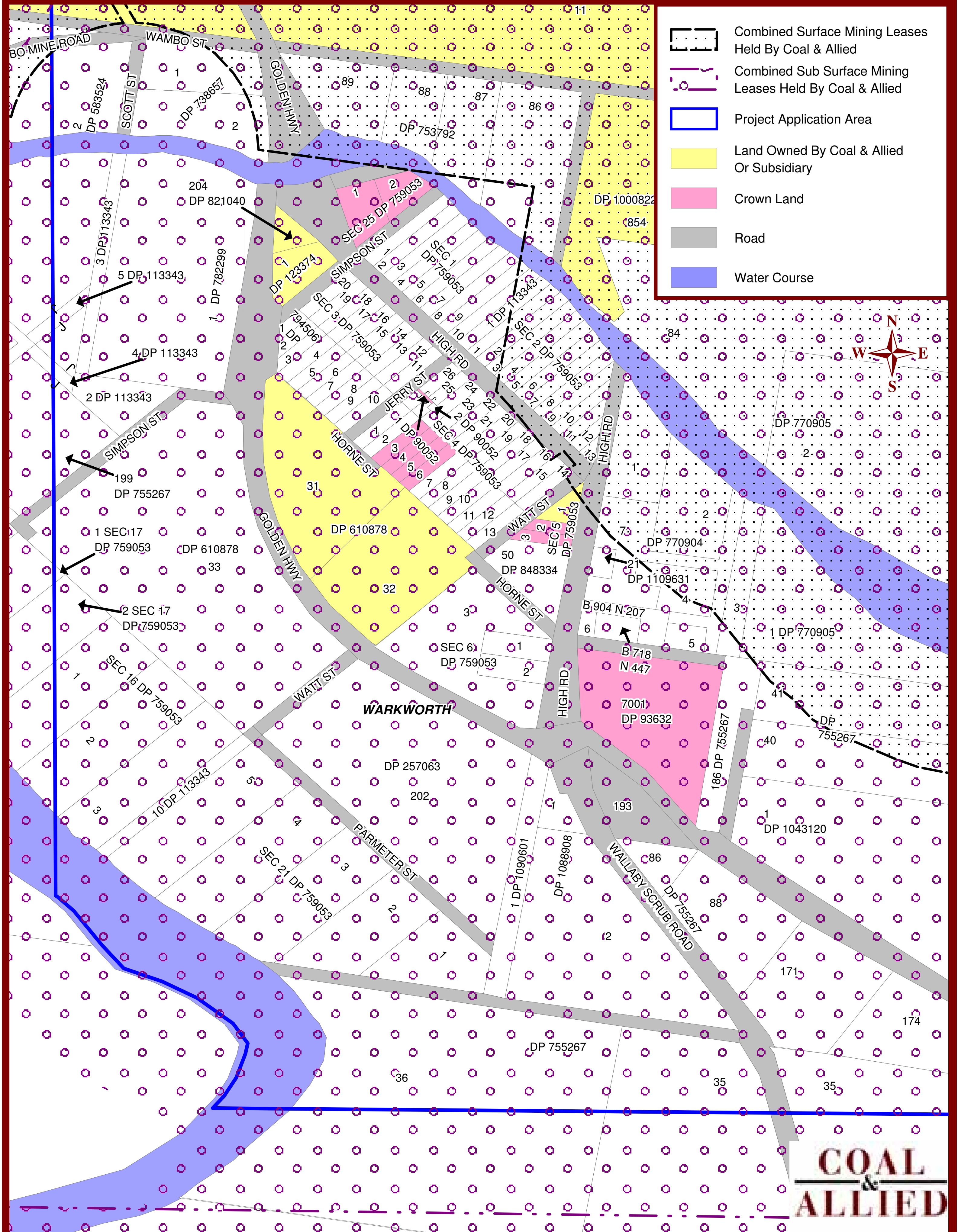

OWNERSHIP SCHEDULE

Lot	Section	DP	Property Owner	Wholly or Partly Affected by Coal & Allied Surface Mining Lease	Wholly or Partly Affected by Coal & Allied Sub Surface Mining Lease	Location
1		48194	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
1		48535	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
1		48592	Coal & Allied Operations Pty Limited	Y	N	Warkworth South of Wollombi Brook
1		49640	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
1		90727	Coal & Allied Operations Pty Limited	Y	N	Lemington
1		105963	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
1		114066	Coal & Allied Operations Pty Limited	Y	N	Lemington
1		121174	Coal & Allied Operations Pty Limited	N	Y	Warkworth Village
1		125808	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
1		182139	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
1		191982	Coal & Allied Operations Pty Limited	Y	N	Lemington
1		195921	Coal & Allied Operations Pty Limited	N	Y	Warkworth South of Wollombi Brook
1		249327	Coal & Allied Operations Pty Limited	Y	N	Warkworth North East
1		251877	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
1		592308	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
1		619309	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
1		632717	Coal & Allied Operations Pty Limited	Y	N	Warkworth North West
1		657394	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
1		719879	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
1		721248	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
1		721449	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
1		729648	Coal & Allied Operations Pty Limited	Y	Y	Lemington
1		729984	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
1		729985	Coal & Allied Operations Pty Limited	Y	N	Warkworth North East
1		717796	Coal & Allied Operations Pty Limited	Y	Y	Lemington
1		717880	Coal & Allied Operations Pty Limited	N	N	Warkworth North West
1		741544	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
1	5	759051	Coal & Allied Operations Pty Limited	N	Y	Warkworth Village
1		785484	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
1		797721	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
1		811121	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
1		811127	Coal & Allied Operations Pty Limited	Y	N	Warkworth North West
1		812177	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
1		822767	Coal & Allied Operations Pty Limited	Y	N	Lemington
1		857021	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
1		876467	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
1		947886	Coal & Allied Operations Pty Limited	N	N	Warkworth North West
1		955714	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
1		997228	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
1		998117	Coal & Allied Operations Pty Limited	N	N	Warkworth North West
1		1061615	Coal & Allied Operations Pty Limited	N	Y	Warkworth North East
1		1103239	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
2		100190	Coal & Allied Operations Pty Limited	N	N	Warkworth North West
2		306421	Coal & Allied Operations Pty Limited	Y	N	Warkworth North West
2		619309	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
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2		710088	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
2		719879	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
2		721248	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
2		717880	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
2		796267	Coal & Allied Operations Pty Limited	N	Y	Warkworth South of Wollombi Brook
2		785484	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
2		808301	Coal & Allied Operations Pty Limited	Y	Y	Lemington
2		876467	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
2		998117	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
3		49640	Coal & Allied Operations Pty Limited	N	Y	Warkworth North East
3		111342	Coal & Allied Operations Pty Limited	N	Y	Warkworth South of Wollombi Brook
3		635392	Coal & Allied Operations Pty Limited	Y	N	Warkworth North West
3		785484	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
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4		785484	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
5		730941	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
5		785484	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
5		1085145	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
10		790181	Coal & Allied Operations Pty Limited	Y	Y	Lemington
11		586929	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
11		943452	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
12		247159	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
12		586959	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
13		247159	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
14		247159	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
14		796267	Coal & Allied Operations Pty Limited	N	Y	Warkworth South of Wollombi Brook
15		247159	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
16		247159	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
20		1085291	Coal & Allied Operations Pty Limited	Y	Y	Lemington
31		610878	Coal & Allied Operations Pty Limited	N	Y	Warkworth Village
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40		752792	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North West
41		796267	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
71		711806	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
101		1017015	Coal & Allied Operations Pty Limited	Y	Y	Lemington
102		588247	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
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141		752792	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East

OWNERSHIP SCHEDULE

Lot	Section	DP	Property Owner	Wholly or Partly Affected by Coal & Allied Surface Mining Lease	Wholly or Partly Affected by Coal & Allied Sub Surface Mining Lease	Location
142		755267	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
143		755267	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
145		755267	Coal & Allied Operations Pty Limited	Y	N	Warkworth South of Wollombi Brook
146		870755	Coal & Allied Operations Pty Limited	Y	Y	Warkworth South of Wollombi Brook
151		753792	Coal & Allied Operations Pty Limited	Y	N	Warkworth North West
152		706486	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
154		706486	Coal & Allied Operations Pty Limited	N	Y	Warkworth North East
155		705486	Coal & Allied Operations Pty Limited	Y	N	Warkworth North East
164		729960	Coal & Allied Operations Pty Limited	Y	N	Warkworth North West
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166		729962	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
167		729963	Coal & Allied Operations Pty Limited	Y	N	Warkworth North East
170		752481	Coal & Allied Operations Pty Limited	Y	N	Lemington
179		823775	Coal & Allied Operations Pty Limited	Y	N	Warkworth North West
182		823775	Coal & Allied Operations Pty Limited	N	N	Warkworth North West
194		755267	Coal & Allied Operations Pty Limited	Y	N	Warkworth South of Wollombi Brook
195		755267	Coal & Allied Operations Pty Limited	Y	N	Warkworth South of Wollombi Brook
204		823040	Coal & Allied Operations Pty Limited	N	Y	Warkworth Village
300		597720	Coal & Allied Operations Pty Limited	N	N	Warkworth North West
745		597327	Coal & Allied Operations Pty Limited	N	N	Warkworth North West
854		1000611	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Village
1001		785197	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
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1420		586039	Coal & Allied Operations Pty Limited	Y	Y	Warkworth North East
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A		386300	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
B		386300	Coal & Allied Operations Pty Limited	Y	Y	Warkworth Near Comleroi Road
1		113381	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
1		733523	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
1		859900	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
1		803179	J. & A. Brown and Abermain Seaham Collieries Limited	Y	Y	Warkworth North West
1		1102219	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
2		113381	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
2		114966	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
3		113381	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
12		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
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17		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
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19		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
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21		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
21		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
22		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
22		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
23		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
24		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
25		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
26		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
27		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
28		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
29		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
30		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
31		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
73		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	Y	Warkworth North West
86		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
88		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
117		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
118		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
119		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
120		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
120		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	Y	Warkworth North West
121		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
121		753792	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Warkworth North West
122		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
123		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
124		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
125		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
126		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
127		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
164		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	N	Lemington
171		752481	J. & A. Brown and Abermain Seaham Collieries Limited	Y	Y	Lemington
1		129821	Warkworth Mining Limited	Y	Y	Warkworth South of Wollombi Brook
1		246205	Warkworth Mining Limited	Y	Y	Warkworth Village
2		129821	Warkworth Mining Limited	Y	Y	Warkworth South of Wollombi Brook
3		129821	Warkworth Mining Limited	Y	Y	Warkworth South of Wollombi Brook
7001		93632	Administered by The State Land Services	N	Y	Warkworth Village
1		96852	Commonwealth of Australia	N	Y	Warkworth Village
1	25	759053	Crown	N	Y	Warkworth Village
2	5	759053	Crown	N	Y	Warkworth Village
2	25	759053	Crown	N	Y	Warkworth Village
3	4	759053	Crown	N	Y	Warkworth Village
3	5	759053	Crown	N	Y	Warkworth Village
4	4	759053	Crown	N	Y	Warkworth Village
5	4	759053	Crown	N	Y	Warkworth Village
6	4	759053	Crown	N	Y	Warkworth Village
130		753792	Crown	Y	Y	Warkworth North East
175		823775	Crown	N	N	Warkworth North West
			Crown Licence 375936 (Coal & Allied Operations Pty Limited)	N	N	Warkworth North West
			Crown Licence 345401 (Coal & Allied Operations Pty Limited)	N	Y	Warkworth North East
203		755267	Crown Land	Y	Y	Warkworth South of Wollombi Brook

OWNERSHIP SCHEDULE

Lot	Section	DP	Property Owner	Wholly or Partly Affected by Coal & Allied Surface Mining Lease	Wholly or Partly Affected by Coal & Allied Sub Surface Mining Lease	Location
1		710088	The State of NSW	N	Y	Warkworth North East
154		704480	The State of NSW	N	Y	Warkworth North East
170		823775	The State of NSW	N	N	Warkworth North West
172		823775	The State of NSW	N	N	Warkworth North West
173		823775	The State of NSW	N	N	Warkworth North West
11		1109610	Brian Kennedy & John Griffiths	N	Y	Warkworth Village
Nu247		86 A04	Ada Elizabeth Wallis	N	Y	Warkworth Village
35		755267	Gaz M Hawkes Pty Ltd	N	Y	Warkworth Village
36		755267	Gaz M Hawkes Pty Ltd	N	Y	Warkworth Village
5		247139	Construction, Forestry, Mining & Energy Union	Y	Y	Warkworth Near Comleroi Road
8		770604	Edward & Carol Borley	N	Y	Warkworth Village
3		3005	Elizabeth Bowman	N	Y	Mason Dieu
4		3005	Elizabeth Bowman	N	Y	Mason Dieu
5		3005	Elizabeth Bowman	N	Y	Mason Dieu
1		113443	Heather Kannar	N	Y	Warkworth Village
1	2	750053	Heather Kannar	N	Y	Warkworth Village
1		794506	Heather Kannar	N	Y	Warkworth Village
2	2	750053	Heather Kannar	N	Y	Warkworth Village
2		794506	Heather Kannar	N	Y	Warkworth Village
3	2	750053	Heather Kannar	N	Y	Warkworth Village
3		794506	Heather Kannar	N	Y	Warkworth Village
4	2	750053	Heather Kannar	N	Y	Warkworth Village
4	3	750053	Heather Kannar	N	Y	Warkworth Village
5	2	750053	Heather Kannar	N	Y	Warkworth Village
5	3	750053	Heather Kannar	N	Y	Warkworth Village
6	2	750053	Heather Kannar	N	Y	Warkworth Village
6	3	750053	Heather Kannar	N	Y	Warkworth Village
7	2	750053	Heather Kannar	N	Y	Warkworth Village
7	3	750053	Heather Kannar	N	Y	Warkworth Village
8	2	750053	Heather Kannar	N	Y	Warkworth Village
8	3	750053	Heather Kannar	N	Y	Warkworth Village
9	3	750053	Heather Kannar	N	Y	Warkworth Village
10	3	750053	Heather Kannar	N	Y	Warkworth Village
11	3	750053	Heather Kannar	N	Y	Warkworth Village
12	3	750053	Heather Kannar	N	Y	Warkworth Village
13	3	750053	Heather Kannar	N	Y	Warkworth Village
14	3	750053	Heather Kannar	N	Y	Warkworth Village
15	3	750053	Heather Kannar	N	Y	Warkworth Village
16	3	750053	Heather Kannar	N	Y	Warkworth Village
17	3	750053	Heather Kannar	N	Y	Warkworth Village
18	3	750053	Heather Kannar	N	Y	Warkworth Village
19	3	750053	Heather Kannar	N	Y	Warkworth Village
20	3	750053	Heather Kannar	N	Y	Warkworth Village
20		247139	Hunter Valley Gliding Club Cooperative Limited	Y	Y	Warkworth Near Comleroi Road
62		718865	Hunter Valley Gliding Club Cooperative Limited	Y	Y	Warkworth Near Comleroi Road
5		251917	Inchmead Pty Ltd	N	Y	Mason Dieu
1		617952	John Maitland, Robert Graham, George Coates	N	N	Warkworth North West
2		835812	John Maitland, Robert Graham, George Coates	Y	N	Warkworth North West
3		835812	John Maitland, Robert Graham, George Coates	Y	N	Warkworth North West
4		835392	John Maitland, Robert Graham, George Coates	N	N	Warkworth Near Comleroi Road
4		835812	John Maitland, Robert Graham, George Coates	Y	N	Warkworth North West
6		247139	John Maitland, Robert Graham, George Coates	N	N	Warkworth Near Comleroi Road
7		247139	John Maitland, Robert Graham, George Coates	N	N	Warkworth Near Comleroi Road
8		247139	John Maitland, Robert Graham, George Coates	N	N	Warkworth Near Comleroi Road
9		835812	John Maitland, Robert Graham, George Coates	N	N	Warkworth North West
144		588175	John Maitland, Robert Graham, George Coates	Y	Y	Warkworth Near Comleroi Road
147		753792	Johnson Woods & Co Pty Ltd	N	N	Warkworth Near Comleroi Road
8		3005	John B. Gregory Ernst	N	Y	Mason Dieu
9		3005	John B. Gregory Ernst	N	Y	Mason Dieu
50		849334	Kenneth & Lorraine Haynes	N	Y	Warkworth Village
9	2	750053	Kenneth Russell Partridge	N	Y	Warkworth Village
10	2	750053	Kenneth Russell Partridge	N	Y	Warkworth Village
11	2	750053	Kenneth Russell Partridge	N	Y	Warkworth Village
12	2	750053	Kenneth Russell Partridge	N	Y	Warkworth Village
13	2	750053	Kenneth Russell Partridge	N	Y	Warkworth Village
75		753792	M F Holdings Pty Ltd	N	N	Warkworth North West
1		486656	Neville Robert Stapleton	N	Y	Warkworth North East
1		770604	Olga Henriksen	N	Y	Warkworth Village
1		770605	Olga Henriksen	N	Y	Warkworth Village
1		1045120	Olga Henriksen	Y	Y	Warkworth Village
2		770604	Olga Henriksen	N	Y	Warkworth Village
3		770604	Olga Henriksen	N	Y	Warkworth Village
4		770604	Olga Henriksen	N	Y	Warkworth Village
5		770604	Olga Henriksen	N	Y	Warkworth Village
7		770604	Olga Henriksen	N	Y	Warkworth Village
40		755267	Olga Henriksen	N	Y	Warkworth Village
41		755267	Olga Henriksen	N	Y	Warkworth Village
186		755267	Olga Henriksen	N	Y	Warkworth Village
1		70807	Philip & Colleen Aigis	N	Y	Mason Dieu
6		3005	R & J Wenham	N	Y	Mason Dieu
45		1011315	Redbank Project Pty Limited	N	Y	Warkworth South of Wollombi Brook
1		66335	Robert Aigis	N	Y	Mason Dieu
7		3005	Robert Aigis	N	Y	Mason Dieu
10		3005	Robert Aigis	N	Y	Mason Dieu
2		770605	Wiana & Glenn Kiss	Y	Y	Warkworth Village
44		753792	Wiana & Glenn Kiss	Y	Y	Warkworth Village
1	6	750053	Singleton Council	N	Y	Warkworth Village
2	6	750053	Singleton Council	N	Y	Warkworth Village
3	6	750053	Singleton Council	N	Y	Warkworth Village
2		96852	Tyldex Corporation Limited	N	Y	Warkworth Village
12		849532	Tyldex Corporation Ltd	N	Y	Warkworth Near Comleroi Road
1		798617	Wambo Coal Pty Ltd	N	Y	Warkworth Village
1		1090620	Wambo Coal Pty Ltd	N	Y	Warkworth Village
2		583524	Wambo Coal Pty Ltd	N	Y	Warkworth Village

OWNERSHIP SCHEDULE

Lot	Section	DP	Property Owner	Wholly or Partly Affected by Coal & Allied Surface Mining Lease	Wholly or Partly Affected by Coal & Allied Sub Surface Mining Lease	Location
2		738817	Wambo Coal Pty Ltd	N	Y	Warkworth Village
1		1085145	Wambo Coal Pty Ltd	Y	Y	Warkworth North West
4		1085145	Wambo Coal Pty Ltd	N	N	Warkworth North West
1		1088608	Wambo Coal Terminal Pty Ltd	N	Y	Warkworth Village
2		1088608	Wambo Coal Terminal Pty Ltd	N	Y	Warkworth Village
86		755267	Wambo Coal Terminal Pty Ltd	N	Y	Warkworth Village
88		755267	Wambo Coal Terminal Pty Ltd	N	Y	Warkworth Village
173		755267	Wambo Coal Terminal Pty Ltd	N	Y	Warkworth Village
174		755267	Wambo Coal Terminal Pty Ltd	N	Y	Warkworth Village
1	17	758053	Wambo Mining Corporation Limited	N	Y	Warkworth Village
2		111949	Wambo Mining Corporation Limited	N	Y	Warkworth Village
2	17	758053	Wambo Mining Corporation Limited	N	Y	Warkworth Village
3		111949	Wambo Mining Corporation Limited	N	Y	Warkworth Village
4		111949	Wambo Mining Corporation Limited	N	Y	Warkworth Village
5		111949	Wambo Mining Corporation Limited	N	Y	Warkworth Village
1	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
2	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
3	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
8	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
9	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
10	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
11	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
12	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
13	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
14	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
15	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
16	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
17	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
18	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
19	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
20	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
21	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
22	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
23	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
24	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
25	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
26	4	758053	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
199		755267	Wambo Mining Corporation Pty Limited	N	Y	Warkworth Village
1	16	758053	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
1	21	758053	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
2	16	758053	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
2	21	758053	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
3	16	758053	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
3	21	758053	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
4	21	758053	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
5	21	758053	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
33		111949	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
202		217083	Wambo Mining Corporation Pty Ltd	N	Y	Warkworth Village
1	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
2	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
3	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
4	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
5	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
6	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
7	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
8	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
9	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
10	1	758053	Wilfred & Rosa Kenner	N	Y	Warkworth Village
86		753792	Wilfred & Rosa Kenner	N	Y	Warkworth Village
87		753792	Wilfred & Rosa Kenner	N	Y	Warkworth Village
88		753792	Wilfred & Rosa Kenner	N	Y	Warkworth Village
89		753792	Wilfred & Rosa Kenner	N	Y	Warkworth Village
2		111942	Wilfred and Rosa Kenner	N	Y	Warkworth South of Wollombi Brook
114		755267	Wilfred and Rosa Kenner	N	Y	Warkworth South of Wollombi Brook
123		755267	Wilfred and Rosa Kenner	N	Y	Warkworth South of Wollombi Brook
[illegible]		96716	William Henry Presswood	N	Y	Warkworth Village
15		830879	William, Maria & Lawrence Kelly	N	Y	Warkworth Village
2		658467	Wyoming Holdings Pty ltd	N	Y	Maison Dieu
1		782299	Xstrata Coal Pty Ltd	N	Y	Warkworth Village
			Crown (Enclosure Permit 11250) Coal & Allied Operations Pty Limited)	Y	Y	Warkworth South of Wollombi Brook
174		823775	Road	N	N	Warkworth North West
176		823775	Road	N	N	Warkworth North West
191		755267	Road	N	Y	Warkworth Village
182		823775	Singleton Shire Council (Road)	Y	N	Warkworth North West
			Various Roads			

Annex B

Director General's Requirements

31 August 2006

Director-General
Major Development and Assessment Unit
Department of Planning
GPO Box 39
SYDNEY NSW 2001

Attention: Mr Mike Young

Dear Mike,

HUNTER VALLEY OPERATIONS

SOUTH COAL PROJECT

Coal & Allied Operations Pty Limited (CNA) are submitting the attached application for Project Approval for the Hunter Valley Operations (HVO) South Coal Project.

The application is to enable the following mining activities at HVO, south of the Hunter River:

- Project Approval for HVO South under Part 3A resulting in one approval for the operation and allowing for the surrender of the 25 existing consents and 13 modifications that apply to HVO South;
- Continuation of approved opencut and highwall mining areas and the associated activities located in HVO South and described in previous applications and assessments;
- Mining of additional opencut, highwall and/or punch longwall mining areas within Cheshunt, Riverview and Lemington Pits;
- Approval for the production of 16 million tonnes per annum (Mtpa) of run of mine (ROM) coal across HVO South;
- Ability to use draglines and truck and shovels at HVO South as suits the operation. This will include the ability to use up to three large shovels and two draglines at any one time across HVO South;
- Upgrades and modifications to infrastructure including upgrade or replacement of the LCPP to allow processing of 16 Mtpa ROM coal and transport of product coal via haul road or overland conveyor to access Wambo rail spur, alternatively via a newly constructed rail spur adjacent to LCPP;
- Construction of infrastructure and stockpiles to support the LCPP and transport options;

- Ability for material and equipment movements across the HVO mining complex, from HVO North to HVO South, including ROM and product coal, rejects, overburden and water;

- Temporary heavy equipment crossings (including draglines, trucks and shovels) of Hunter River, Wollombi Brook and Jerrys Plains Road;

- Relocation of Comleroi Road;

- Relocation of powerlines, water lines and phone lines;

- Relocation or reconfiguration of the Hunter Valley Gliding Club (HVGC) airstrip and facilities, to accommodate the integration of the Riverview Pit with the South Lemington Pit 2.

The result of the grant of a single Project Approval for HVO South will be the formal integration of operations at HVO South into one effective operation.

The application will include surface disturbance of an additional 250 ha, in Riverview south west, Riverview south east to join with the consented South Lemington Pit 2, and South Lemington Pit 1. Mining in Cheshunt to greater depth to access the Broonie and Bayswater seams will not increase the surface disturbance of the currently consented footprint.

An Environmental Assessment Report is being produced to support the application in accordance with Part 3A legislation.

The proponents details are:

Coal & Allied Operations Pty Limited
1011 Lemington Road
Lemington NSW 2330
PO Box 315
Singleton NSW 2330

Phone (02) 6570 0301
Fax (02) 6570 0377

The following documents have been provided to support the application:

- Development Application with Schedule of Land; and
- Hunter Valley Operations South Coal Project Preliminary Assessment report (3 paper copies and 1 CD-rom).

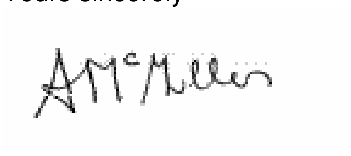
We believe the proposed development is development of a kind described in Section 75E of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

If the Minister is of the opinion that the proposal is a project to which Part 3A of the EPA Act applies, we request that this letter and the attached application form be regarded as an application for approval to carry out the project under section 75E of the EP&A Act and that environmental assessment requirements for the project be issued under section 75F.

As per our discussion on the 26th July, please note that no cheque for the application fee is attached, this will be provided when the cost of the development has been estimated.

If you have any questions in relation to this application please do not hesitate to contact me on (07) 3361 4131.

Yours sincerely



Anna McMullen
Manager – Project Approvals (NSW)

Enc Major Projects Application form
Schedule of Land and associated figures
Hunter Valley Operations South Coal Project Preliminary Assessment Report (3 paper copies)
CD-rom with report provided in electronic copy

Major Projects application

NSW GOVERNMENT
Department of Planning

Date received: ____/____/____ Project Application No. ________________

1. Before you lodge

This form is required to apply for the approval of the Minister to carry out a Project to which Part 3A of the *Environmental Planning and Assessment Act, 1979* (the Act) applies.

Before lodging this application, it is recommended that you first consult with the Department of Planning (the Department) concerning your Project.

Please be aware that you may need to conduct a Planning Focus Meeting before lodging this application involving the Department, relevant agencies, Council or other groups identified by the Department. If you are required to conduct a Planning Focus Meeting, you will need to provide details and outcomes arising from the meeting.

To ensure that your application is accepted as being duly made, you must

- complete ALL parts of this form, **and**
- submit all relevant information required by this form.

All applications must be lodged with the Director-General, by courier or mail.

Ground floor, 23-33 Bridge Street, SYDNEY NSW 2000
GPO Box 39 SYDNEY NSW 2001
DX 10181 Sydney Stock Exchange
t: 02 9228 6111
f: 02 9228 6455

2. Details of the proponent

Company/organisation/agency: Coal & Allied Operations Pty Limited

ABN: 16000023656

☐ Mr ☐ Ms ☒ Mrs ☐ Dr ☐ Other

First name:

Family name:

STREET ADDRESS

Unit/street no.: 1011

Street name: Lemington Road

Suburb or town: Lemington

State: NSW

Postcode: 2330

POSTAL ADDRESS (or mark 'as above'): PO Box 315

Suburb or town: Singleton

State: NSW

Postcode: 2330

Daytime telephone: (02) 6570 0301

Fax: (02) 6570 0377

Mobile: 0409 475 561

Email: Anna.McMullen@rtca.riotinto.com.au

3. Identify the land you propose to develop

STREET ADDRESS

Unit/street no.:

Street or property name: Hunter Valley Operations

Suburb, town or locality: Lemington

Postcode: 2330

Local government area: Singleton & Muswellbrook

REAL PROPERTY DESCRIPTION

OR: detailed description of land attached: ☒

The real property description is found on a map of the land or on the title documents for the land. If you are unsure of the real property description, you should contact the Department of Lands.

Please ensure that you place a slash (/) to distinguish between the lot, section, DP and strata numbers. If the Major Project applies to more than one piece of land, please use a comma to distinguish between each real property description.

Where the Major Project is subject to Clause 8F of the *Environmental Planning and Assessment Regulation 2000* and in lieu of completing the above, a description or detailed plan of the land affected must be included with the documents required with Part 4 below.

4. Proposed Major Project – Description and other Requirements

Provide a brief title for your Project that includes all significant components. If the application relates to only part of a Project, include a clear title that describes the relevant part.

HVO South Coal Project

- Project Approval for HVO South under Part 3A resulting in one approval for the operation and allowing for the surrender of the 25 existing consents and their various modifications that apply to HVO South;
- Continuation of approved opencut and highwall mining areas and the associated activities located in HVO South and described in previous applications and assessments;
- Mining of additional opencut, highwall and/or punch longwall mining areas within Cheshunt, Riverview and Lemington Pits to the Bayswater Seam;
- Approval for the production of 16 Mtpa ROM coal across HVO South;
- Ability to use draglines and truck and shovels at HVO South as suits the operation. This will include the ability to use up to three large shovels and two draglines at any one time across HVO South;
- Upgrades and modifications to infrastructure including upgrade or replacement of the LCPP to allow processing of 16 Mtpa ROM coal
- Transport of product coal via haul road or overland conveyor to access Wambo rail spur, alternatively via a newly constructed rail spur adjacent to the LCPP;
- Construction of infrastructure and stockpiles to support the LCPP and transport options;
- Ability for material and equipment movements across the HVO mining complex, from HVO North to HVO South, including ROM and product coal, rejects, overburden and water;
-Temporary heavy equipment crossings (including draglines, trucks and shovels) of Hunter River, Wollombi Brook and Jerrys Plains Road;
-Relocation or reconfiguration of Comleroi Road and the Hunter Valley Gliding Club airstrip and facilities;
-Relocation of powerlines, water lines and phone lines;

Is the application related only to a part of a Project? ☐ Yes ☒ No

You are also required to provide a Project Description Report and address any matters required by the Director-General in accordance with 75E of the Act. Failure to do so may lead to your application being rejected.

Is a Project Description attached:

Hard copy: ☒ Yes ☐ No

Electronic version: ☒ Yes ☐ No

(NB: An electronic copy is required as all applications must be provided on the Department's website. You should contact the Department on the correct electronic format).

Is the Project Description Report consistent with the requirements of any Guideline produced by the Department (including any draft)? ☒ Yes ☐ No

Does the Project Description Report include additional matters required by the Director-General, such as evidence of a Planning Focus Meeting and consultation? ☒ Yes ☐ No

CONCEPT APPROVAL

If you are applying for a **concept approval**, the Department's *Concept Approval Guideline* should be consulted and the matters identified therein must be addressed as part of your application.

Does the Project Description Report submitted address the relevant guidelines for Concept Approvals?

☐ Yes ☒ No

FULL TIME EQUIVALENT JOBS

Please indicate the number of jobs created by the proposed Major Project. This should be expressed as a proportion of full time jobs over a full year.

Construction jobs (full-time equivalent): 100

Operational jobs (full-time equivalent): 50

5. Approvals from state agencies

Does the proposed Major Project require any of the following: (tick all appropriate)

- ☐ an aquaculture permit under section 144 of the *Fisheries Management Act 1994*
- ☒ an approval under section 15 of the *Mine Subsidence Compensation Act 1961*
- ☒ a mining lease under the *Mining Act 1992*
- ☐ a production lease under the *Petroleum (Onshore) Act 1991*
- ☒ an environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* (for any of the purposes referred to in section 43 of that Act)
- ☒ a consent under section 138 of the *Roads Act 1993*

6. Application fee

You are required to pay a fee for the assessment of a Major Project. This fee is based on the estimated cost of the Major Project.

The Department requires that you pay a proportion of the total fee with this application and you should consult with the Department before lodging this application to determine the proportion to be paid.

Estimated Project Cost

To be advised

7. Owner's Consent

As the owner(s) of the above property, I/we consent to this application being made on our behalf by the Proponent:

Signature	Signature
Subject to Clause 8F	

Name	Name

Date	Date

Note: The Department will not accept an application for a Major Project without having the signature of the owner of the land, **unless** the Major Project is subject to Clause 8F of the *Environmental Planning and Assessment Regulation 2000*.

8. Proponent's Signatures

As the proponent(s) of the proposed Major Project and in signing below, I/we hereby:

- provide a description of the proposed Project and address all matters required by the Director-General pursuant to Section 75E of the Act, and
- apply, subject to satisfying Clause 8D of the *Environmental Planning and Assessment Regulation 2000*, for the Director-General Environmental Assessment Requirements pursuant to Part 3A of the *Environmental Planning and Assessment Act 1979*, and
- declare that all information contained within this application is accurate at the time of signing.

Signature

Name

Rory Gordon

Date

1/9/06

In what capacity are you signing if you are not the proponent

General Manager HSE

Name, if you are not the proponent

NSW GOVERNMENT
Department of Planning

Mining & Extractive Industries
Major Development Assessment
Phone: (02) 9228 6306
Fax: (02) 9228 6466
Email: michael.moore@planning.nsw.gov.au
Level 4 Western Gallery
23-33 Bridge Street
GPO Box 39
SYDNEY NSW 2001

Our ref: S02/02690

Anna McMullen
Manager – Project Approvals (NSW)
Coal & Allied Pty Limited
PO Box 315
SINGLETON NSW 2330

Dear Anna

Director-General's Requirements – Environmental Assessment for the Hunter Valley Operations South Coal Project

The Department has received your application for the Hunter Valley Operations South Coal Project in the Singleton local government area (reference number: 06_0261).

I have attached a copy of the Director-General's requirements (DGRs) for the Environmental Assessment for the project. These requirements have been prepared in consultation with the relevant Government authorities, and are based on the information you have provided to date. I have also attached a copy of the Government authority comments for your information.

Please note that under section 75F(3) of the *Environmental Planning and Assessment Act 1979*, the Director-General may alter these requirements at any time.

I would appreciate it if you would contact the Department at least two weeks before you propose to submit your Environmental Assessment for the project to determine the:
- fees applicable to the application;
- consultation and public exhibition arrangements that will apply; and
- number and format (hard-copy or CD-ROM) of the Environmental Assessment that will be required.

As you may know, the Department will review the Environmental Assessment in consultation with the relevant authorities to determine if it adequately addresses the Director-General's requirements. If the Director-General considers the Environmental Assessment to be inadequate, you will be required to revise it prior to public exhibition.

The Director-General's requirements will be placed on the Department's website along with other relevant information which becomes available during the assessment of the project. As a result, the Department would appreciate it if the documents submitted to the Department are in a suitable format for the web, and if you would arrange for an electronic version of the Environmental Assessment for the project to be hosted on a suitable website with a link to the Department's website.

Finally, if your proposal contains any actions that could have a significant impact on Matters of National Environmental Significance, it will require an additional approval under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). This approval would be in addition to any approvals required under NSW legislation. If you have any questions about the application of the EPBC Act to your proposal, you should contact the Commonwealth Department of Environment and Heritage in Canberra (6274 1111 or http://www.deh.gov.au).

If you have any enquiries about these requirements, please contact Michael Moore of the Department's Mining & Extractive Industries team (02 9228 6306).

Yours sincerely

Yolande Stone 25/1/07

Yolande Stone
A/Executive Director
Major Project Assessments
As delegate for the Director-General

Director-General's Requirements

Section 75F of the *Environmental Planning and Assessment Act 1979*

Application number	06_0261
Project	The Hunter Valley Operations (HVO) South Coal Project, which includes: • consolidation of 25 existing consents to allow production and processing of up to 16 million tonnes of run-of-mine coal across the HVO South mining complex; • extending Cheshunt, Riverview and South Lemington Pits; • transport of coal, overburden, tailings and rejects between HVO South and HVO North; • transport of coal via haul road or conveyor to the Wambo rail spur, or alternatively construction of a new rail spur, and transport of coal to market via rail; • upgrade and modification of existing surface facilities and infrastructure; • relocation of Comleroi Road and various utilities; • relocation or reconfiguration of the Hunter Valley Gliding Club; and • rehabilitation and revegetation of the site.
Location	Approximately 15 kilometres southwest of Singleton, in the Hunter Valley
Proponent	Coal & Allied Operations Pty Limited
Date of Issue	25 January 2007
Date of Expiration	25 January 2009

General Requirements	The Environmental Assessment must include
	• an executive summary;
	• a detailed description of the project including the:
	  – need for the project;
	  – various components and stages of the project; and
	  – the likely inter-relationship between the proposed operations and the existing or approved mining operations at HVO South and HVO North;
	• consideration of any relevant statutory provisions;
	• a general overview of the environmental impacts of the project, identifying the key issues for further assessment, and taking into consideration the issues raised during consultation;
	• a detailed assessment of the key issues specified below, and any other significant issues identified in the general overview of environmental impacts of the project (see above), which includes:
	  – a description of the existing environment;
	  – an assessment of the potential impacts of the project including potential cumulative impacts (particularly on noise, air quality, surface water and groundwater) that may arise from the combined operation of the project, together with the other approved and existing mines in the region;
	• a description of the measures that would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the impacts of the project, and how the existing environmental monitoring and management programs/plans at HVO South and HVO North would be revised to accommodate the proposed changes;
	• a draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures;
	• a conclusion justifying the project, taking into consideration the environmental impacts of the project, the suitability of the site, and the benefits of the project; and
	• a signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false nor misleading.

Key Issues	• **Surface and Groundwater** - including detailed modelling of potential surface and groundwater impacts; a site water balance; a salinity balance; and a detailed description of final void management; • **Flora and Fauna** – including impacts on critical habitats (including riparian habitat), threatened species, populations or ecological communities; and native vegetation; • **Rehabilitation and Final Landform** – including a detailed Rehabilitation and Landscape Management Strategy that describes how the site would be progressively rehabilitated and integrated into the landscape, taking into consideration the rehabilitation plans of existing and approved mines in the area, the Department of Primary Industry's Synoptic Plan, and any other relevant strategic land use objectives for the area. The strategy must also describe what measures would be put in place for the long term protection and management of the site following cessation of mining; • **Noise** – including operational and off-site road and rail noise impacts; • **Blasting and Vibration**; • **Air Quality** – including spontaneous combustion; • **Greenhouse Gases** – a greenhouse gas assessment (including a quantitative analysis of the greenhouse gas emissions associated with the combustion of product coal, and a qualitative assessment of the impacts of these emissions on the environment); • **Subsidence** – an assessment of subsidence impacts associated with any highwall mining; • **Heritage** - both Aboriginal and non-Aboriginal; • **Traffic and Transport**; • **Visual**; and • **Social and Economic**.
References	The Environmental Assessment should take into account relevant State Government technical and policy guidelines. While not exhaustive, guidelines which may be relevant to the project are included in the attached list.
Consultation	During the preparation of the Environmental Assessment, you must consult with the relevant local, State or Commonwealth government authorities, service providers, community groups or affected landowners. The consultation process and the issues raised must be described in the Environmental Assessment. In particular you must consult with: • Department of Environment and Conservation; • Department of Natural Resources; • Department of Primary Industries; • Australian Rail Track Corporation; • NSW Roads and Traffic Authority; and • Singleton Council. The consultation process and the issues raised must be described in the Environmental Assessment.
Deemed refusal period	60 days

State Government Technical and Policy Guidelines - For Reference

Aspect	Policy /Methodology
Soil and Water	
	• *Managing Urban Stormwater: Soils & Construction* (Landcom); • *Guidelines for Fresh and Marine Water Quality* (ANZECC); • *Rehabilitation Manual for Australian Streams* (Land and Water Resources Research and Development Corporation); • the various *State Groundwater Policy* documents (DNR); • *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (DEC);
Flora and Fauna	
	• draft *Guidelines for Threatened Species Assessment* (DEC); • *Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities* (DEC); • *NSW Groundwater Dependent Ecosystem Policy* (DNR)
Blasting and Vibration	
	• *Technical Basis for Guidelines to Minimise Annoyance due to Blasting and Ground Vibration* (ANZECC);
Noise	
	• *NSW Industrial Noise Policy* (DEC); • *Environmental Criteria for Road Traffic Noise* (DEC); • *Environmental Noise Control Manual* (DEC);
Air Quality	
	• *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC);
Greenhouse Gases	
	• *AGO Factors and Methods Workbook* (Australian Greenhouse Office);
Heritage	
	• draft *Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation* (DEC); • *Assessing Heritage Significance* (NSW Heritage Office); • *NSW Heritage Manual* (NSW Heritage Office); • *Archaeological Assessment Guidelines* (NSW Heritage Office, 1996)
Traffic	
	• *Guide to Traffic Generating Development* (RTA); • *RTA Road Design Guide* (RTA); • relevant Austroad standards;
Rehabilitation	
	• NSW Department of Mineral Resources (1999) *Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of NSW*;
Waste	
	• *Environmental Guidelines: Assessment and Classification and Management of Liquid and Non-Liquid Wastes* (DEC).

Our reference : 270731A17; DOC 06/56259
Contact : Karen Marler, 49086803

Anna McMullen JM 5/12/06.
Manager Project Approvals (NSW)
Rio Tinto Coal Australia
GPO Box 391
BRISBANE QLD 4001

2 9 NOV 2006

Dear Ms McMullen

AMENDMENT TO DIRECTOR-GENERALS REQUIREMENTS FOR PREPARATION OF ENVIORNMENTAL ASSESSMENT - PROPOSED EXTENSION OF OPERATIONS AND CONSOLIDATION OF EXISTING CONSENTS – HUNTER VALLEY OPERATIONS – SOUTH

I refer to your request to amend the Director-General's requirements issued by the Department of Environment and Conservation (DEC) for preparation of an Environment Assessment for the above project. I refer also to discussions between Rio Tinto Coal Australia and Mr Larry Clarke of DEC's Noise Assessment Unit regarding the appropriate level of noise assessment required for this proposal.

The DEC agrees to amend the existing Director-General's requirement to remove the need to determine the existing background and ambient noise levels in accordance with the DEC's Industrial Noise Policy (INP) where there are existing noise limits for the subject premises that have been derived from measurements, and in accordance with the INP.

Please find attached the amended Section 4 of the DEC's Director-General's requirements.

PO Box 488G, Newcastle NSW 2300
117 Bull Street, Newcastle West, NSW 2302
Tel: (02) 4908 6800 Fax: (02) 4908 6810
ABN 30 841 387 271
www.environment.nsw.gov.au

Department of **Environment and Conservation** NSW

If you have any questions regarding this matter, please contact Karen Marler on 49086803

Yours sincerely

ROSS BRYLYNSKY
A/Head Regional Operations Unit
North East Branch
Environment Protection and Regulation

Enclosure: Amended Section 5 of DEC Director-General's requirements for preparation of Environmental Assessment for proposed extension of operations and consolidation of existing consents – Hunter Valley Operations – South.

CC: The Department of Planning
Mining and Extractive Industries
GPO Box 39
SYDNEY NSW 2001
Attention: Mr Michael Young

AMENDMENT TO SECTION 4 OF DEC ENVIRONMENTAL ASSESSEMENT REQUIREMENTS FOR THE HUNTER VALLEY OPERATIONS - SOUTH EXTENSION AND CONSOLIDATION PROJECT

4. Noise

The EA Report must include a comprehensive noise assessment of the existing environment, potential impacts and proposed noise amelioration measures. The *New South Wales Industrial Noise Policy* (EPA, 2000) provides a guide to the methodology and assessment criteria preferred by the DEC to determine noise planning levels. The EA Report must determine the existing background (L_{A90}) and ambient (L_{Aeq}) noise levels in accordance with the NSW Industrial Noise Policy (INP), for premises for which an INP assessment has not previously been undertaken.

The evaluation should take into account the construction and operational phases of the development over the "operating" hours proposed and take into account adverse weather conditions including temperature inversions. The assessment must identify any noise sensitive locations likely to be affected by activities at the site, such as residential properties, schools, churches, and hospitals.

The project specific noise levels for the site must be determined for premises not having noise limits that have been derived subsequent to an INP assessment. For each identified potentially affected receiver, this should include:

- determination of the intrusive criterion for each identified potentially affected receiver,
- selection and justification of the appropriate amenity category for each identified potentially affected receiver,
- determination of the amenity criterion for each receiver,
- determination of the appropriate sleep disturbance limit.

The noise and vibration levels likely to be received at the most sensitive locations (these may vary for different activities at each phase of the development) should be determined. Potential impacts should be determined for any identified significant adverse meteorological conditions. Predicted noise levels under calm conditions may also aid in quantifying the extent of impact where this is not the most adverse condition.

Sound power levels measured or estimated for all plant and equipment should be clearly stated and justified. The expected noise level and noise character (eg: tonality, impulsiveness, vibration, etc) likely to be generated from noise sources during the following phases should be determined:

- site establishment
- construction
- operational phases
- transport including traffic noise generated by the proposal
- other services.

The EA Report should include an assessment of cumulative noise impacts, having regard to existing developments and developments which have received development consent in the area but which have not commenced. Of particular interest is the noise generated due to increased use of the rail loop.

Coal & Allied Operations Pty Ltd

Hunter Valley Operations South Coal Project

Environmental Assessment Report Part C - Social and Environmental Interactions

FINAL REPORT

Coal & Allied Operations Pty Limited

Hunter Valley Operations South Coal Project *Planning and Regulatory Framework*

January 2008

Environmental Resources Management Australia
Building C, 33 Saunders Street
Pyrmont, NSW 2009
Telephone +61 2 8584 8888
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www.erm.com

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1 INTRODUCTION

1.1 GENERAL

Coal & Allied Operations Pty Limited (CNA) is seeking Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (*EP&A Act*) to allow for infrastructure upgrades, modifications and extension to mining and replacement of the existing 35 approvals that currently apply to their Hunter Valley Operations (HVO) South with a singular Project Approval. Environmental Resources Management Pty Ltd (ERM) has been commissioned to document the regulatory framework for the proposal.

This report is structured to discuss relevant Commonwealth, State and Local legislation.

1.2 PROJECT PROPOSAL

The proposal, known as the HVO South Coal Project, will include:

- an extension of mining operations at the Riverview, Cheshunt and South Lemington Pits (and subsequently extensions to the approved disturbance area);
- mining up to 16 Million tonnes per annum (Mtpa) by dragline, shovels, excavators and associated haul trucks;
- the full integration of operations at HVO South through new activities and upgrades and modifications to existing approved operations; and
- the granting of a Project Approval to replace all existing consents.

The Director General of the Department of Planning (DoP) issued environmental assessment requirements (DGRs). The DGRs identify key issues to be addressed and the level of assessment required. They also include requirements to prepare a draft Statement of Commitments setting out how the project will be managed in an environmentally sustainable manner, consultation requirements and the deemed refusal period. The DGRs are presented as *Annex B* of Volume 2.

2 EXISTING CONSENTS

There are 25 existing development consents and 10 associated modifications that apply to HVO South. These consents have been issued by both the SSC and the DoP and a summary is provided as *Appendix A* to this report.

3 COMMONWEALTH LEGISLATION

3.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) requires approval from the Commonwealth Minister for the Environment for actions that may have a significant impact on matters of national environmental significance. The *EPBC Act* also requires Commonwealth approval for certain actions on Commonwealth land. Matters of national environmental significance under the *EPBC Act* include the following:

- World Heritage properties;
- Natural heritage places;
- Ramsar wetlands of international importance;
- Threatened species or ecological communities listed in the *EPBC Act*;
- Migratory species listed in the *EPBC Act*;
- Commonwealth marine environment; and
- Nuclear actions.

The study area is not a world heritage property, a natural heritage place, a Ramsar wetland of international importance, or a Commonwealth marine environment and the proposal does not include nuclear actions. A search of threatened species and ecological communities and migratory species listed in the *EPBC Act* was completed as part of the Environmental Assessment and is documented in the *Hunter Valley Operations South Coal Project: Ecological Assessment*, prepared by ERM (2007).

No species or communities listed as threatened under the *EPBC Act* were recorded within the HVO South study area. However, several species listed as migratory or marine under the *EPBC Act* have been recorded. The proposal is not likely to have a significant impact on any migratory or marine protected under the *EPBC Act* such that a referral to the Minister for Environment and Conservation is not required. Ecological management measures relating to the proposal are detailed in *Section 6* of *Annex L*.

3.2 ENERGY EFFICIENCY OPPORTUNITIES ACT 2006 AND REGULATIONS 2006

This Act aims to improve the identification and evaluation of energy efficiency opportunities by large energy using businesses and, as a result, to encourage implementation of cost effective energy efficiency opportunities.

The Act requires large energy using businesses:

(a) to undertake an assessment of their energy efficiency opportunities to a minimum standard in order to improve the way in which those opportunities are identified and evaluated; and

(b) to report publicly on the outcomes of that assessment in order to demonstrate to the community that those businesses are effectively managing their energy.

This Act applies to HVO South project by virtue of the fact that the energy use threshold of HVO is greater than the trigger level of 0.5 petajoules for a financial year.

Rio Tinto Limited has registered on the Register of Corporations for the Energy Efficiency Opportunities program. As such, Rio Tinto Limited will be the reporting entity for CNA under the program. CNA's reporting requirements will include the energy efficiency projects associated with the HVO South project. Rio Tinto Limited will lodge annual Assessment Reports with the Department of Industry Tourism and Resources (DITR) that outline the outcomes of energy efficiency opportunity assessments undertaken at its operations.

Energy saving activities undertaken at HVO South are identified in *Chapter 17 - Energy Use and Greenhouse Gas*.

4 STATE LEGISLATION

4.1 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

Part 3A of the *EP&A Act* details the approval of major infrastructure and other significant 'projects'. It applies to:

"… the carrying out of development that is declared under this section to be a project to which this Part applies:

(a) by a State environmental planning policy, or

(b) by order of the Minister published in the Gazette" (Section 75(b)).

If the Minister forms the opinion that development is development of a kind described in the Schedules to State Environmental Planning Policy Major Projects (SEPP MP) 2005 the development is declared to be a project to which Part 3A of the *EP&A Act* applies. The project requires approval under Part 3A from the Minister for Planning. [

Under Section 75R of the *EP&A Act,* Environmental Planning Instruments (EPIs) (other than State Environmental Planning Policies (SEPPs)) do not apply to an approved 'Major Project' under Part 3A except to the extent that any EPI wholly prohibits the development. A discussion of the SEPPs applicable to the proposed development is found below. The development is permissible under Singleton Local Environmental Plan.

The Environmental Assessment Report, which assesses the likely impact of the proposal on the environment, has been prepared in accordance with Section 75(F) of the *EP&A Act* and the DoP DGRs.

Pursuant to Section 75U the following authorisations are not required for an approved project:

a) *"the concurrence under Part 3 of the Coastal Protection Act 1979 of the Minister administering that Part of the Act,*

b) *a permit under section 201, 205 or 219 of the Fisheries Management Act 1994,*

c) *an approval under Part 4, or an excavation permit under section 139, of the Heritage Act 1977,*

d) *a permit under section 87 or a consent under section 90 of the National Parks and Wildlife Act 1974,*

e) *an authorisation referred to in section 12 of the Native Vegetation Act 2003 (or under any Act to be repealed by that Act) to clear native vegetation,*

f) *a permit under Part 3A of the Rivers and Foreshores Improvement Act 1948,*

g) *a bush fire safety authority under section 100B of the Rural Fire Act 1997,*

h) *a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the Water Management Act 2000.*

2) *Division 8 of Part 6 of the Heritage Act 1977 does not apply to prevent or interfere with the carrying out of an approved project".*

Pursuant to Section 75V of the *EP&A Act*, authorisation of a Mining Lease under the *Mining Act 1992* or an Environment Protection Licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* (for any of the purposes referred to in section 43 of that Act) cannot be refused if it is necessary for carrying out a project approved under Part 3A of the *EP&A Act* and it is substantially consistent with the Project Approval.

Under Section 81 of the *EP&A Act* a construction certificate will be required for the erection of any buildings as part of the approved project. An occupancy certificate for the building will not be required if it is used for the purpose for which the building is approved.

The Part 3A approvals process is set out in *Figure 4.1*.

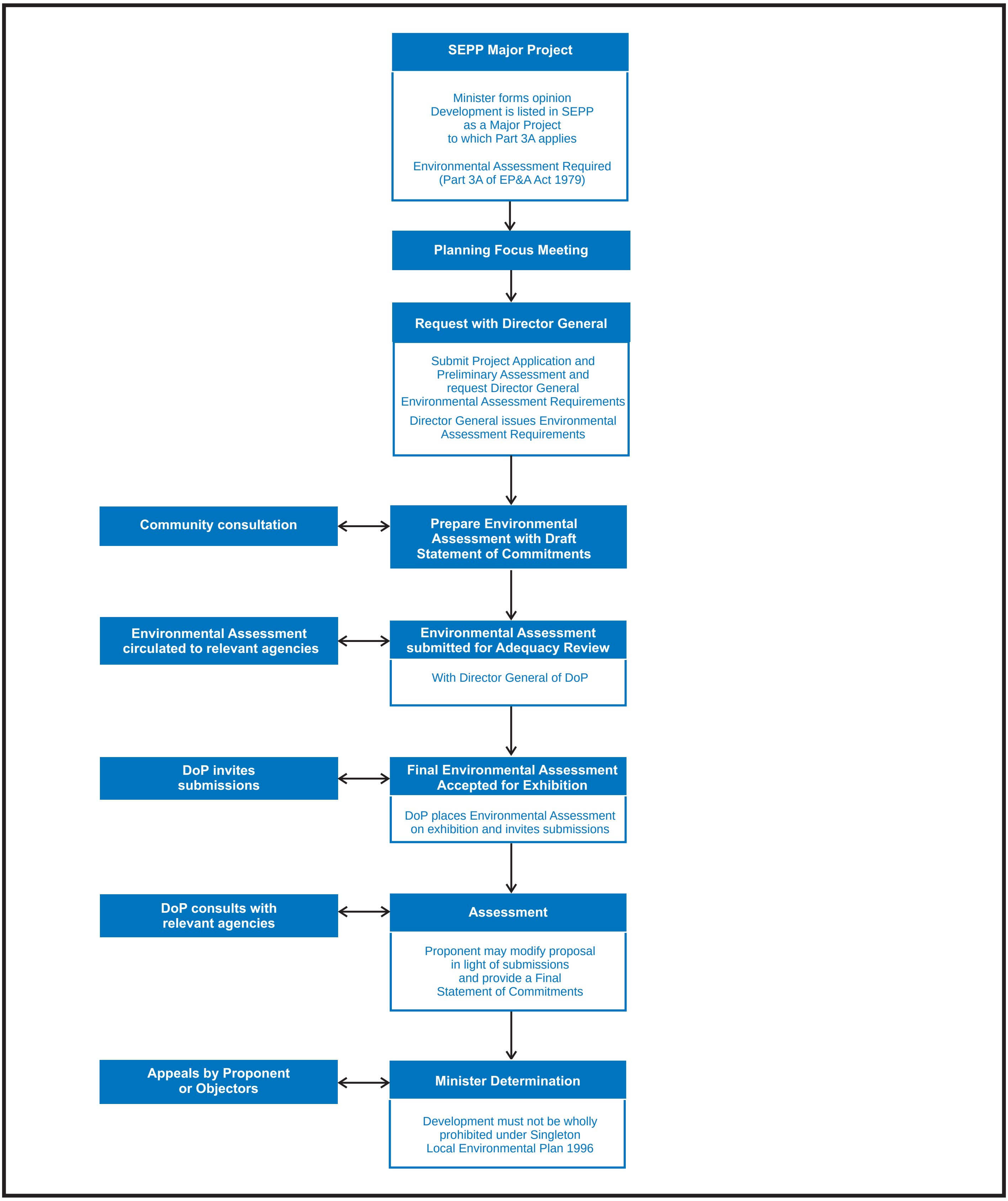

Figure 4.1

Environmental Assessment Process Under Part 3A of the EP&A Act

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_IC_08_R3		
Date:	26/09/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	LS
Source:	-		
Scale:	N/A		

Environmental Resources Management Australia Pty Ltd
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ERM

4.2 *STATE ENVIRONMENTAL PLANNING INSTRUMENTS*

4.2.1 *State Environmental Planning Policy – Major Projects 2005*

The SEPP MP applies to development that is referred to in Schedules 1, 2 or 3 of the SEPP MP. Mining is included in Schedule 1 to the SEPP MP and enables the Minister to form the opinion that the development is a Project to which Part 3A of the *EP&A Act* applies.
Mining is included in Schedule 1 as follows:

(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.

(2) Extracting a bulk sample as part of resource appraisal or a trial mine comprising the extraction of more than 20,000 tonnes of coal or of any mineral ore.

(3) Development for the purpose of mining related works (including primary processing plants or facilities for storage, loading or transporting any mineral, ore or waste material) that:

(a) is ancillary to or an extension of another Part 3A project, or

(b) has a capital investment value of more than $30 million or employs 100 or more people".

Section 5 of the SEPP MP states that where there is an inconsistency between it and any other environmental planning instrument, the SEPP MP prevails.

As the proposal relates to coal mining, the proposal satisfies the relevant criteria set out in SEPP MP and Part 3A of the Act applies. The policy establishes the Minister for Planning as the determining authority for any development classified as a 'Major Project'.

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

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (SEPP 2007) consolidates and updates planning provisions related to these industries as well as ensuring that potential environmental and social impacts are adequately addressed during the assessment and determination of project applications. SEPP 2007 repeals State Environmental Planning Policy No 45 – Permissibility of Mining (SEPP 45).

Under clause 7, development for the purposes of mining may be carried out only with consent.

Under clause 12, the consent authority is required to consider the land use. HVO is an existing brownfield operation that has been active since 1949. The proposal involves the replacement of consents and an extension of the existing pits within the current HVO South Mine Lease boundary. As such, the potential for land use conflict and land use constraint in respect to adjacent landuses is considered to be low.

Clause 14 of SEPP 2007 requires the consent authority to apply consent conditions that ensure a mining development is undertaken in an environmentally responsible manner, and in particular that impacts to significant surface and groundwater resources, threatened species and biodiversity and greenhouse gas emissions are avoided, or are minimised to the greatest extent practicable.

Assessment of the potential impact of the proposal on these key natural resources has been carried out as part of the Environmental Assessment Report and includes appropriate management measures where required.

The consent authority, under clause 15 of SEPP 2007, must also consider the efficiency or otherwise of the proposal in terms of resource recovery and the minimisation of waste through reuse or recycling of material. *Chapter 17 – Energy Use and Greenhouse Gas*, outlines CNA's energy reduction initiatives (refer to *Section 4.3.5* for further discussion on energy efficiency). CNA's 'Total Waste Management System' is recognised as best practice in non-mineral waste management within the coal industry and is detailed in *Chapter 16 – Waste Management*.

Before granting approval, under clause 16 of SEPP 2007 the consent authority must consider whether a mining application limits the transport of material via the public road system. The proposal will surrender the existing road haulage consent which currently applies to the operation.

In accordance with clause 17 of SEPP 2007, the consent authority must consider the need for a rehabilitation plan to be prepared for a mining development, which addresses the proposed waste generation and handling of the operation, and potential contamination and public safety issues associated with the proposed end use. The SEPP 2007 Planning Circular states that a rehabilitation strategy is required for all mines as part of the development approval process.

The fundamentals for mine closure are presented in *Chapter 19 – Mine Landscape and Closure Planning.* The holistic approach to closure enables the development of a final landform that integrates biodiversity, the Hunter Valley Synoptic Plan objectives, strategic land use i.e. agricultural versus biological benefits including the restoration of previous high value land capability such as Class II lands through progressive rehabilitation, and integration of landscape characteristics such as final voids and slopes. Public safety in relation to final landform and contamination of natural systems including groundwater and surface water are addressed in Volume one of the Environmental Assessment.

4.2.3 State Environmental Planning Policy No. 11 – Traffic Generating Developments

State Environmental Planning Policy No. 11 – Traffic Generating Developments (SEPP 11) aims to ensure that the Roads and Traffic Authority (RTA) is made aware of, and given the opportunity to make representations in respect of developments such as mining.

Under Section 7 of SEPP 11 a consent authority is required to forward a copy of any development application for mining to the RTA and cannot approve the application until it has received representation from the RTA, or been informed that the RTA does not wish to make any representation, or 21 days has lapsed after the application was forwarded to the RTA.

As the proposal requires an approval under Part 3A, the DoP is required to forward the application to the RTA for comment.

4.2.4 State Environmental Planning Policy No 33 - Hazardous and Offensive Development

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) seeks to require development consent for hazardous or offensive development proposed to be carried out and to ensure that in determining whether a development is a hazardous or offensive industry, any measures proposed to be employed to reduce the impact of the development are taken into account.

Clause 2 of SEPP 33 stipulates the specific aims of the Policy which are:

a) *'to amend the definitions of hazardous and offensive industries where used in environmental planning instruments, and*

b) *to render ineffective a provision of any environmental planning instrument that prohibits development for the purpose of a storage facility on the ground that the facility is hazardous or offensive if it is not a hazardous or offensive storage establishment as defined in this Policy, and*

c) *to require development consent for hazardous or offensive development proposed to be carried out in the Western Division, and*

d) *to ensure that in determining whether a development is a hazardous or offensive industry, any measures proposed to be employed to reduce the impact of the development are taken into account, and*

e) *to ensure that in considering any application to carry out potentially hazardous or offensive development, the consent authority has sufficient information to assess whether the development is hazardous or offensive and to impose conditions to reduce or minimise any adverse impact, and*

f) *to require the advertising of applications to carry out any such development'.*

All hazardous materials will continue to be managed in accordance with existing CNA Environmental Management System procedures that are currently implemented successfully at HVO South.

The DoP in their in 1994 document, *Applying SEPP 33*, state *that "Typically, the level of offence would not be considered significant if relevant EPA (or any other relevant pollution control) licences can be obtained; that is, if the EPA (or other licensing authority) is willing to issue a licence under its pollution control legislation".* The existing Environment Protection Licence (EPL) for HVO will be updated to reflect changes to HVO South resulting from the proposal. The proposal is not considered to be an offensive industry.

4.2.5 *State Environmental Planning Policy No. 44 – Koala Habitat Protection*

State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free – living population over their present range and reverse the current trend of koala population decline. An assessment of the potential for koala habitat within the site was documented in the *Hunter Valley Operations South Coal Project: Ecological Assessment*, prepared by ERM (2007).

No evidence of koala activity has been recorded in previous assessments at HVO South, and no direct or indirect evidence (such as scats or scratches on tree trunks) were recorded during ERM surveys in May 2006. The remnant vegetation at HVO South is not considered to represent core koala habitat, as defined under SEPP 44.

4.3 *OTHER STATE LEGISLATION*

4.3.1 *Coal Mine Health and Safety Act 2002*

The *Coal Mine Health and Safety Act 2002* regulates activities undertaken on coal mines to ensure that the health, safety and welfare of persons involved in their operation are protected. Activities undertaken within HVO South will continue in accordance with this Act. The replacement of current consents with a Project Approval and extension of mining areas is not expected to require additional consideration under this legislation.

4.3.2 *Coal Mines Regulation Act 1982*

The *Coal Mines Regulation Act 1982* regulates activities undertaken on coal mines including mine management and operations. Activities undertaken at HVO South will continue in accordance with the provisions of this Act.

4.3.3 *Crown Lands Act 1989*

The *Crown Lands Act 1989* seeks to ensure that Crown land is managed for the benefit of the people of New South Wales and in particular to provide for the reservation or dedication of Crown land for public purposes and the management and use of the reserved or dedicated land.

The Minister may grant a 'relevant interest' (lease, licence or permit in respect of, or an easement or right-of-way) over a Crown reserve for the purposes of any facility or infrastructure or for any other purpose the Minister thinks fit. The relocation of travelling stock route number 52974 will require the written consent of the State Minister for Environment and Conservation in consultation with the Hunter Rural Lands Protection Board.

4.3.4 *Dams Safety Act 1978*

The Dams Safety Committee is the State's regulator for dam safety under the NSW *Dams Safety Act 1978*. It is responsible for the development and implementation of policies and procedures for effective dam safety management to protect life, property and the environment from dam failures.

The Dams Safety Committee poses conditions on Mining Leases to prevent or mitigate any damage to a prescribed dam. Schedule 1 of the *Dams Safety Act 1978* lists the prescribed dams, and includes the Lemington Mine Tailings dam and Lemington Mine Tailings Dam No. 5 within HVO South. The Committee may prescribe and attach conditions on any new dams to be constructed as part of the proposed water management system for HVO South. Consultation will occur with the Dams Safety Committee as the engineering designs progress.

4.3.5 *Energy and Utilities Administration Act 1987 No 103*

The Energy and Utilities Administration Act 1987 No 103 seeks to 'promote and maintain the efficiency and accountability of energy producers and suppliers and their responsiveness to community needs and expectations'. Part 6A of the Act was introduced in May 2005 to encourage a better understanding of energy and water use by business, government agencies and local councils and establish detailed plans of action for savings.

Under section 34(Q) of the Act, designated energy users were required to prepare a draft energy savings action plan to be submitted to the Minister for approval by 30 June 2006. Designated energy users are businesses in NSW using more than 10 gigawatt-hours per year at a site and are listed in Schedule 1 of the NSW Energy Savings Order 2005. Schedule 1 includes CNA's HVO.

CNA are therefore required to/have prepared a draft energy savings plan every four years. In accordance, CNA has prepared a draft energy savings plan that included a number of energy saving activities undertaken at HVO South. These activities are documented in *Chapter 17 – Energy Use and Greenhouse Gas.* As stipulated, CNA will continue to prepare a plan for their HVO every four years.

4.3.6 *Mine Subsidence Compensation Act 1961*

The *Mine Subsidence Compensation Act 1961* provides for compensation or repair services where improvements are damaged by mine subsidence resulting from the extraction of coal. The Mine Subsidence Board is a service organisation operating for the community in coal mining areas of NSW and is responsible for administering the Act. The Act also makes the Board responsible for reducing the risk of mine subsidence damage to properties by assessing and controlling the types of buildings and improvements which can be erected in Mine Subsidence Districts.

HVO South is located within the Patrick Plains Mine Subsidence District. Approval is required from the Board to alter or erect improvements or subdivide land within a Mine Subsidence District. If the proposal is granted Project Approval under the Part 3A planning process, approval must not be refused by the Mine Subsidence Board and must be substantially consistent with the terms of the Project Approval.

4.3.7 *Mining Act 1992*

The *Mining Act 1992* refers to the granting of Mining Leases and mining activities generally.

A 'mine' is defined:

a) *'when used as a noun—any place, pit, shaft, drive, level or other excavation, drift, gutter, lead, vein, lode, reef or salt-pan (whether occurring naturally or artificially created) in, on or by means of which, any mining operation is carried on, and*

b) *when used as a verb—to extract material from land for the purpose of recovering minerals from the material so extracted or to rehabilitate land from which material has been so extracted, but does not include any activity declared not to be mining by a regulation under section 11A.'*

Under the *Mining Act 1992* environmental protection and rehabilitation are regulated by conditions in all Mining Leases, including requirements for the submission and approval from the Department of Primary Industries (DPI) of a Mining Operations Plan (MOP) prior to the commencement of operations. Environmental protection and rehabilitation has been addressed in Volume 1 of this Environmental Assessment.

An application to the DPI is being considered for a Mining Lease that, where appropriate, encompasses the Project Application area. This will improve and simplify the mining tenure situation currently in place for HVO South. If the proposal is granted Project Approval under the Part 3A planning process, approval must not be refused by the DPI and must be substantially consistent with the terms of the Project Approval.

4.3.8 *Protection of the Environment Operations Act 1997*

The *Protection of the Environment Operations Act 1997* (*POEO Act*) provides an integrated system of licensing for polluting industries. Schedule 1 of the *POEO Act* identifies types of development that require an EPL. Included in Schedule 1 are opencut coal mines that:

a) *"have an intended production or processing capacity of more than 500 tonnes per day of coal or carbonaceous material, or*

b) *have disturbed, are disturbing or will disturb a total surface area of more than 4 hectares of land by:*

(i) clearing or excavating, or

(ii) constructing dams, ponds, drains, roads, railways or conveyors, or

(iii) storing or depositing overburden, coal or carbonaceous material or tailings".

Section 48 of the *POEO Act* requires scheduled activities listed in Schedule 1 to hold a premises-based EPL applies across HVO as a whole. This EPL will be reviewed and updated as necessary to reflect changes to HVO South resulting from the proposal. If the proposal is granted Project Approval under the Part 3A planning process, approval must not be refused by the DECC and must be substantially consistent with the terms of the Project Approval.

4.3.9 Roads Act 1993

Under section 138 of the *Roads Act 1993* consent is required to erect a structure or carry out a work, in, on or over a public road or connect a road (whether public or private) to a classified road. A consent may not be given with respect to a classified road except with the concurrence of the RTA.

The proposal involves the relocation of a short section of the public Comleroi Road. Comleroi Road connects to the Golden Highway/Jerrys Plains Road (a classified road), however this intersection will not be altered as part of the proposal. Comleroi Road is a non-classified road under the care and control of SSC such that an approval/concurrence from the RTA will not be required for this work. An approval under Section 138 of the *Roads Act 1993* will be required from SSC for work in, on or over this road. If the proposal is granted Project Approval under the Part 3A planning process, approval must not be refused by the SSC and must be substantially consistent with the terms of the Project Approval.

4.3.10 Threatened Species Conservation Act 1995

Projects determined by a statutory authority of the NSW State Government, are required to be assessed in accordance with the *EP&A Act*, as amended by the *Threatened Species Conservation Act 1995* (*TSC Act*). Licences are required to harm or pick threatened species, populations or ecological communities or their habitat. Section 3 lists the objects of the *TSC Act*, which are:

(a) to conserve biological diversity and promote ecologically sustainable development, and

(b) to prevent the extinction and promote the recovery of threatened species, populations and ecological communities, and

(c) to protect the critical habitat of those threatened species, populations and ecological communities that are endangered, and

(d) to eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities, and

(e) to ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed, and

(f) to encourage the conservation of threatened species, populations and ecological communities by the adoption of measures involving co-operative management.'

The presence of threatened fauna species and endangered ecological communities was investigated as part of the Environmental Assessment and documented in the *Hunter Valley Operations South Coal Project: Ecological Assessment*, prepared by ERM (2007).

One species listed as vulnerable under the *TSC Act*, the Grey-crowned Babbler, and one population listed as endangered under the *TSC Act*, *Eucalyptus camaldulensis* (River Red Gum) in the Hunter Catchment, were recorded during field surveys in May 2006. Management measures that will be implemented at HVO South to manage potential impacts to the Grey-crowned Babbler and River Red Gum population are listed in the aforementioned report.

4.3.11 Water Act 1912

The *Water Act 1912* is administered by Department of Water and Energy (DWE) and under this Act, a licence is required if water is extracted from a creek or if any waterways are proposed to be realigned.

Current licences to pump water from the Hunter River are expected to be adequate.

4.3.12 Water Management Act 2000

The *Water Management Act 2000* (WM Act) incorporates the provisions of various acts relating to the management of surface and groundwater in NSW, and provides a single statute for the regulation of water use and works that affect surface and groundwater, both marine and fresh.

Parts of the *WM Act* commenced on 1 January 2001. Since 1 July 2004 the new licensing and approval system has been in effect in the areas of NSW covered by 36 operational water sharing plans.

There is an operational water sharing plan for the 'Hunter Regulated River Water Source' which commenced on 1 July 2004. It regulates the Hunter River from Glenbawn Dam to Maitland. This proposal involves the continued extraction of water from the Hunter Regulated River Water Source which is subject to the Water Sharing Plan for the Hunter Regulated River Water Source 2003.

The licensing provisions of the *WM Act* therefore apply to the proposal to the extent that the proposal involves the continued extraction of water from the Hunter River.

Advice received from DWE indicates that the provisions of the *WM Act* relating to controlled activities and aquifer interference activities are yet to be enacted for this water source, such that exemptions for a proposal approved under Part 3A of the *EP&A Act* for *a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the WM Act,* do not currently apply.

The proposed extraction of water from a water source is not covered by exemptions from the requirement to hold a water access licence under the *WM Act* and *Water Management Regulations 2004*, and therefore an allocation under a water access licence will be required. Advice received from the DWE, however, has indicated that it is not practically possible to separate works approvals and water access licences under the *WM Act*. The proposal will therefore require any additional water approvals to be sought concurrently with the Part 3A approval process. Water licences are discussed further in *Chapter 10 – Surface Water Management*.

4.4 NON LIMITING STATE LEGISLATION

Following are Acts that apply to the site but do not limit development in a Part 3A application pursuant to Section 75R of the *EP&A Act*.

4.4.1 *Fisheries Management Act 1994*

The *Fisheries Management Act 1994* as amended by the *Fisheries Management Amendment Act 1997* includes provisions to declare and list threatened species of fish and marine vegetation, endangered populations and ecological communities, and key threatening processes. Section 75U of the *EP&A Act* excludes projects approved under Part 3A from requiring a permit under section 201, 205 or 219 of this Act.

4.4.2 *Heritage Act 1977*

The *Heritage Act 1977* protects the natural and cultural history of NSW with emphasis on non-Aboriginal cultural heritage through protection provisions and the establishment of a Heritage Council. As this proposal is being assessed under Part 3A of the *EP&A Act* the *Heritage Act 1977* does not apply (see section 75U of EP&A Act).

4.4.3 *National Parks and Wildlife Act 1995*

An object of the *National Parks and Wildlife Act 1995* (*NPW Act*) is to conserve objects, places or features (including biological diversity) of cultural value within the landscape.

Sections 87 and 90 of the *NPW Act* requires a permit to disturb or excavate land for the purpose of discovering an aboriginal object and Section 90 requires consent to destroy an Aboriginal object.

Section 75U of the *EP&A Act* excludes projects approved under Part 3A from requiring these permits.

4.4.4 *Native Vegetation Act 2003*

Clause 12 of the *Native Vegetation Act 2003* requires consent from the Minister for the clearing of 'native vegetation', which is defined in the as:

"*any of the following types of indigenous vegetation:*

(a) trees (including any sapling or shrub, or any scrub),

(b) understorey plants,

(c) groundcover (being any type of herbaceous vegetation),

(d) plants occurring in a wetland.

(2) Vegetation is indigenous if it is of a species of vegetation, or if it comprises species of vegetation, that existed in the State before European settlement".

Section 75U of the *EP&A Act* excludes projects approved under Part 3A from requiring "*an authorisation referred to in section 12 of this (or under any Act to be repealed by that Act) to clear native vegetation*".

4.4.5 *Rivers and Foreshores Improvements Act 1948*

Under Section 22B of the *Rivers and Foreshore Improvements Act 1948* a permit is required to excavate on, in or under protected land, or remove material from protected land, or do anything which obstructs, or detrimentally affects, the flow of protected waters, or which is likely to do so. Section 75U of the *EP&A Act* excludes projects approved under Part 3A from requiring a permit.

5 LOCAL ENVIRONMENTAL PLANNING INSTRUMENTS

5.1 SINGLETON LOCAL ENVIRONMENT PLAN 1996

Pursuant to Section 75J(3) of the *EP&A Act* the Minister cannot approve the carrying out of a project that would be wholly prohibited under an environmental planning instrument. Under the *Singleton Local Environment Plan 1996* (SLEP), the study area and its surrounds are zoned Rural 1(a), within which mining is permissible. The SLEP 1996 defines a 'mine' as

"*any place, open cut, shaft, tunnel, pit, drive, level or other excavation, drift, gutter, lead, vein, lode or reef on, in or by which any operation is carried on for or in connection with the purpose of obtaining any metal or mineral by any mode or method and any place on which any product of the mine is stacked, stored, crushed or otherwise treated, but does not include a quarry*". *"*

An objective of the Rural 1(a) zone is:

"…*to allow mining where environmental impacts do not exceed acceptable limits and the land is satisfactorily rehabilitated after mining, …".*

The existing Hunter Valley Clay Target Shooting Club and Hunter Valley Gliding Club (HVGC) are permissible in the Rural 1(a) zone.

The proposed relocation of the HVGC will require Project Approval as part of the current proposal. In addition, under Section 81 of the *EP&A Act* a construction certificate will be required for the erection of any buildings. An occupancy certificate for the building will not be required if it is used for the purpose for which the building is approved.

All other licences and approvals which may be required for the HVGC do not constitute part of the current proposal and will be the subject of a separate development approval for the operation of the facility.

6 OTHER PROVISIONS

Other plans that apply to the site but do not limit development in a Part 3A application pursuant to Section 75R of *EP&A Act* are set out below.

6.1 HUNTER REGIONAL ENVIRONMENT PLAN 1989

The Hunter Regional Environment Plan 1989 (HREP) applies to land in a number of local government areas including Singleton. It sets a policy framework for development in the Hunter Region which aims to promote a balanced development of the region, improvement of urban and rural environments and the orderly and economic development and optimum use of its land and other resources, consistent with conservation of natural and man made features, so as to meet the needs and aspirations of the community. The HREP guides the preparation of environmental planning instruments and the processing of development applications in accordance with regional objectives

The parts of the HREP with direct relevance to coal mining are set out below.

Division 1 of Part 4 – Land use and Settlement

The objective of the HREP in relation to rural land is to protect prime crop and pasture land from alienation, fragmentation, degradation and sterilisation. This Environmental Assessment assesses land use and the suitability of the study area.

Division 1 of Part 5 - Transport

The HREP seeks to maximise accessibility and facilitate the movement of people and goods throughout the region in a manner which has regard to social, economic, environmental and safety considerations. It encourages the transport of goods, especially coal and other bulk materials, by rail and other non – road modes where practical. The Environmental Assessment assesses the potential impact to the external road and rail transport network.

Division 1 of Part 6 – Natural Resources

Section 41 of the HREP lists a range of matters that a consent authority must consider when determining an application for mining, including progressive rehabilitation of mined areas, the likelihood and extent of a final void and the impact of any final void, the impact on ground and surface water quality and flow characteristics, the impact on air quality and acoustical environment, transport and relevant Total Catchment Strategies. These are addressed in Volume 1 of this Environmental Assessment Report.

Appendix A

Summary of Existing Consents

Table A.1 *Summary of Approvals for Cheshunt and Riverview Pits*

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
85/27	Consent	4/5/1986	DEP(1)	• Development of Hunter Valley No. 2 Mine; • Transport of 4.5 Mt ROM coal from south of the Hunter River to HVCPP, Liddell coal preparation plant or HVLP; and • Short and long term re-alignments of Jerrys Plains Road to the south.
37/90	Consent	18/10/1990	SSC(2)	• Western out-of-pit emplacement of overburden in conjunction with development of Hunter Valley No. 2 Mine; • Rescheduling of mining of Riverview Pit.
81/828	Mod 1(3)of DA 85/27	12/11/1990	SSC	• Permanent re-alignment of Jerrys Plains Road.
144/96	Consent	24/1/1997	SSC	• Small extension (56 ha) to the south west of South Mine (former Hunter Valley No. 2 Mine) to re-orientate mining strips to increase mining efficiency.
144/96 (37) M1	Mod 1 of DA 144/96	27/8/1997	DUAP(4)	• Modification of DA 114/96 to take weather measurements prior to blasting.
114-12-98	Consent	15/3/2000	DUAP	• Increase rate of mining to 8 Mtpa and development of the Cheshunt Pit with mining to progress south west through Riverview Pit; • Out-of-pit emplacement of overburden on the Lemington Mine site; and • Overland conveyor from HVO South to HVCPP.
85/27 M2	Mod 2 of DA 85/27	2/10/2001 (Expired)	DUAP	• Interim coal transport from Riverview Pit to LCPP for processing prior to CNA approval for revised Cheshunt/ Riverview mine plans.
14-01-01-M1	Mod 1 of DA 114-12-98	2/11/2001	DUAP	• Change in mining schedule to seven day operations from year one rather than year nine; and • Amendment to Dewatering Management Plan and timing of submission of Environmental Management Plans (EMPs).

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
114-12-98-M2	Mod 2 of DA 114-12-98	11/3/2002	DUAP	• Altering mine plan including concurrent mining at Cheshunt and Riverview Pits; • Operation of dragline at Riverview Pit; and • Haulage of coal from Cheshunt and Riverview Pits to either or both the LCPP or the HVCPP.
114-12-98-M3	Mod 3 of DA 114-12-98 (S02/02690)	23/1/2003	SSC	• Establish 13 month blasting schedule from Feb 2003.
181-8-05	Consent	31/3/2006	DoP	• Extension of opencut coal mining from the Cheshunt Pit through the Barry Property enabling the extraction of approx 8 Mtpa of ROM coal.
114-12-98-M4	Mod 4 of DA 114-12-98	11/5/2006	DoP	• Extension of opencut coal mining to the south west of the Riverview Pit.

1. Department of Environment and Planning which is now DoP
2. Singleton Shire Council
3. Mod = Modification
4. Department of Urban Affairs and Planning which is now DoP

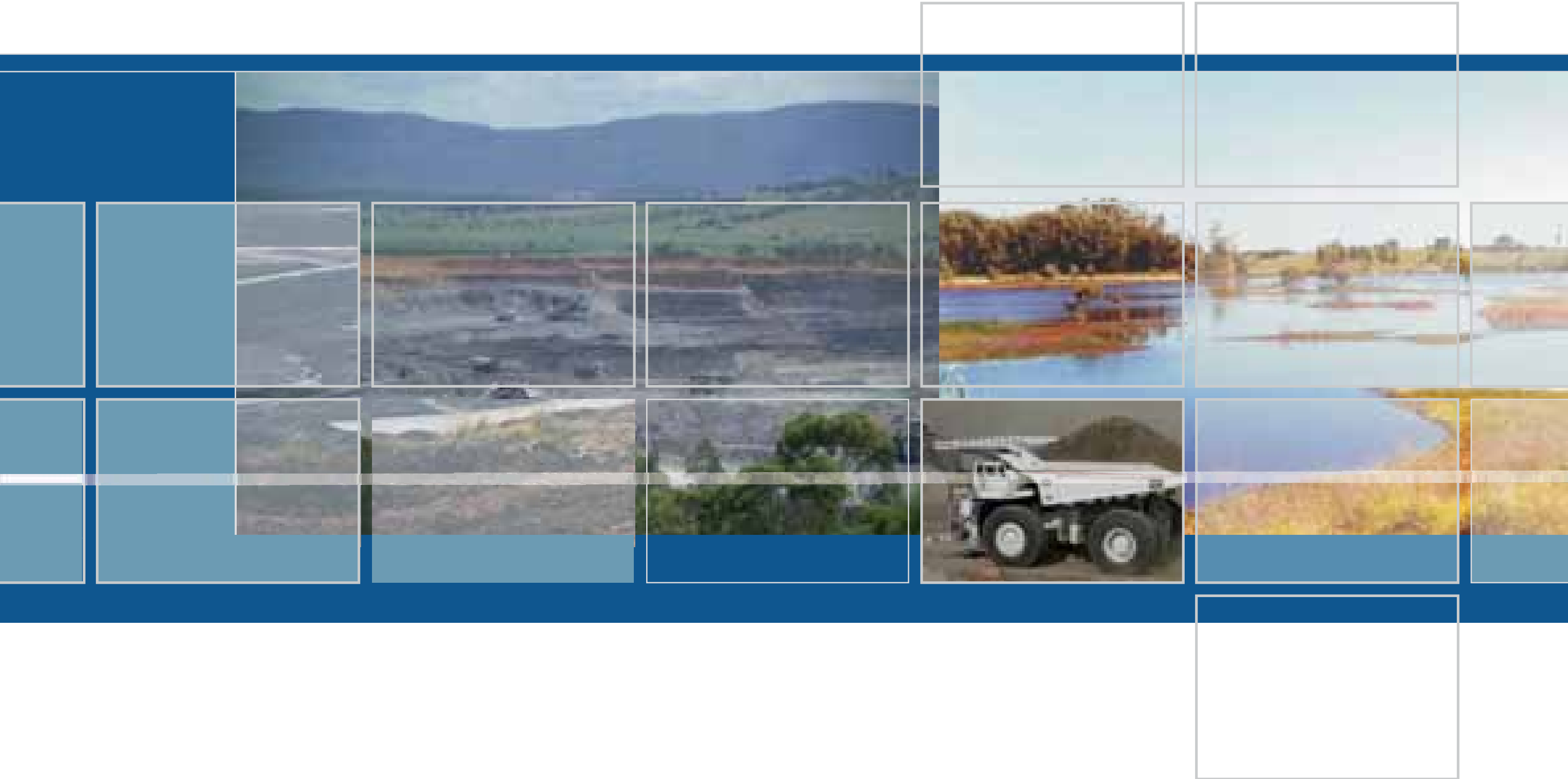
Table A.2 *Summary of Approvals for Lemington Mine and Coal Preparation Plant*

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
Unknown	Consent	24/6/1971	SSC(1)	• Establish opencut mine and No. 1 underground mining complex with 1 Mtpa ROM coal limit; and • Construct LCPP.
88/76	Consent	24/2/1976	SSC	• Extend mining into No. 2 underground mining complex area and increase ROM coal to 2 Mtpa; and • Construct second (current) LCPP at 440 tph of ROM coal.
78/42	Consent	27/10/1978 (Expired)	SSC	• Extract 3,000 tonne bulk sample (trial pit) over 12 month period.
79/48	Consent	17/6/1980	SSC	• Extend opencut and underground mining operations within Buchanan-Lemington Colliery; • Construct haul road from South Lemington to Lemington across Wollombi Brook; and • Increase capacity of No. 2 LCPP to 660 tph ROM coal.
80/71	Consent	24/11/1980	SSC	• Extend opencut mining operations within Buchanan-Lemington Colliery Holding.
80/70	Mod 1(2) to DA 80/71	10/8/1981	SSC	• Increase product coal production to 3 Mtpa.
83/145	Consent	3/1/1984	SSC	• Erect an office block for mine administration.
83/153	Consent	10/2/1984	SSC	• Establish and rehabilitate out of pit overburden dump within a Crown Road Reserve and the Colliery Holding.
80/961 (equivalent DEP(3) 84/115)	Consent	19/8/1985	SSC	• Northern extension of opencut mining within Buchanan-Lemington Colliery Holding.
84/115 (equivalent SSC 80/961)	Consent	19/8/1985	DEP	• North west extension of Lemington Mine.
86/75	Consent	24/07/1986	DEP	• Establish Lemington bathhouse.
86/104	Consent	4/11/1986	SSC	• Extensions to No. 2 Mine workshop.
86/119	Consent	4/11/1986	SSC	• Erection of a 40 unit carport.

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
87/42	Consent	18/12/1987 (Lapsed)		• Establish new opencut and underground mine within the Lemington Colliery Holding and partial replacements of existing operations.
115/90	Consent	20/9/1990	SSC	• Conversion of part of an existing carport into a laboratory.
73/91	Consent	10/7/1991	SSC	• Erect a store building extension to the existing opencut mobile equipment workshop.
101/92	Consent	9/7/1992	SSC	• Establish V-demountable offices.
225/92	Consent	29/1/1993	DEP	• Install a coarse reject transport conveyor. Fill and progressively rehabilitate underground mine No. 2 portal using coarse reject from LCPP (over 4-5 years).
214/97	Consent	10/12/1997 (Expired)	SSC	• Increase in production from 3 Million tonnes (Mt) to 3.2 Mt for a 12 month period.
215/97	Consent	17/7/1998	SSC	• Establish mining in South Lemington – two opencut pits, a scraper slot and trench, supplemented by highwall mining operations to 0.6 Mtpa product; • Total combined product limit of 3 Mtpa; and • Removal of 82 ha of Warkworth Sands Woodland (not listed under *TSC Act* at that time).
84/115 M2 (N93/00245/ 009)	Mod 2 of DA 80/961	23/1/1998	DUAP(4)	• Minor modification of DA 84/115 regarding required apprentice ratios.
405/98	Mod 1 of DA 84/115 and DA 215/97	11/1/1999	SSC	• Increase production to 3.5 Mtpa of product coal (north to 2.9 Mtpa and south to 0.6 Mtpa).
195/2000	Certificate	6/2/2001	SSC	• Establishment and occupation certificate for Comleroi Farm hay shed.
215/97.2 and 405/98.2	Mod 1 of DA 405/98 and DA 215/97	9/1/2001	SSC	• Increase saleable(5) production to 4.4 Mtpa (north to 3.2 Mtpa and south to 1.2 Mtpa).
396/2001	Consent	22/10/2001	SSC	• Temporary crossings and relocate dragline and electric shovel.
114-12-98 M2	Mod 2 of DA 114-12-98	11/3/2002	DUAP	• Second modification of DA 114-12-98 to allow permanent transport of ROM coal to LCPP in addition to HVCPP.

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
651/2001	Consent	13/2/2002	SSC	• Temporary shovel crossing (Wollombi Brook).
215/97.3 and 405/98.3	S.96(1A) Mod 2 of DA 405/98 and DA 215/97	22/11/2002	SSC	• Modification for the extension of time limit for the road haulage of 0.9 Mtpa product coal from Lemington South only, from LCPP to MTCL until 9/1/2006 (Coal from North Lemington treated at LCPP can still be transported by haul road to MTCL).
58/2007	Consent	27/2/2007	SSC	• Installation of one bore on CNA land west of South Lemington Pit 1.

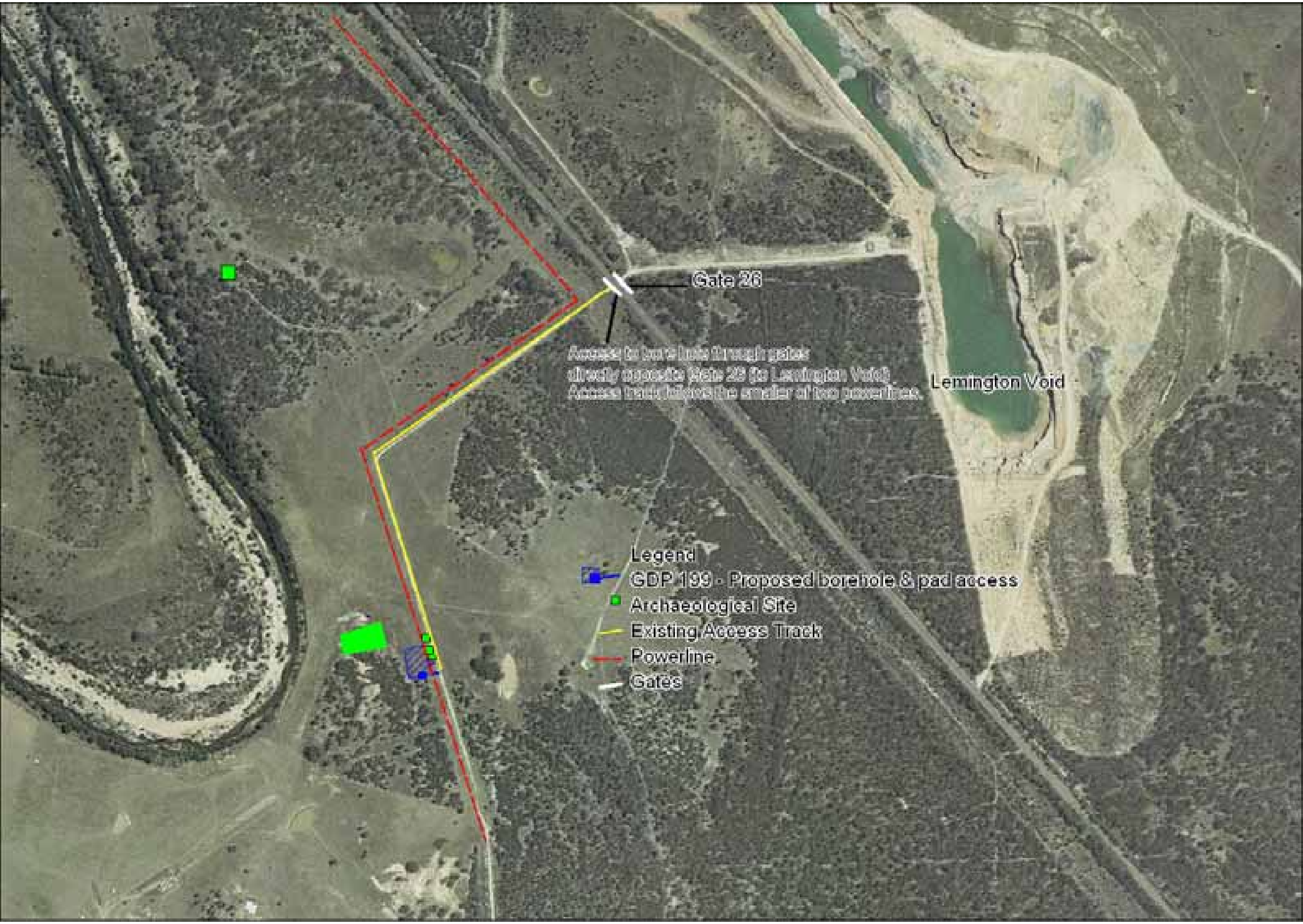
1. Singleton Shire Council
2. Mod = Modification
3. Department of Environment and Planning which is now DoP
4. Department of Urban Affairs and Planning which is now DoP
5. Saleable equivalent to Product coal = ROM coal multiplied by 75%



Annex D

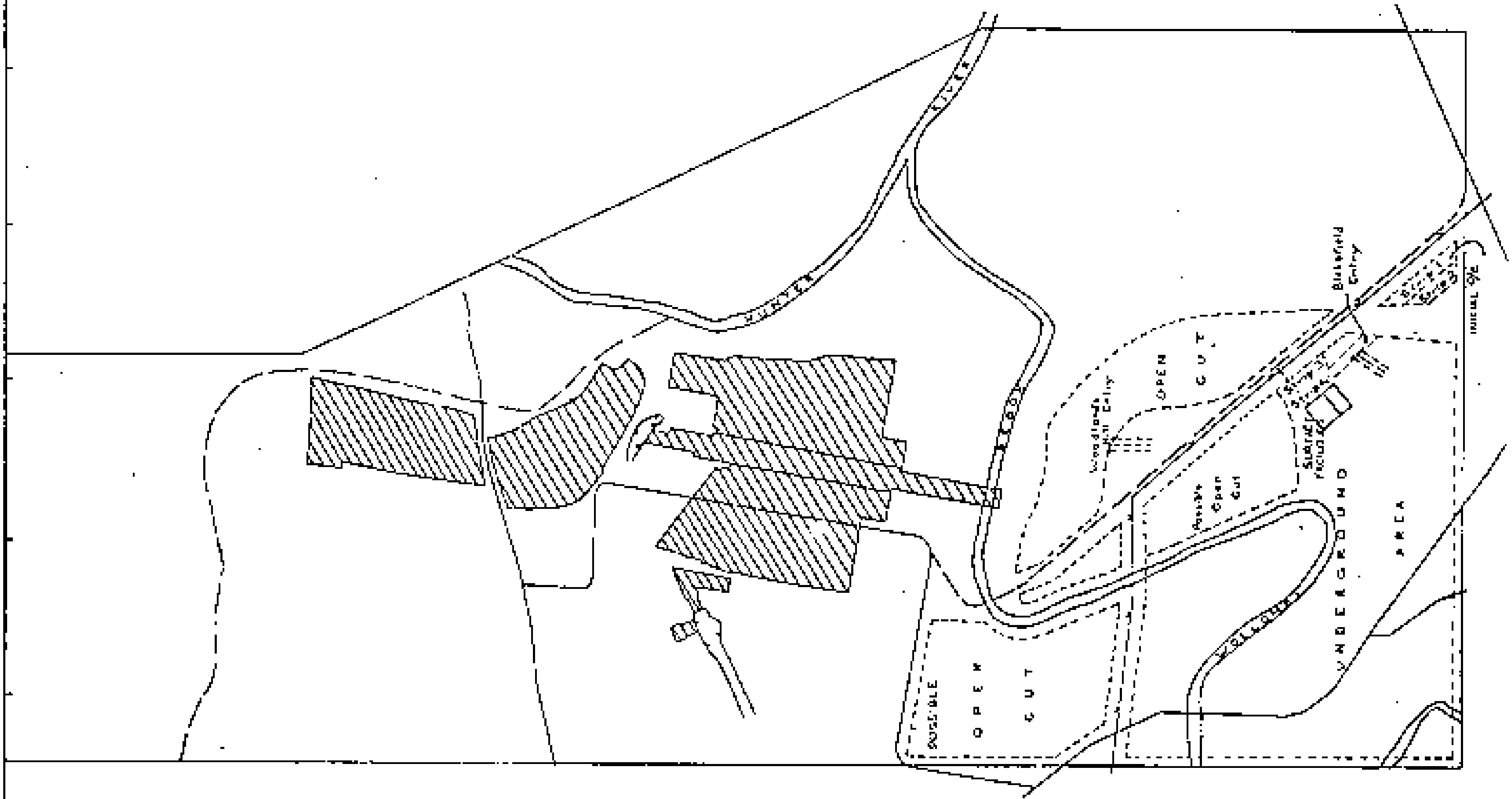
Summary of Existing Consented Operations

Document	Date	Activities
DA 58/2007	27/02/2007	Installation of Production Bores - Lemington
		Access & extraction of Lemington underground water supply
		Installation of a pump
		Extensions to existing pipelines
		Maximum extraction rate of 3000 ML/annum


Gate 26
Access to bore hole through gates
directly opposite Gate 26 (to Lemington Void)
Access track follows the smaller of two powerlines.
Lemington Void
Legend
GDP 199 - Proposed borehole & pad access
Archaeological Site
Existing Access Track
Powerline
Gates

Document	Date	Activities
DA 73/91	10/07/1991	Erection of a 12.38 m x 8.175 m store building extension to the existing Lemington Mine opencut mobile equipment workshop

Document	Date	Activities
EIS - Proposed Southern Mining Extensions, Lemington Colliery	1/01/1980	Extend open cut and underground mining operations into the southern portion of the lease area
		Mining of the Woodlands Hill and Blakefield seams, extension of working of Mt Arthur seams.
		Mining of seams by continuous miners
		ROM coal to be hauled from pit and dumped at a raw coal stockpile
		ROM coal to be conveyed to portal entry then to surface coal storage bin.
		Raw coal will be trucked to the No.2 CPP
		Coal to be washed at the No.2 CPP
		Modification to the existing washery to increase capacity from approx 460 tph to 660 tph (raw coal)
		Reject will be returned to the open cut and buried
		Construction of a new road to transport raw coal to the No.2 CPP over a low level crossing on Wollombi Brook and clean coal directly to the Mt Thorley complex
		Facilities include workshops, a bathhouse, fuel tanks, car parking and a coal storage bin.
		Movement of machines from the northern open cut area to the southern mining area
DA 79/48	17/06/1980	Extend open cut and underground mining operations and increase the capacity



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MINE PLAN - Woodlands Hill &

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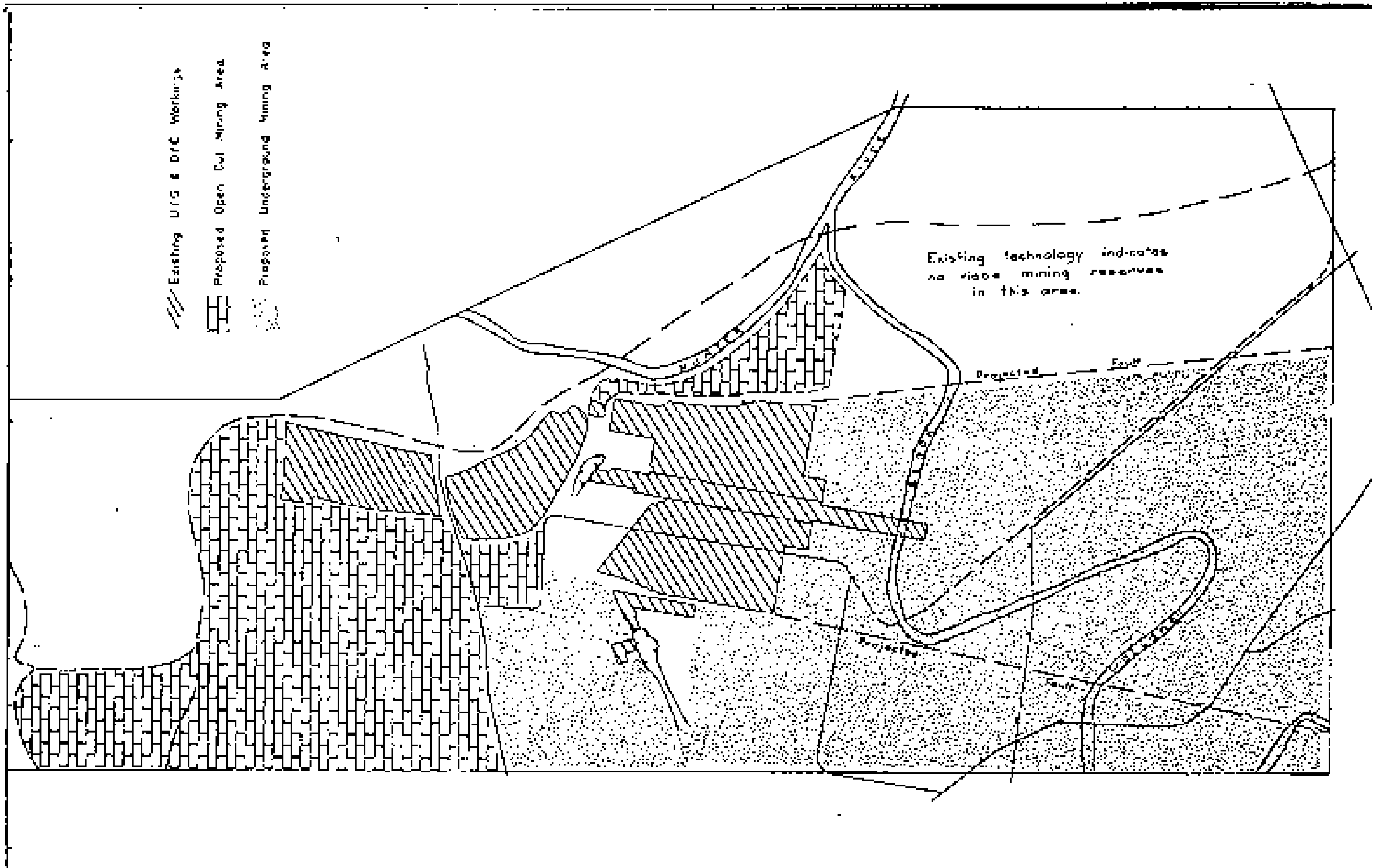

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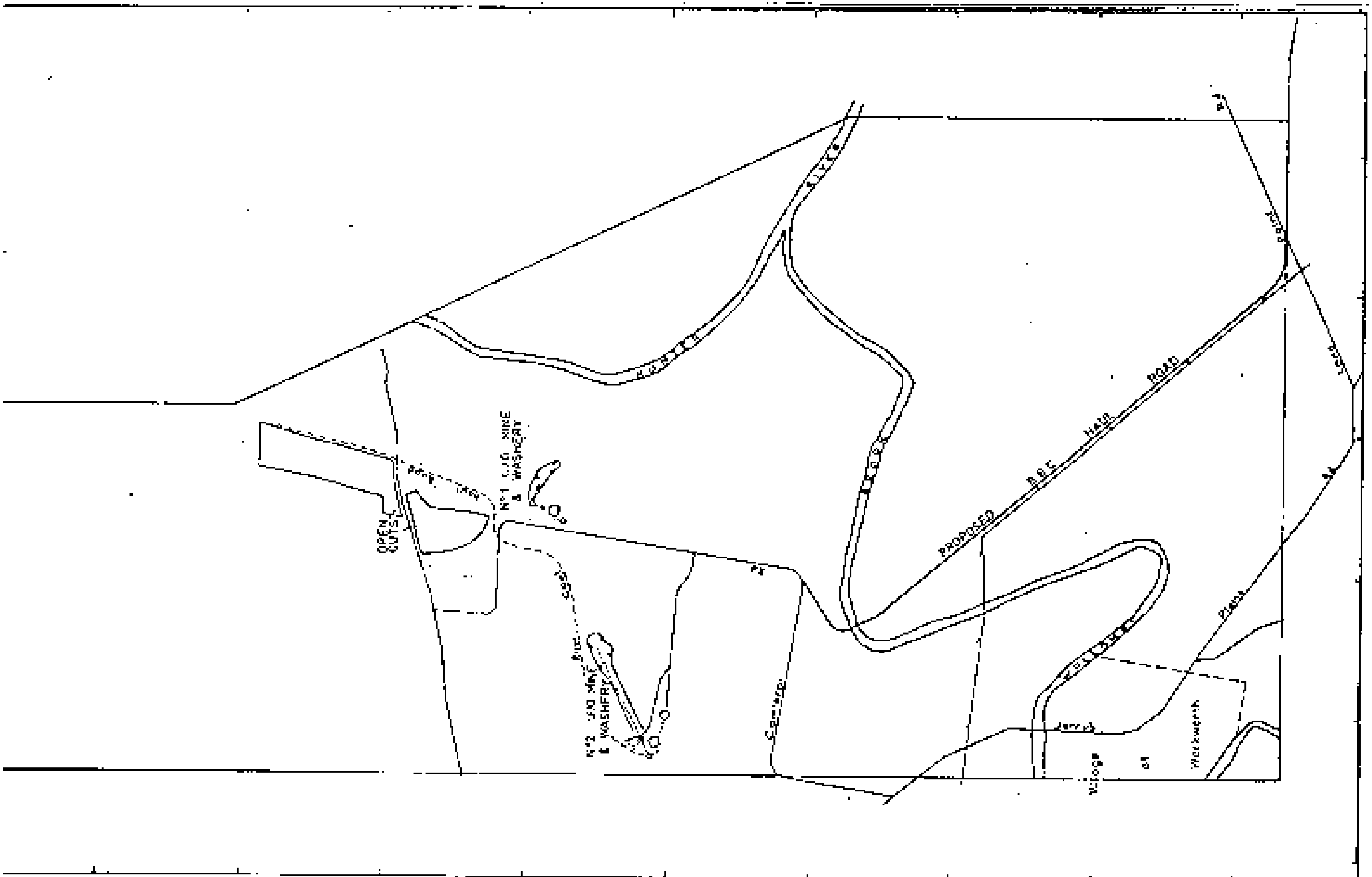
BUCHANAN BOREHOLE COLLIERIES PTY. LTD.

BUCHANAN LEMINGTON COLLIERY

MINE PLAN

Fig 1



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BUCHANAN LEMINGTON COLLIERY

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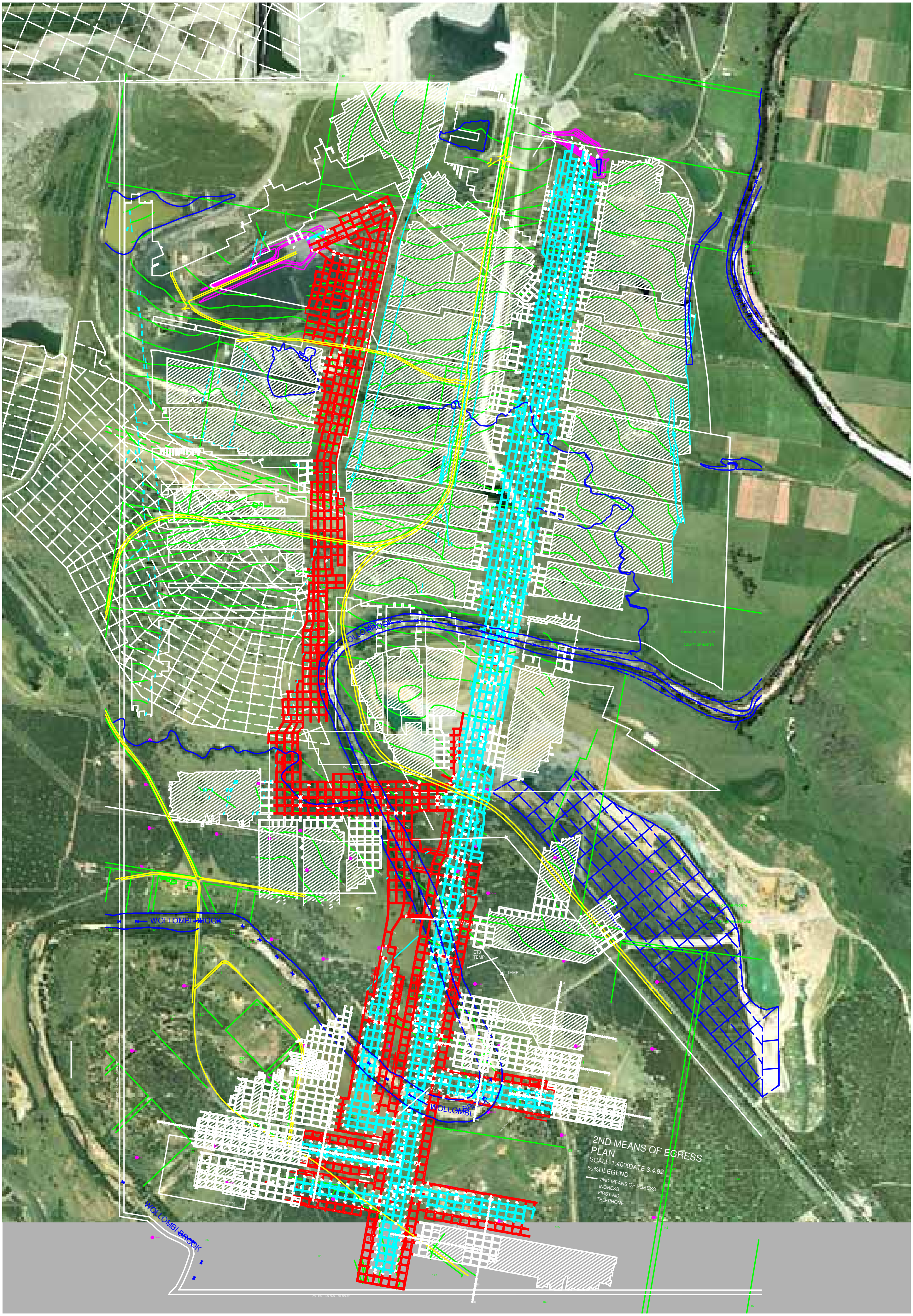

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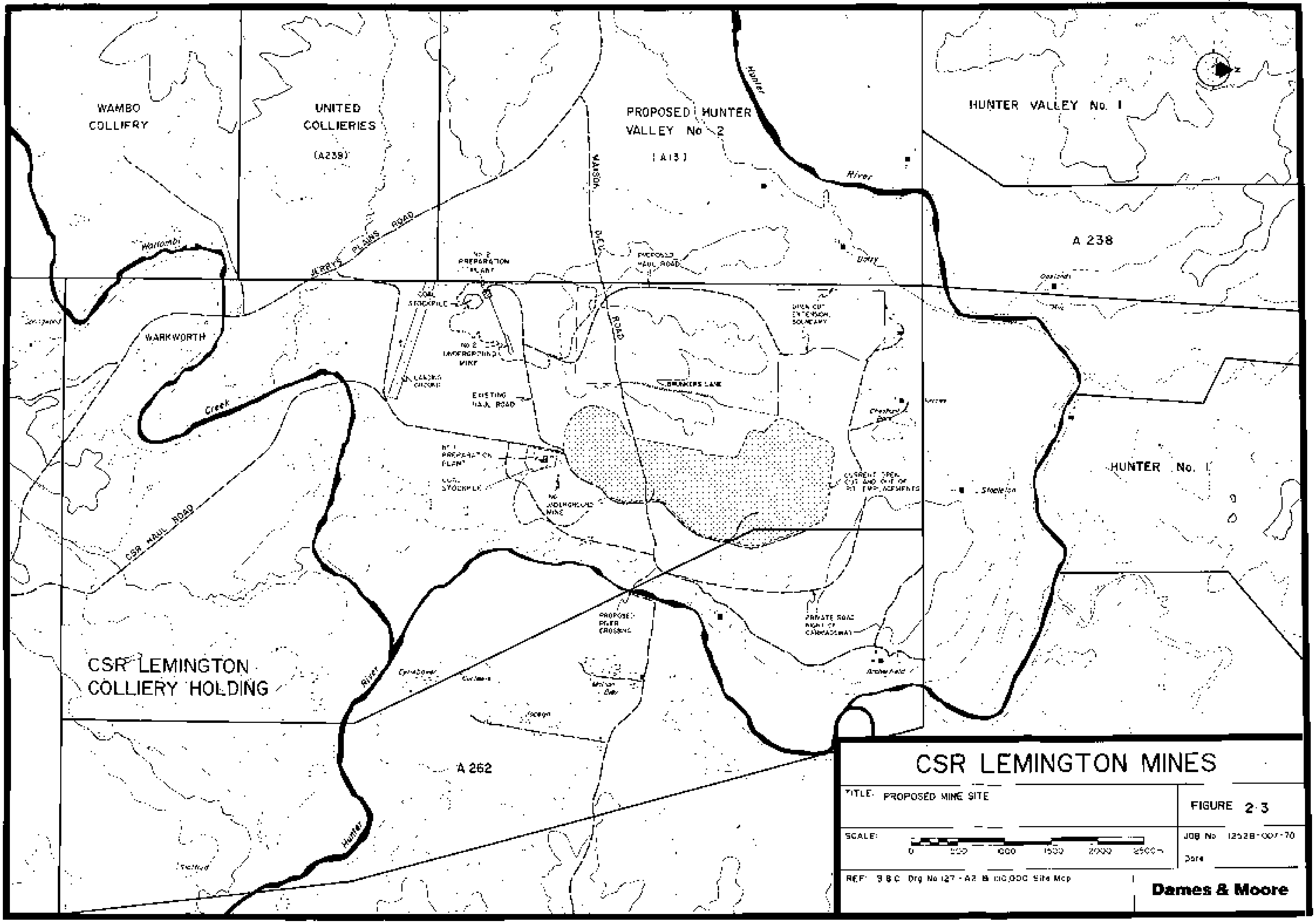
WOLLOMBI BROOK
WOLLOMBI BROOK
WOLLOMBI BROOK
ET3 TEMP
TEMP
2ND MEANS OF EGRESS PLAN
SCALE 1:4000
DATE 3.4.92
%%ULEGEND
2ND MEANS OF EGRESS
INGRESS
FIRST AID
TELEPHONE

Document	Date	Activities
DA 80-71	24/11/1980	Extension of open cut mining activities
		Total production level of 3 Mtpa raw coal
		Haulage to Mt Thorley between the hours 7am to 7pm Monday to Saturday unless agreed with Council
		Blasting between 6:30am and 8:30am
DA 80-70	10/08/1981	Total production level of 3 Mtpa clean coal

Document	Date	Activities
DA 83-145	3/01/1984	Erection of an office block for mine administration - Lot 1 DP 182139

Document	Date	Activities
DA 80/961	29/07/1981	letter to DoP re 84/115
DA 84/115	15/08/1985	Open cut extension to Lemington Mine
EIS Northern Open Cut Extension CSR Lemington Mine (Dames and Moore)	Aug-84	Extension of Northern Lemington open cut operations to the west
		Withdrawal of 1982 EIS & DA for scraper mining to allow for this proposal
		Warkworth, Mt Arthur & Piercefield seams - depth of mining of approximately 120 m
		Truck and shovel operations, 180m wide strips
		Total production of approximately 53 Mt ROM coal
		Production of 2.2 Mtpa ROM coal
		Up to 2.6 Mtpa product coal
		Haul trucks (22 to 50 t) transport coal to either No.1 or No.2 CPP or to stockpiles
		Transport of 3 Mtpa coal from site to Mt Thorley along Jerrys Plains Road
		No.1 CPP takes coal from No.1 underground and the opencut
		No.2 CPP takes coal from No.2 underground and the opencut
		Overburden disposal by backfill into pit or out of pit overburden emplacements
		5 tailings dam locations (2 undergoing rehabilitation)
		Tailings disposal into tailings dams or overburden dumps
		No new infrastructure
		Additional equipment
		Close and mine through Maison Dieu Road & Brunkers Lane
		Alternative access road to the eastern edge of Maison Dieu Road
		Low level crossing of Hunter River at Maison Dieu
		Construction of bund walls between operations and western residences of Maison Dieu
		Final void in west of colliery holding
		Final landform slopes slightly more convex than currently exist.
DA 214/97 M1	10/12/1997	Increase in clean coal production from 3 Mtpa to 3.2 Mtpa for a 12 month period
DA 84/115 M2	6/01/1998	Modification to ratio of apprentices required


CSR LEMINGTON MINE
LEMINGTON MINE
EMPLACEMENT AREA
PROPOSED OPEN CUT EXTENSION
PROPOSED HUNTER VALLEY Nº 2
OPEN CUT
MAISON DIEU ROAD
MAISON DIEU CROSSING
Nº 1 UNDERGROUND MINE
Nº 2 UNDERGROUND MINE
AUTHORISATION AREA Nº 282
UNITED COLLIERIES A 229
WAMBO MINING CORPORATION PTY. LTD.
WARKWORTH
CSR LEMINGTON COLLIERY HOLDING
WARKWORTH MINING


WAMBO
COLLIERY
UNITED
COLLIERIES
(A238)
PROPOSED HUNTER
VALLEY No 2
(A13)
HUNTER VALLEY No. 1
A 238
Hunter
River
JERRYS PLAINS ROAD
WAMBO DIEU ROAD
Wallombi
Creek
WARKWORTH
No 2
PREPARATION
PLANT
COAL
STOCKPILE
No 2
UNDERGROUND
MINE
EXISTING
HAUL ROAD
PROPOSED
HAUL ROAD
OPEN CUT
EXTENSION
BOUNDARY
BRUNKERS LANE
No 1
PREPARATION
PLANT
COAL
STOCKPILE
No 1
UNDERGROUND
MINE
CURRENT OPEN
CUT AND OUT OF
PIT EMPLACEMENTS
HUNTER No. 1
Stapleton
CSR HAUL ROAD
PROPOSED
RIVER
CROSSING
PRIVATE ROAD
RIGHT OF
CARRIAGEWAY
CSR LEMINGTON
COLLIERY HOLDING
A 262
CSR LEMINGTON MINES
TITLE: PROPOSED MINE SITE
FIGURE 2·3
SCALE:
0 500 1000 1500 2000 2500m
JOB No 12528-007-70
Date
REF: S B C Drg No 127-A2 B 100,000 Site Map
Dames & Moore

Document	Date	Activities
EIS Hunter Valley No. 2 Mine	Sep-84	Establishment of an open cut mine in 2 stages on Authorisation 13
		Integrated operation – HV No. 1 Mine, Liddell Colliery, HV No. 2 Mine, Liddell
		Mining of all coal seams down to the Vaux seam.
		Opencut methods using shovel, truck and loader combinations and a small dragline are to be employed for overburden removal and coal extraction
		Raw coal production rate of 4.5 Mtpa
		Augmentation of HVCPP and associated coal stockpiles
		HVCPP - 2 x 80,000t raw coal stockpiles, 1 x 73,000 t product coal stockpile. 1 reclaimer of 1250 tph capacity. 4 modules - nominal capacity of 225 tph raw coal each, total capacity of 900 tph. Coal accepted from HV No.2
		Liddell Colliery - continuous miners producing approximately 1.3 Mtpa ROM coal, conveyed to Liddell CPP
		Liddell CPP - 10,000 t ROM coal daily - from Liddell Colliery and HV No. 1 Mine
		HVLP - product from HVCPP. 2 stockpiles - 200,000 t each. 2 reclaimers with a nominal capacity of 2000 tph.
		ROM coal to be crushed and washed at HVCPP (Stage 1), or crushed then
		ROM coal to be transported to HVCPP by haul road (Stage 1) and by overland conveyor (Stage 2).
		ROM coal to be transported to LCPP and HVLP by existing overland conveyor.
		Raw coal to be transported by road and OLC to storage areas adjacent to the HVCPP
		Two further modules to be added to HVCPP, to provide average and maximum capacities of 1350 and 1500 tph respectively.
		Extension of raw and product coal stockpiles and conveyors at HVCPP
		Overland conveyor from HVCPP to Liddell CPP & HVLP - 7.4km, 2000 tph.
		Road and conveyor haulage of coal to HVCPP
		Use of HVLP where steaming coal will be loaded onto trains
		Use of Liddell CPP where coal will be beneficiated to a coking product
		Use of Liddell Loading Point where coking coal will be loaded onto trains
		Coarse and fine reject disposed in backfilling operations or tailings dams at HV No. 1 Mine
		Backfill of pits with spoil
		Overburden to be placed out of pit, on the eastern side of the Authorisation between Redbank and Hobden Pits
		Final void adjacent to the Hunter River, to be used as water storage
		Future applications for extraction of coal resources beyond year 21.
		Surface and coal handling facilities on the northern boundary of Authorisation 13 at a site known as ‘Hunter View’
		Temporary surface facilities known as ‘Birnamwood’ in the central eastern portion of Authorisation 13
		Construction and use of a private sealed road from Authorisation 13 to HVCPP
		Construction and operation of an overland conveyor from Hunter View to HVCPP
		Facilities to include administration building, bathhouse, workshop, fuel storage bay, sewage treatment plant, water treatment and storage facilities, coal dump hoppers, breaker station, conveyors and coal storage bins.
		Sealed access road to (Hunter View) facilities from Jerrys Plains Road
		Two relocations of Jerrys Plains Road and the closure of the section of Maison Dieu Road on Authorisation 13
		Closure of the section of the Mitchell Line passing through Authorisation 13
		Relocation of two 66/11 kV transmission lines
		Employees from HV No.1 Mine to HV No.2 Mine
		24 hour, 7 day operations

Document	Date	Activities
DA 85/27	4/05/1986	Open cut coal mine and associated facilities, known as the HV No. 2 Mine
SEE – EA of proposed mods to HV No. 2 Mine	Mar-90	Construction of WOOP Emplacement
		Modified Riverview Pit mining schedule
		Mining of Bowfield and Warkworth seams in the Riverview Pit
		Truck and shovel mining - electric rope shovels, front end loader and trucks.
		Processing of all coal at the HVCPP
		Out of pit overburden emplacement adjacent to the pit, then in the WOOP dump. Proportion of overburden in-pit.
		Temporary voids along the southern and eastern sections of the pit - mining will continue in these areas in later stages of mine development
		Two main haul roads, one from the pit to the WOOP dump, one to the HVCPP. Permanent road across previously mined areas to the pit in the east.
		Expansion and utilisation of the existing HV1 facilties
		Construction of bridge over the Hunter River
		Construction of water management structures
		Runoff water to be used for in-pit dust suppression or pumped to minewater storage dams
		Possible relocation of existing HV1 facilities to rehabilitated areas of the Riverview Pit.
DA 37-90	18/10/1990	Emplacement of overburden in conjunction with development of HV No. 2 Mine
DA 81-828	12/11/1990	Construction and operation of a coal mining project known as HV No. 2 Mine
		Permanent diversion of Jerrys Plains Road
		Modified Riverview Pit mining schedule

PLATE 1 SITE BOUNDARIES

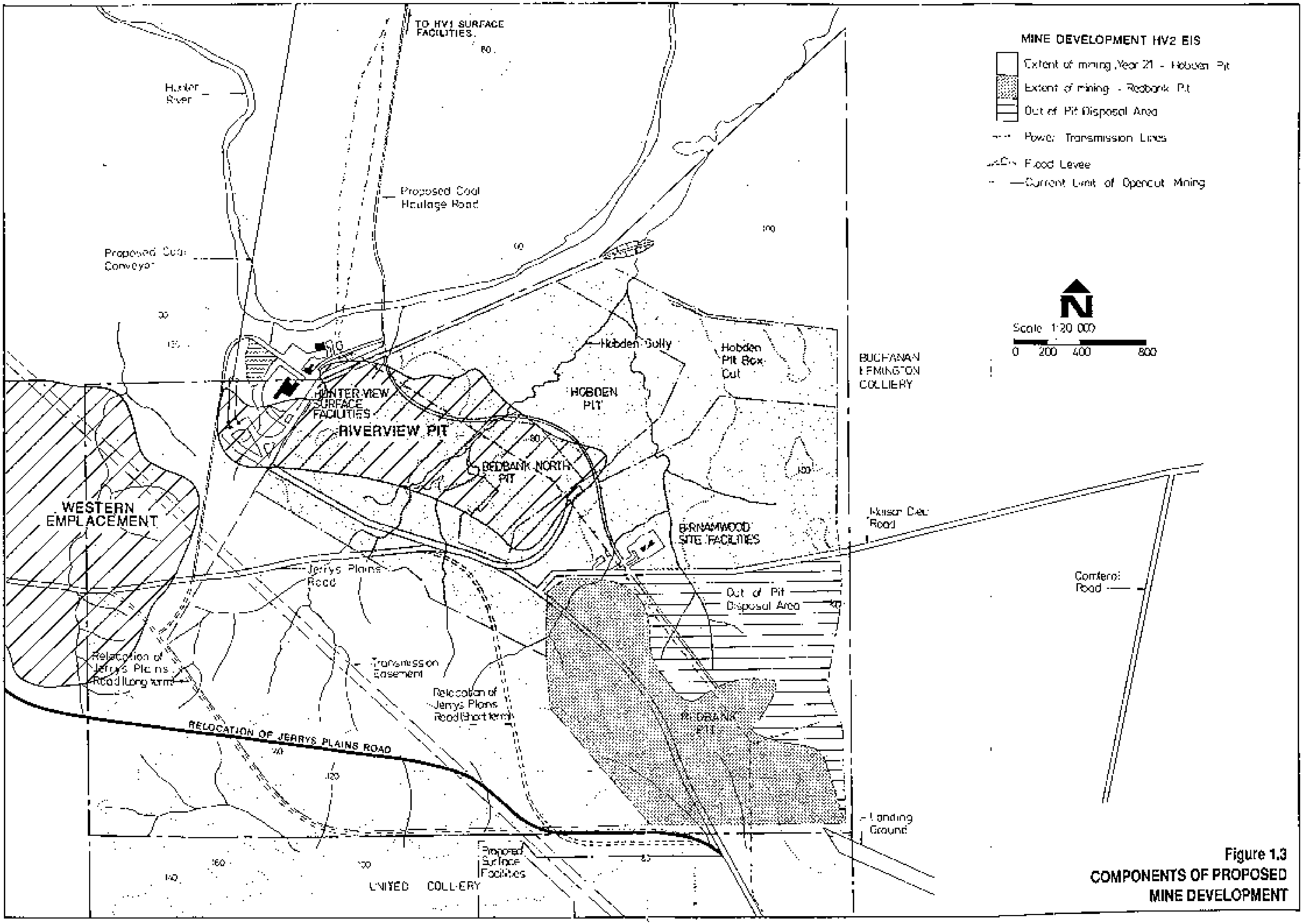


Figure 1.3
COMPONENTS OF PROPOSED MINE DEVELOPMENT

Document	Date	Activities
DA 86/75	24/07/1986	Erection of a bathhouse at Lemington Mine - Part Portions 142 & 143

Document	Date	Activities
DA 86-104	4/11/1986	Extensions to No.2 Mine Workshop - Lot 17 DP 247239

Document	Date	Activities
DA 86/119	4/11/1986	Erection of a 40 unit carport

Document	Date	Activities
A Proposal for Expanding Lemington Colliery from 1 to 2 MTPY Capacity (BBC)	Aug-75	Increase ROM production from 1 to 2 Mtpa, from both opencut and underground
		Additional underground entry
		Provision of further coal treatment plant
		ROM coal transported by truck to stockpile near (L)CPP
		Clean coal transported by truck to rail loading facility
		Coarse reject disposed with overburden in back-filling operation
		Tailings disposed into tailings dam
		Removal of tailings from dam when full to open cut to allow re-use of tailings dam
		Overburden disposal into pit
		Additional equipment
		Duplication of existing CPP
		Offices, workshop and stores, bathhouses, weighbridge, stores area, carpark and electrical substation located at the Colliery
		Sewage treatment in septic tank and open ponds system.
		Spoil to be used to construct a bund wall, dams, internal roads and to fill and level the CPP and stockpile areas
		Overflow from clear water dam via a diversion channel to Wollombi Brook.
		Water make from underground mining to be pumped to clear water dam
		Additional water to be pumped from the Hunter River to clear water day - approximately 2.6 ML/day
		Sewage effluent from secondary treatment in natural aeration ponds overflows into a wooded area.
DA 88/76	24/02/1976	Extend mining into No.2 complex area, increase ROM to 2 mtpa, construct Lemington CHPP#2.
DA T12-1 DA/JH (SSC)	5/03/1976	Extend open cut mining of Lemington Colliery

Figure 2
LEASE AREA MAP

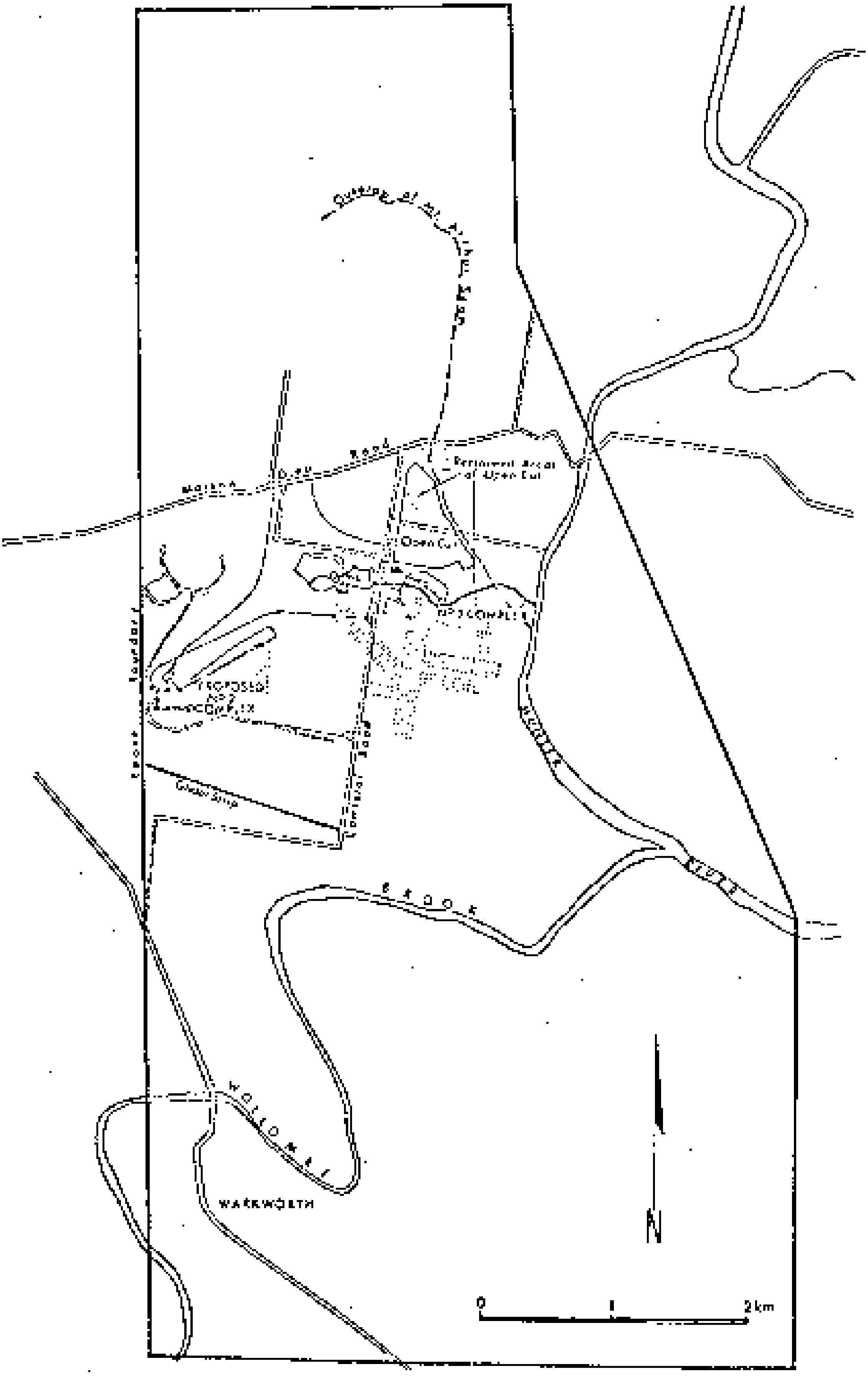
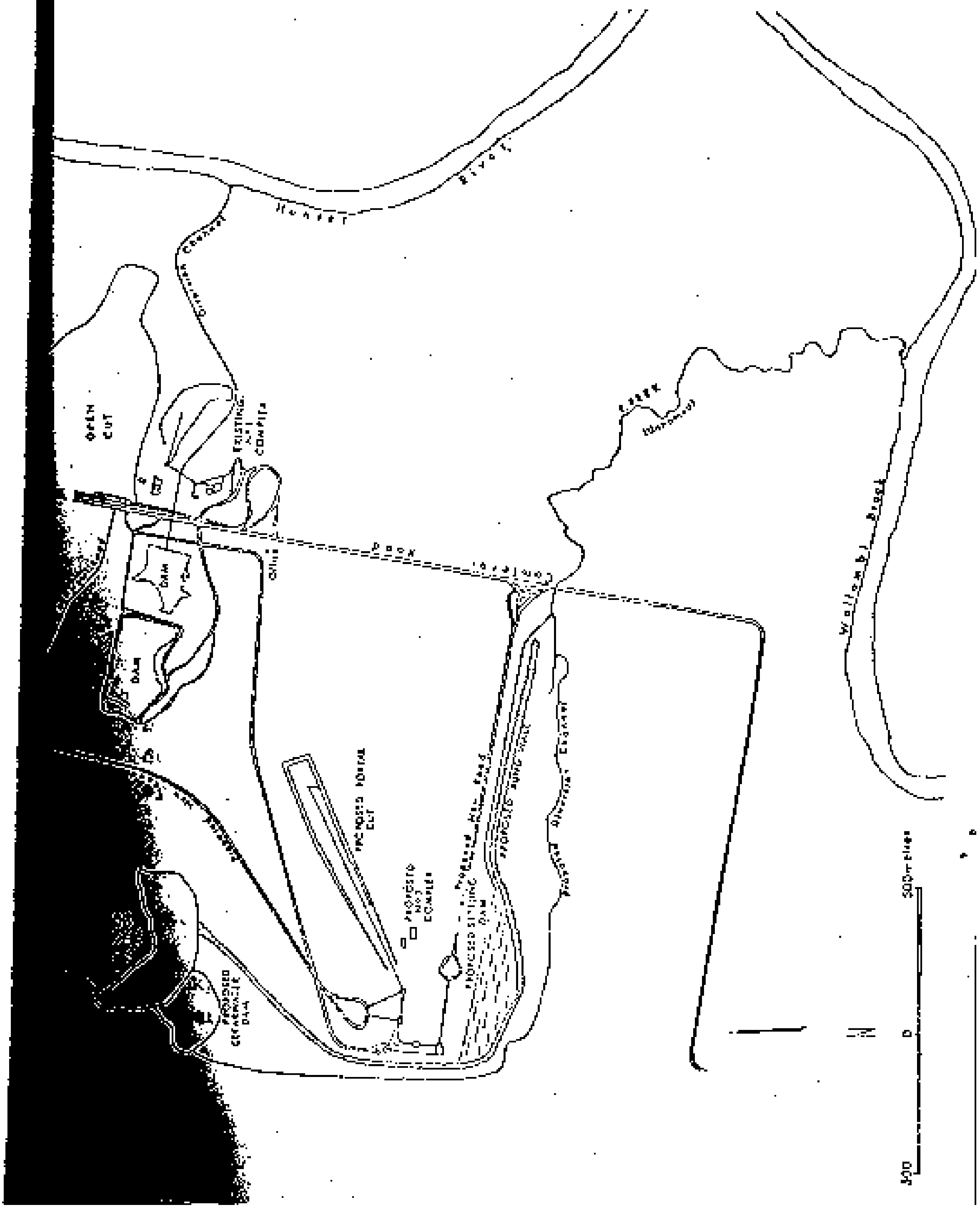


Figure 4

DETAILED PLAN OF EXITING FACILITIES AND
PROPOSED NEW FACILITIES



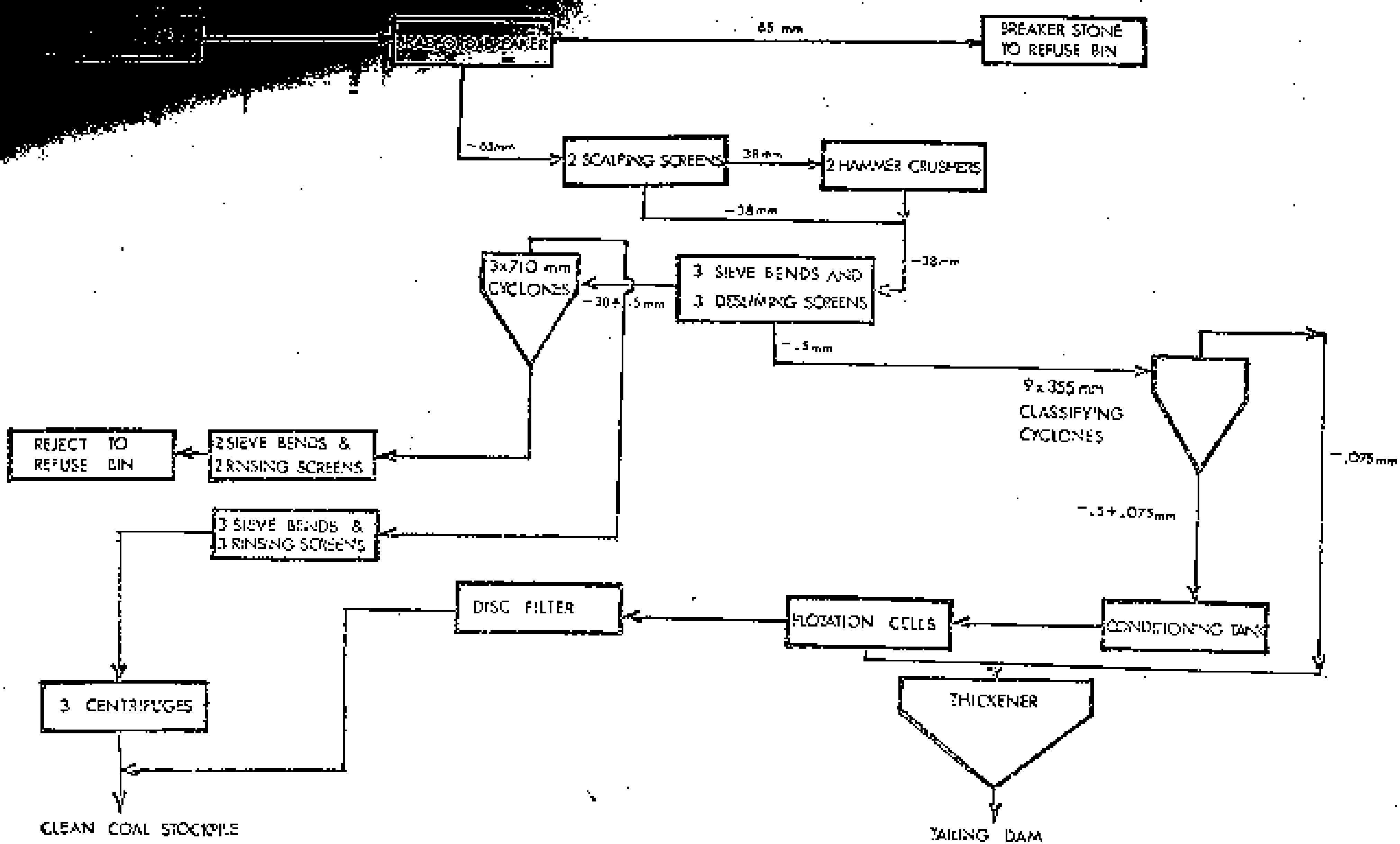


Figure 6

,COAL PREPARATION PLANT : SIMPLIFIED FLOW DIAGRAM

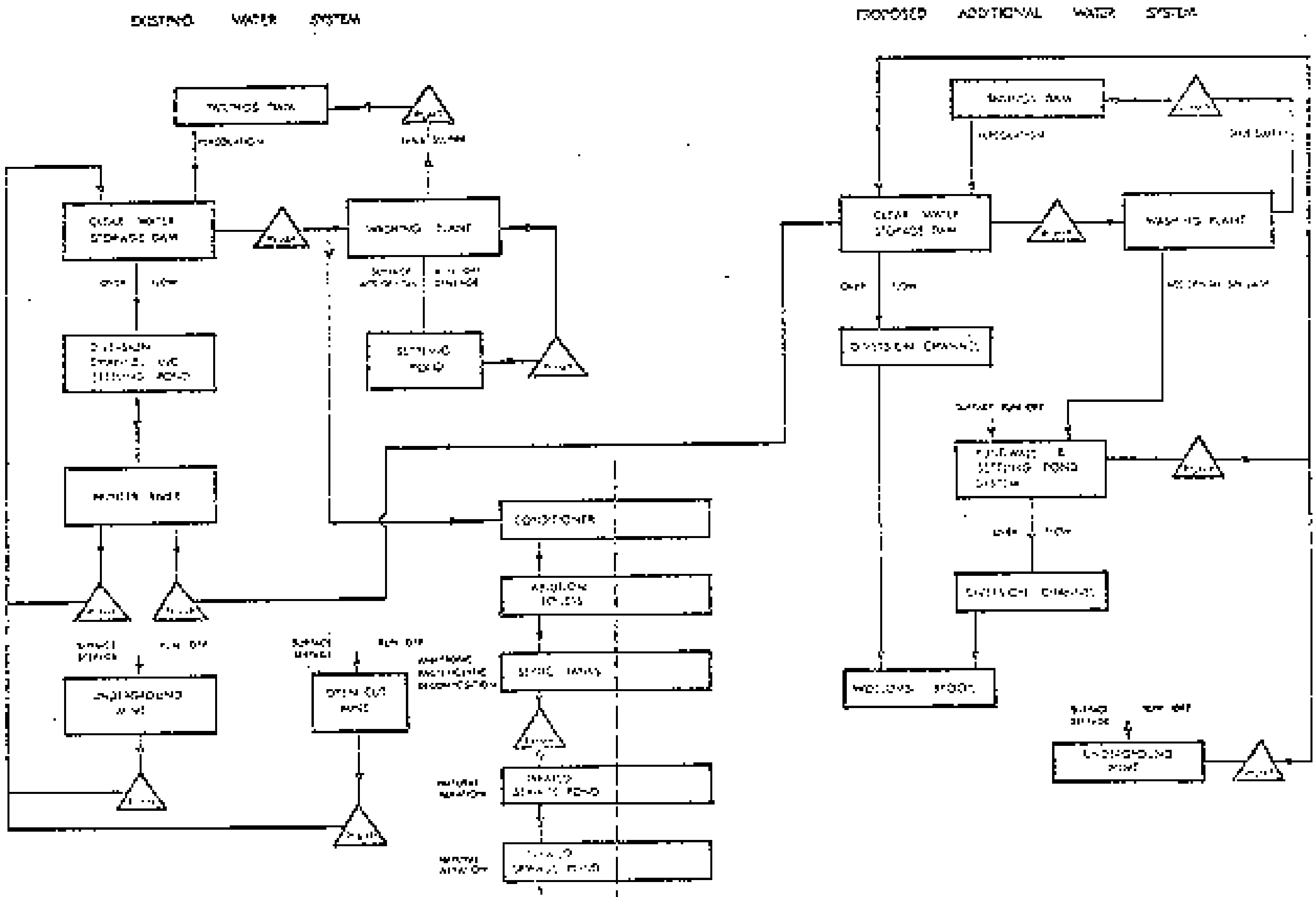


Figure 15

WATER FLOW DIAGRAM

Document	Date	Activities
DA 101/92	9/07/1992	Building of V-demountable offices (engineers) - Lot 2 DP 710088

Document	Date	Activities
DA 113-12-98		Information not available
Hunter Valley No.1 Mine South Pit Modifications EIS	Dec-98	Extraction of 162 million tonnes ROM coal from South Pit over 21 years - from seven seams in the Whittingham Coal Measures.
		Production of 8 Mtpa from South Pit
		Mining to begin in north-east corner and progress to south-west in 120 m wide strips divided into 300 m blocks.
		HVCPP to accept coal from South Pit
		Coal conveyed from HVCPP to HVLP.
		Coarse rejects to be mixed into overburden emplacements, at least 2 m below final rehabilitated surface. In some areas coarse rejects to be used as a surface mulch.
		Fine rejects to be pumped to North Pit, then North Pit void.
		Overburden disposal to eastern out of pit emplacement or backfilling of Riverview.
		Year 1 - 8: 5 day, 24 hour roster, 10:30pm Sunday to 10:30pm Friday. Year 9-21: 7 day, 24 hour roster.
		Relocation of 330kv and 66kv transmission lines
DA 114-12-98	15/03/2000	Modification to the open cut mining of HV No.1 Mine South Pit operations
		Out of pit overburden emplacement at Lemington
Statement of Environmental Effects in support of a Section 96(2) application for Hunter Valley Operations – South Pit	Jan-01	Change in mining schedule to 7 day operations from Year 1 rather than Year 9
		Truck and shovel operation in Cheshunt Pit, concurrent dragline operation in Riverview Pit
		Haulage of coal from both Riverview and Cheshunt Pits to either HVCPP or LCPP
		Up to 4.5 Mtpa ROM coal to be transported to Liddell CPP, HVCPP, LCPP or HVLP.
		Transport of product coal to MTCL by truck.
		Reduction in size of equipment fleet and deferring purchase of new vehicles
		Amendment to timing of Dewatering Management Plan
		Amendment to timing of EMPs generally
DA 14-01-01 M1	2/11/2001	Reduction in equipment fleet and resulting need to operate over 7 days from year 1
		Flexibility in the submission of the Dewatering Management Plan and other EMPs
Statement of Environmental Effects in support of a Section 96(2) application for the Hunter	Nov-01	350,000 t of coal from Riverview Pit to LCPP
		Truck and shovel operation in Cheshunt Pit
		Dragline operation in Riverview Pit
		Haulage of coal from Cheshunt and Riverview Pits to either HVCPP or LCPP
		Revision of mine plan to allow concurrent mining in Riverview & Cheshunt
DA 114-12-98 M2	11/03/2002	Altering sequence of mining including concurrent mining at Riverview & Cheshunt Pits
		Operation of a dragline at Riverview
		Haulage of coal from Cheshunt and Riverview Pits to either or both HVCPP or LCPP
Hunter Valley Operations Development Consent Modification Application	29/10/2002	Blasting to be conducted between 7am and 6pm Monday to Saturday
DA 114-12-98 M3	23/01/2003	Blasting between 7am and 6pm Monday to Saturday for a 13 month period beginning Feb 2003
Riverview Pit Extended SEE	Oct-05	Extension of mining to the south (35 ha) and west (2 ha) of the currently approved limit of mining.

Document	Date	Activities
		Mining of Woodlands Hill, Arrowfield and Bowfield seams to produce 1.94 Mt ROM coal and 1.69 Mt product coal
		Both truck and shovel and dragline operations at a rate of 8 Mtpa ROM coal
		Transport of ROM coal by private haul road to LCPP and HVCPP
		Transport of product coal by conveyor or truck to HVLP, NLP, RCT or MTLP
		Mining footprint within 60-70m of Jerrys Plains Road for 1km
DA 114-12-98 M4	11/05/2006	Modification to open cut mining of HV No.1 Mine South Pit operations to the south and west of the currently approved limit of mining

Figure 2.1 **Mine Sequence Plan**

ERM

0 500m
Approximate only

Hunter Valley Operations
Section 96(2) Modification of Development Consent

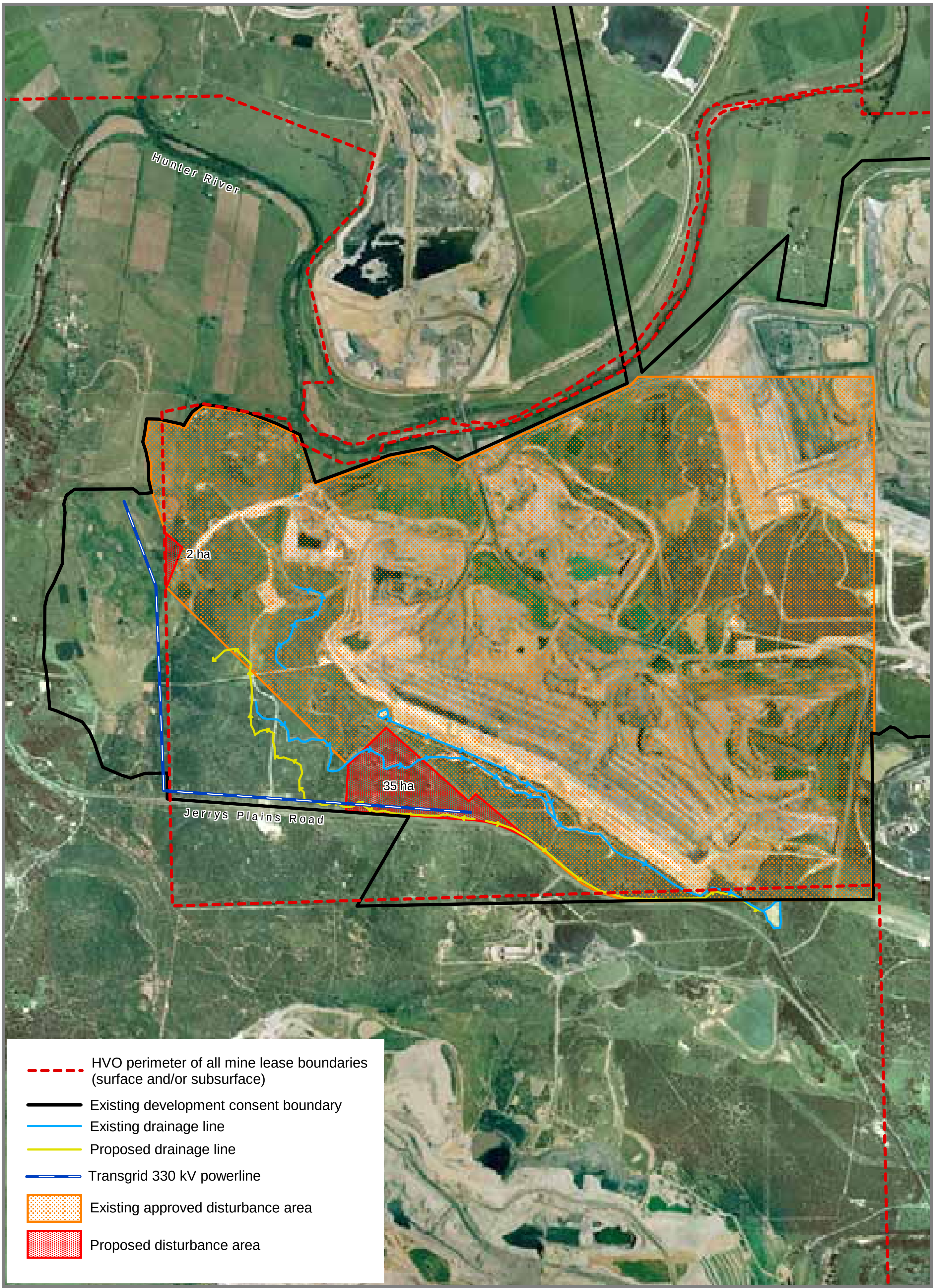


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Figure 1.2

Proposed Riverview Pit Extension and Features

Document	Date	Activities
DA 115/90	20/09/1990	Conversion of part of an existing carport into a laboratory - Lot 2 DP 719789

Document	Date	Activities
Cheshunt Extension SEE for Hunter Valley Operations	Jul-05	Extension of approximately 50ha
		Mining of 8 Mtpa for 18-24 months
		Truck and shovel operation
		ROM coal transported by private haul road to LCPP HVCPP or HCPP.
		Product coal transported by conveyor or truck to HVLP, NLP, RCT or MTCL.
		Two levees – northern and southern.
		Relocation of Sed Dam SD14
DA 181-8-2005	31/03/2006	Extension of Cheshunt open cut mining to extract approximately 8 Mtpa ROM coal

ERM

0 1km
Approximate only

Figure 1.2 **Site Location**

Cheshunt Extension - SEE

0022793 F1_2 REV D 28/02/2005 Environmental Resources Management Australia Pty Ltd

Document	Date	Activities
DA 195/2000	6/02/2001	Occupy or use Comleroi Farm Hay Shed - DP 182139

Document	Date	Activities
EIS for South Lemington Open Cut	Sep-97	Development and operation of two opencut pits, a scraper slot and trench, each supplemented by HWM operations
		0.6 Mtpa product coal
		Mining sequence: - South Lemington Pit 1 opencut and highwall mining - South Lemington Pit 2 opencut and highwall mining - Scraper slot south of Pit 2 and highwall mining - Trench south of Pit 1 and highwall mining
		Overburden disposed by backfill into pit or out of pit overburden emplacements
		Modification of 1980 & 1987 proposals: - 1980: Mining of 2 seams by opencut & underground in southern part of colliery holding. Construction of private haul road to bypass Jerrys Plains Road at Warkworth. - 1987: Resubmission of 1980 proposal excluding approval to open cut mine west of Wollombi Brook.
		Relocation of mobile mining equipment
		High level bridge crossing of Wollombi Brook
South Lemington EIS Response to Submissions	May-98	Redesign of South Lemington Pit 2 - removal of southeastern corner of pit near Redbank Creek
		Shrinking of the scraper slot - eastern and western ends near Wollombi Brook and Redbank Creek respectively
		Changes to highwall mining blocks - reduction of block south of scraper slot and south of South Lemington Pit 1.
DA 215/97	17/07/1998	Development and operation of two opencut pits, a scraper slot and trench, each supplemented by HWM operations producing approximately 600,000 tpa saleable coal
		Total production levels for all Lemington Mines of 3 Mtpa
Lemington Coal Mine SEE	Oct-98	Increase production of Lemington Mines from 3 to 3.5 Mtpa
		Removal of the scraper slot from the mine plan
		Deletion of clause requiring acquisition of Saada properties
		Substitution of superseded noise criteria
DA 405/98	11/01/1999	Coal mine - increase production tonnage of clean product coal
		Total production levels for all Lemington Mines of 3.5 Mtpa
		0.5 Mtpa clean product coal to be transported to MTCL using B Double vehicles only
SEE for an increase in coal production at Lemington Coal Mine	Aug-00	Increase production of Lemington Mines from 3.5 to 4.4 Mtpa (increasing South Lemington from 0.6 Mtpa to 1.2 Mtpa; increasing North Lemington to 3.2 Mtpa for a short duration)
DA 215/97.2 & 405/98.2	9/01/2001	Total production for all Lemington Mines of 4.4 Mtpa
		0.9 Mtpa clean product coal to be transported to MTCL using B Double vehicles only
DA 215/97.3 & 405/98.3	22/11/2002	Cessation of approval to transport 0.9 Mtpa

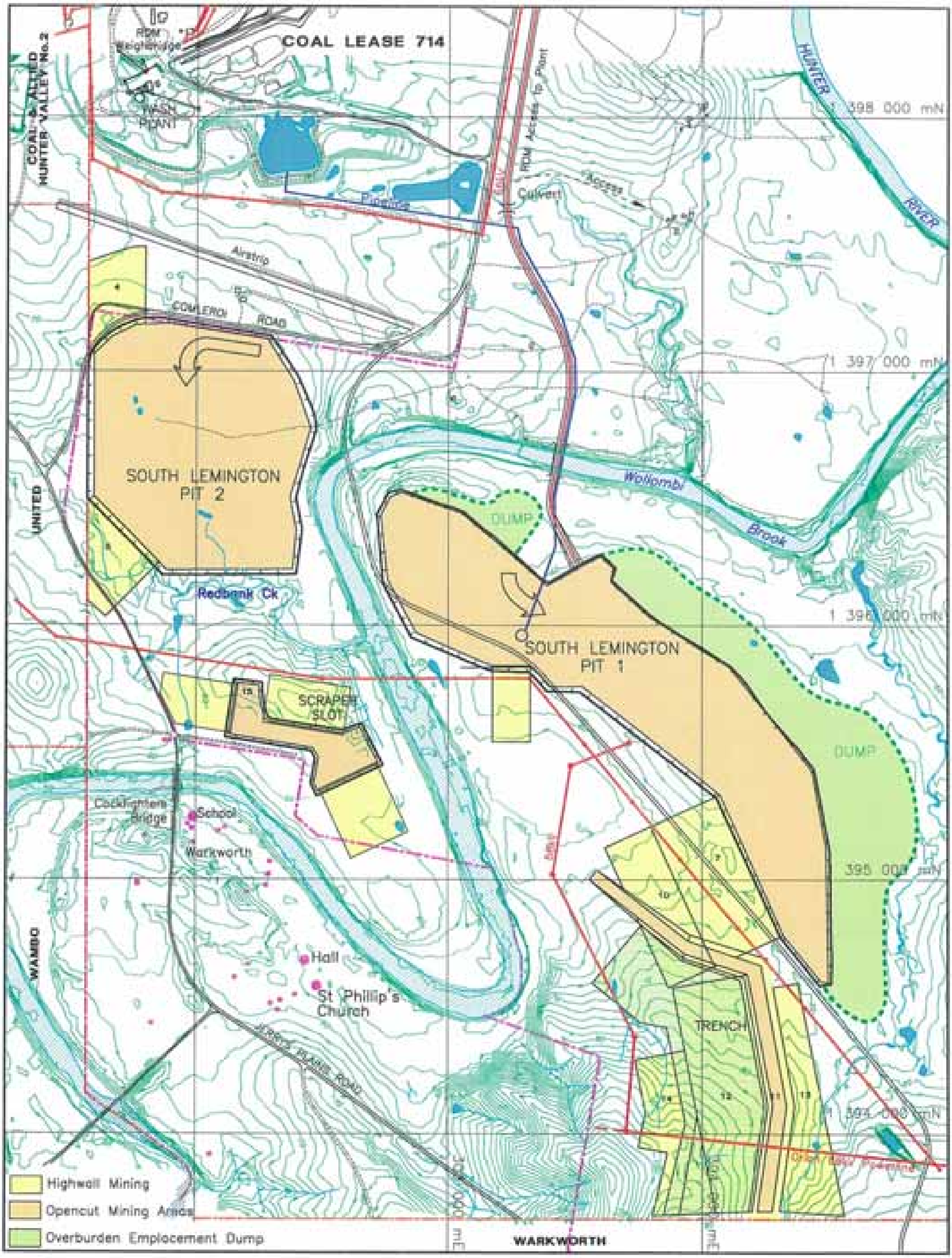


Figure 1.1 - Proposed Opencut and Highwall Mining

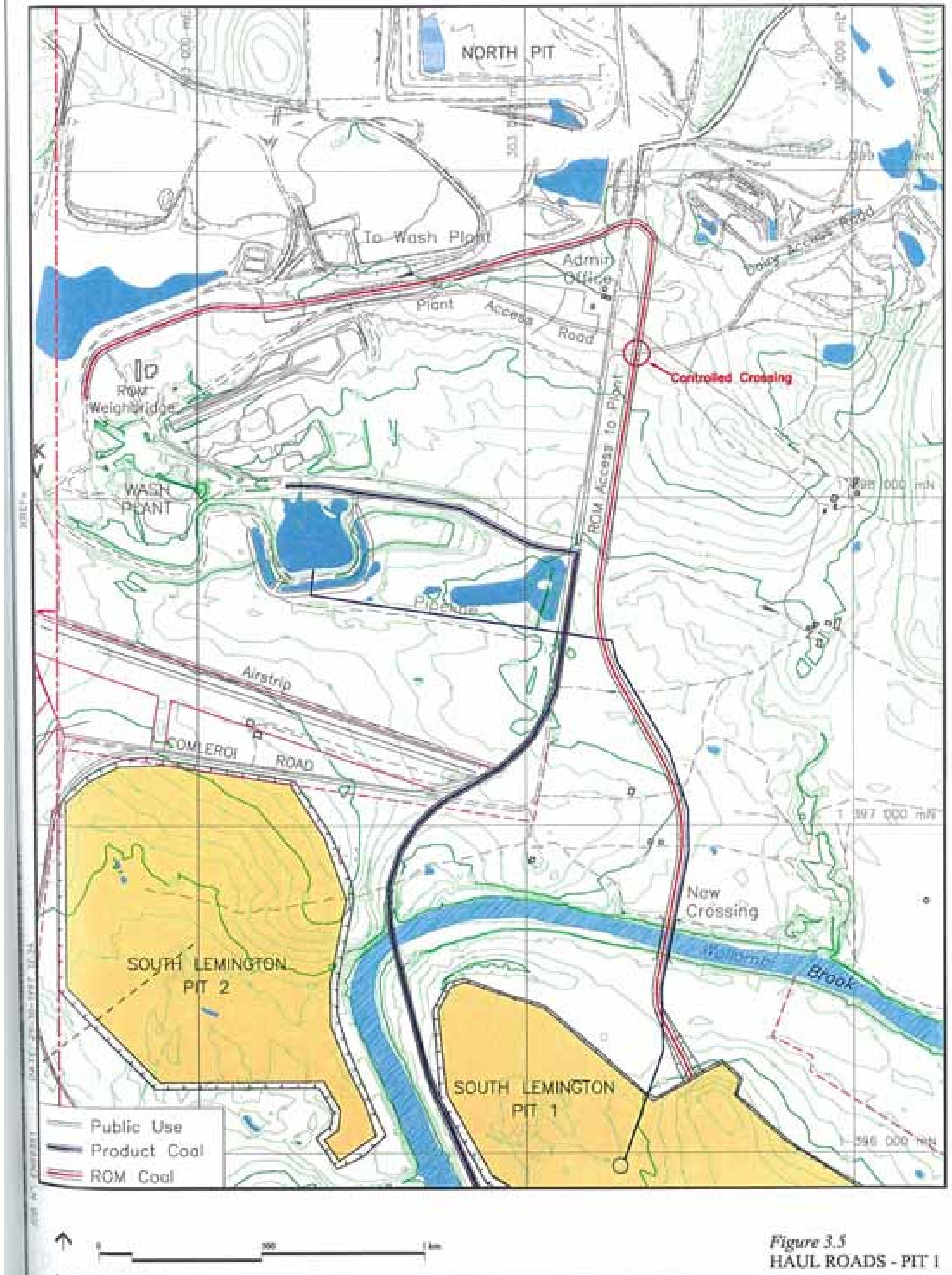
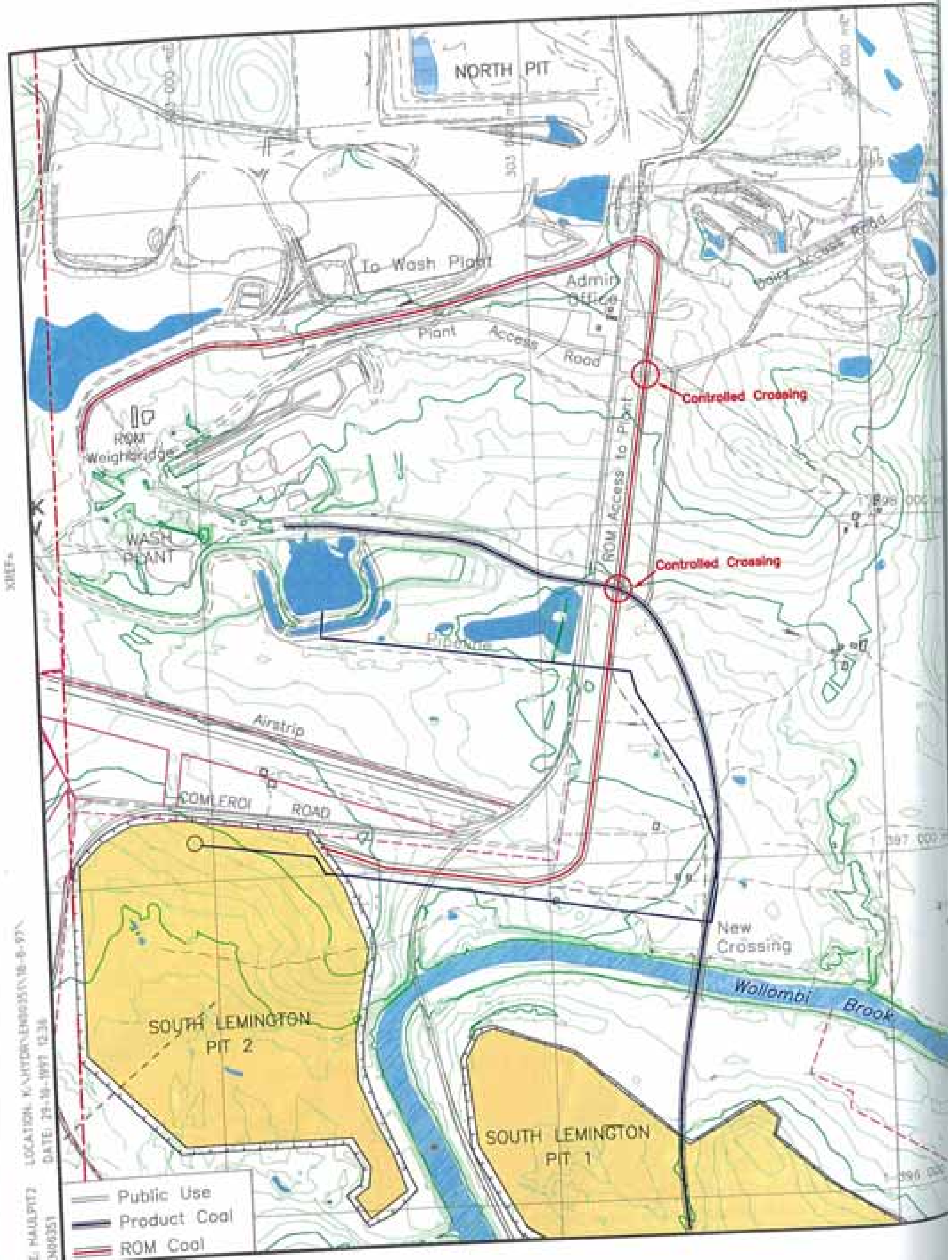
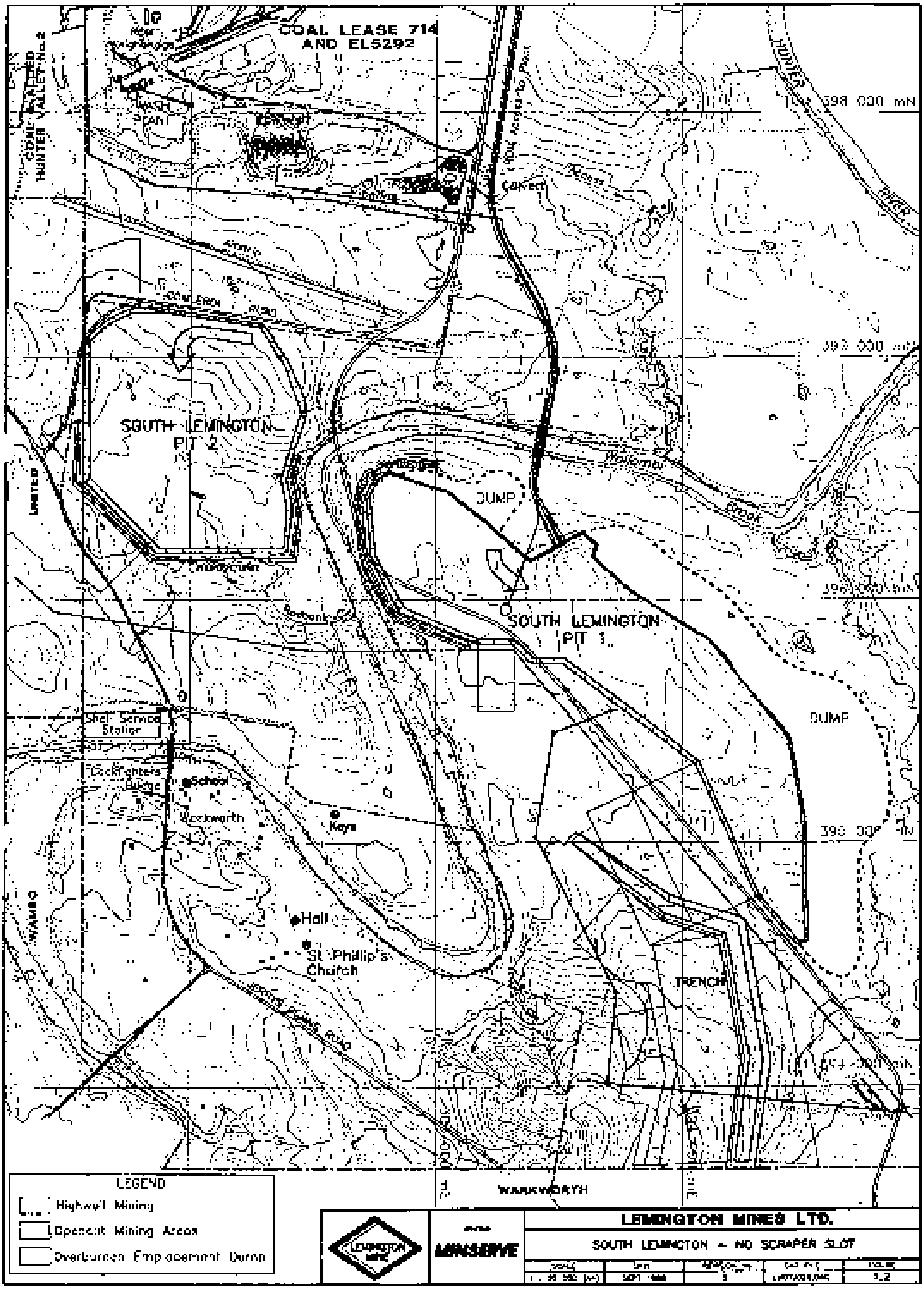


Figure 3.5
HAUL ROADS - PIT 1



FILE NAME: HAULPIT2 LOCATION: K:\HYDR\EN00351\18-8-97\
JOB N°: EN00351 DATE: 29-10-1997 12:36

Figure 3.6
HAUL ROADS - P


COAL LEASE 714
AND EL5292
SOUTH LEMINGTON
PIT 2
SOUTH LEMINGTON
PIT 1
DUMP
DUMP
TRENCH
Shell Service
Station
School
Warkworth
Keys
Hall
St. Phillip's
Church
Culvert
WARKWORTH
HUNTER
UNITED
WAMBO
398 000 mN
394 000 mN
LEGEND
Highwall Mining
Opencut Mining Areas
Overburden Emplacement Dump
LEMINGTON MINES LTD.
MINSERVE
SOUTH LEMINGTON - NO SCRAPER SLOT

Document	Date	Activities
DA 225/92	29/01/1993	Install a coarse reject transport conveyor and fill and rehabilitate an underground mine portal - Lot 2 DP 719879

Document	Date	Activities
West Pit Extension and Minor Modifications EIS	Oct-03	Continuation of activities at HVO north of the Hunter River
		Consolidation of 18 approvals for activities undertaken at HVO north of the Hunter River
		Extension of mining at West Pit to the east
		Increase of production rate at Carrington from 6 to 10 Mpta
		Increase in haulage of coal from mining areas south of the Hunter River to HVCPP from 8 to 16 Mtpa ROM coal
		Intermittent transport of product coal between the HVLP, NLP and RCT
		Intermittent haulage of coal from HVCPP to the HVLP, NLP or RCT along the privately owned Belt Line Road
		Increase in capacity of HVCPP from 13 Mtpa to 20 Mtpa ROM coal
		HVCPP and HCPP to process coal from any of the mining areas in HVO (including south of the Hunter River)
		Construction of a conveyor between the HVLP and NLP
		Upgrade of Belt Line Conveyor between HVCPP and HVLP
		Transfer of heavy equipment across the Hunter River via temporary crossings
		Disposal of reject from any CPP in any approved disposal area within HVO
DA 450-10-2003	12/06/2004	Consolidation of 15 development approvals applying to HVO north of the Hunter River into a single consent
		Extension of open cut mining to the east of currently approved development
		Coal production rate of 12 Mtpa
		Increase in approved production capacity of Carrington Pit from 6 to 10 Mtpa
		Increase in approved coal haulage from south of the Hunter River to HVCPP from 8 to 16 Mtpa
		Processing of up to 6 Mtpa coal at HCPP
		Upgrade of capacity of HVCPP from 13 to 20 Mtpa
		Upgrade of belt line conveyor from HVCPP to HVLP
		Construction of conveyor between HVLP and NLP
		Intermittent coal haulage between HVLP and NLP and RCT
		Intermittent coal haulage between HVCPP and HVLP along a private haul road
		Movement of coal and rejects between mining areas and facilities of HVO, including mining areas and facilities located south of the Hunter River
		Use of coal reject disposal facilities
		Construction of temporary crossings of the Hunter River to allow the relocation of heavy mining equipment
S96(1) Mod Application	Apr-05	Upgrade of HVLP including: - increasing the rate of two portal reclaimers from 2,000 tph to approximately 3,000 tph each - increasing the rate of two yard conveyors from 2,000 tph to approximately 3,600 tph each - increasing the rate of the train loading conveyor from 4,000 tph to approximately 7,200 tpa - installation of train speed control and automated train loading and improved spill detection
DA 450-10-2003 Mod 1	16-Aug-05	HVLP Upgrade as per application
Carrington Pit	Oct-05	Modification and extension of the development consent boundary

Document	Date	Activities
Extended SEE		Mining of approximately 19 Mt coal from surface to below the Bayswater seam
		Extension of Carrington Pit to the south and to the east
		Construction of up to three levees and a groundwater barrier wall
		Diversion of an existing drainage line to the west
		A service corridor around the southern extension area to allow provision of water pipelines, light vehicle access roads, mining equipment substations and other services
		Relocation of the remaining void to the north and modification of the void to perform as an evaporative sink
		Rehabilitation of the pit and disturbed areas to a final landform
DA 450-10-2003 Mod 2 (Mod 166-10-2005)	25-Jun-06	Development in accordance with the application

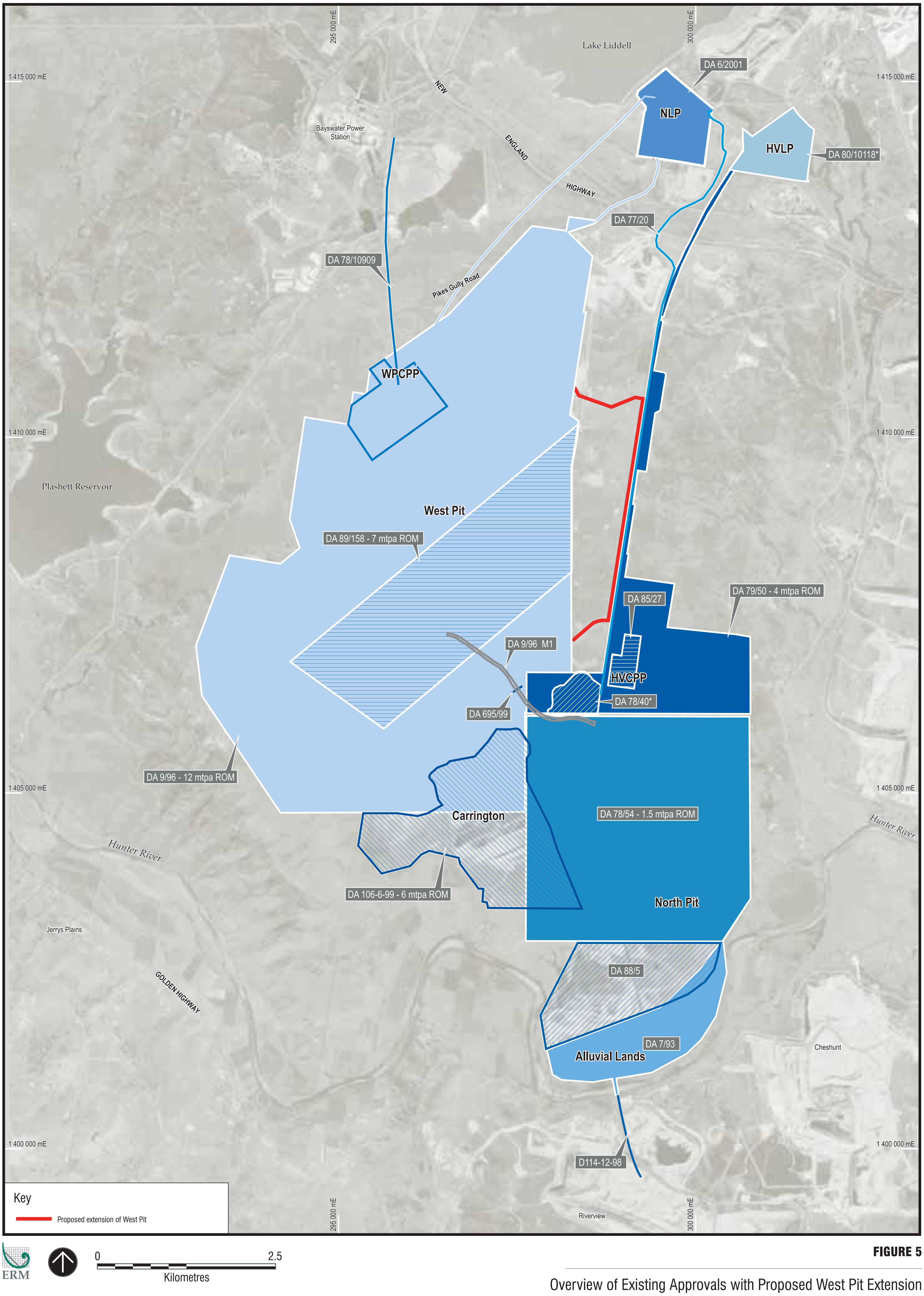


FIGURE 5

Overview of Existing Approvals with Proposed West Pit Extension

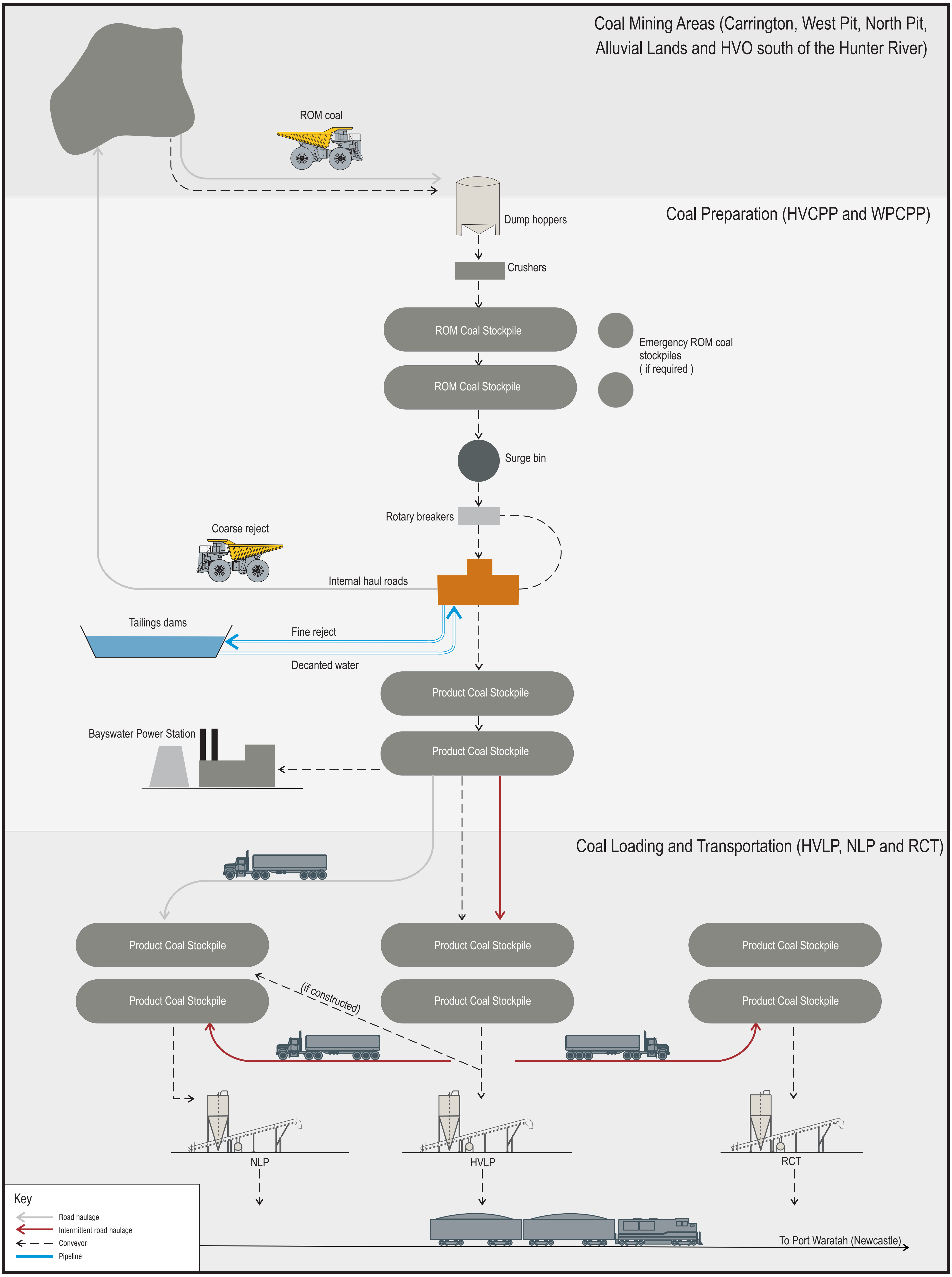


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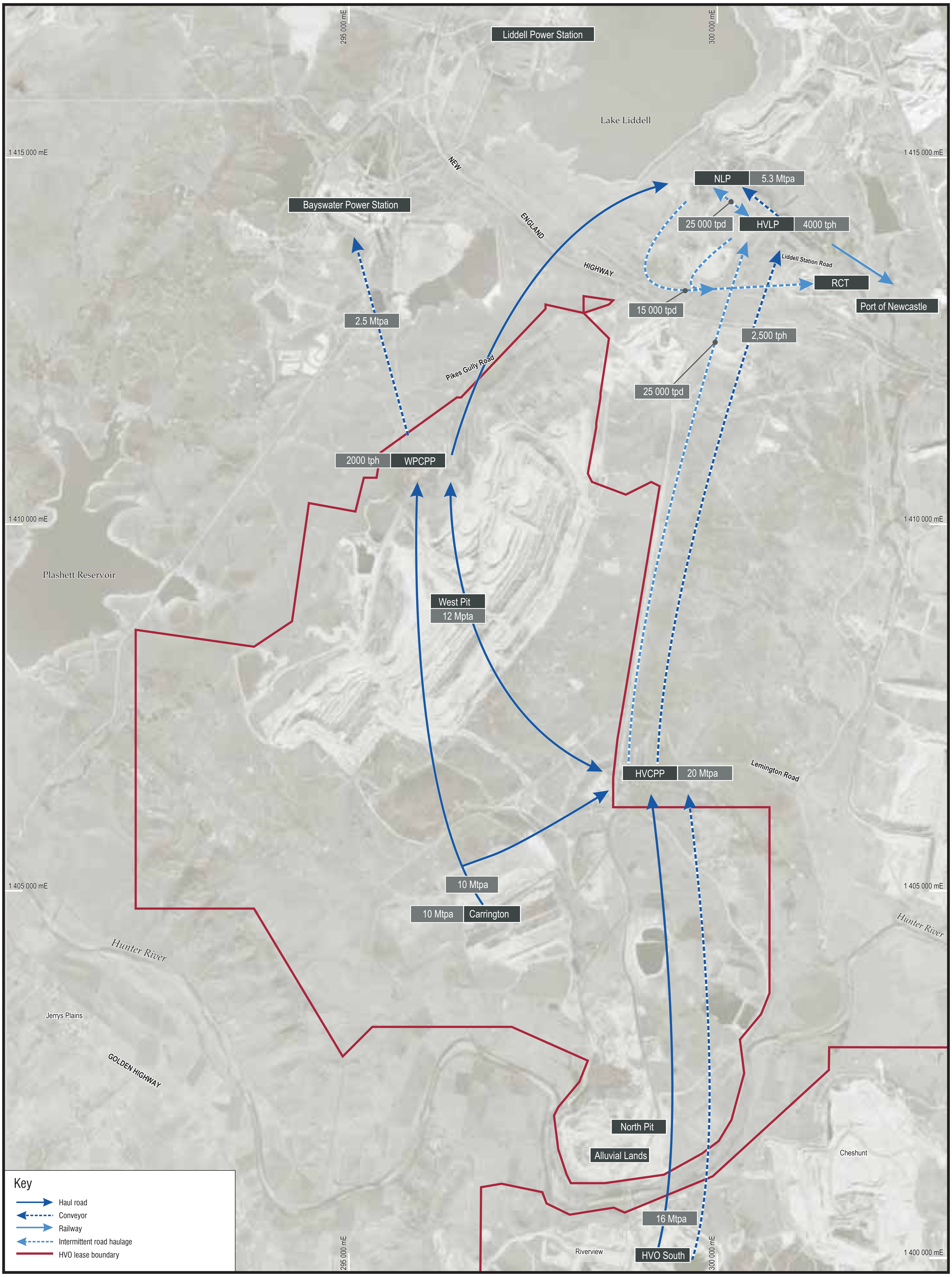
FIGURE 6

Flowchart of Proposed Operations



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0 2.5
Kilometres

FIGURE 12

Proposed Coal Movements

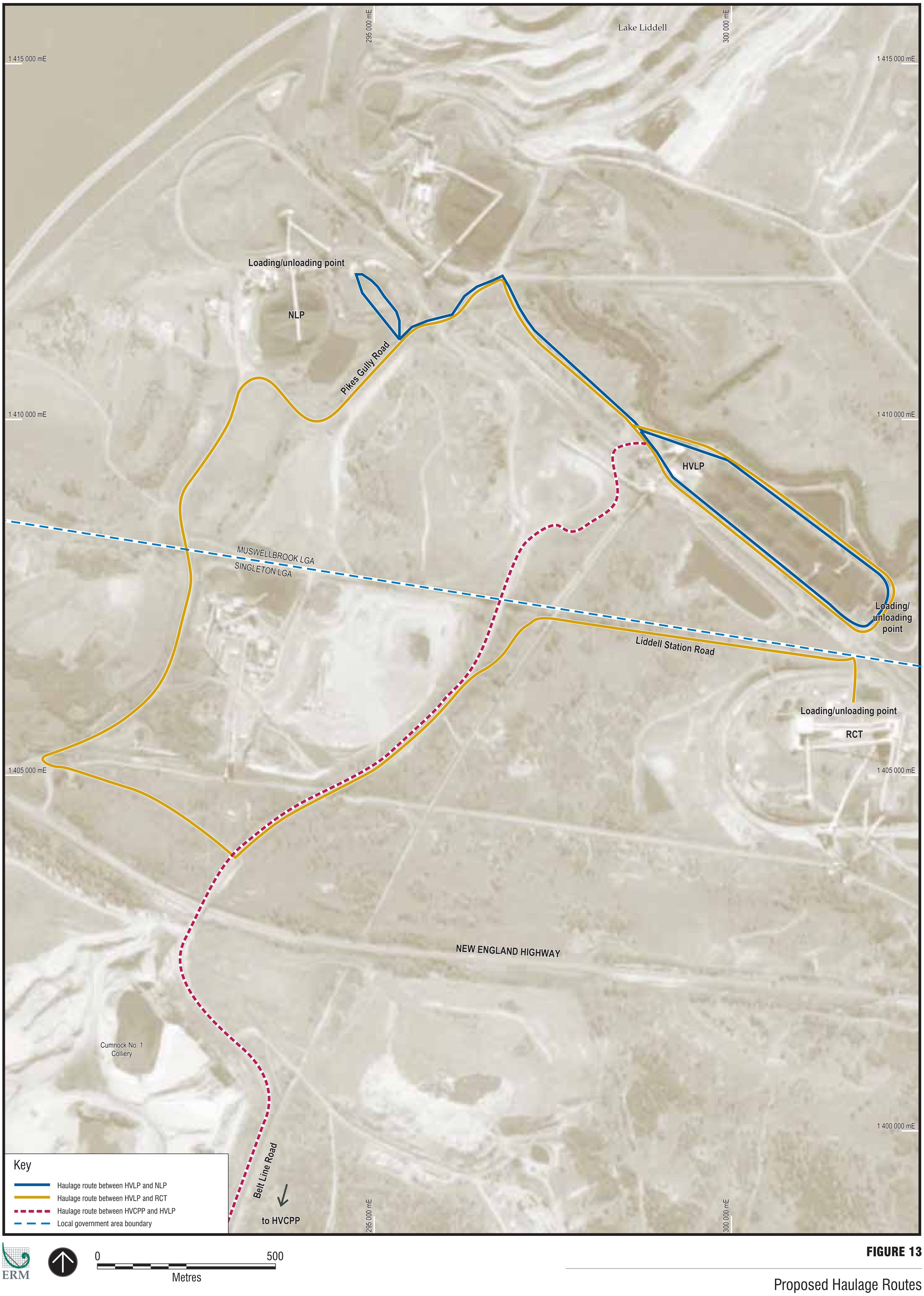

FIGURE 13

Proposed Haulage Routes

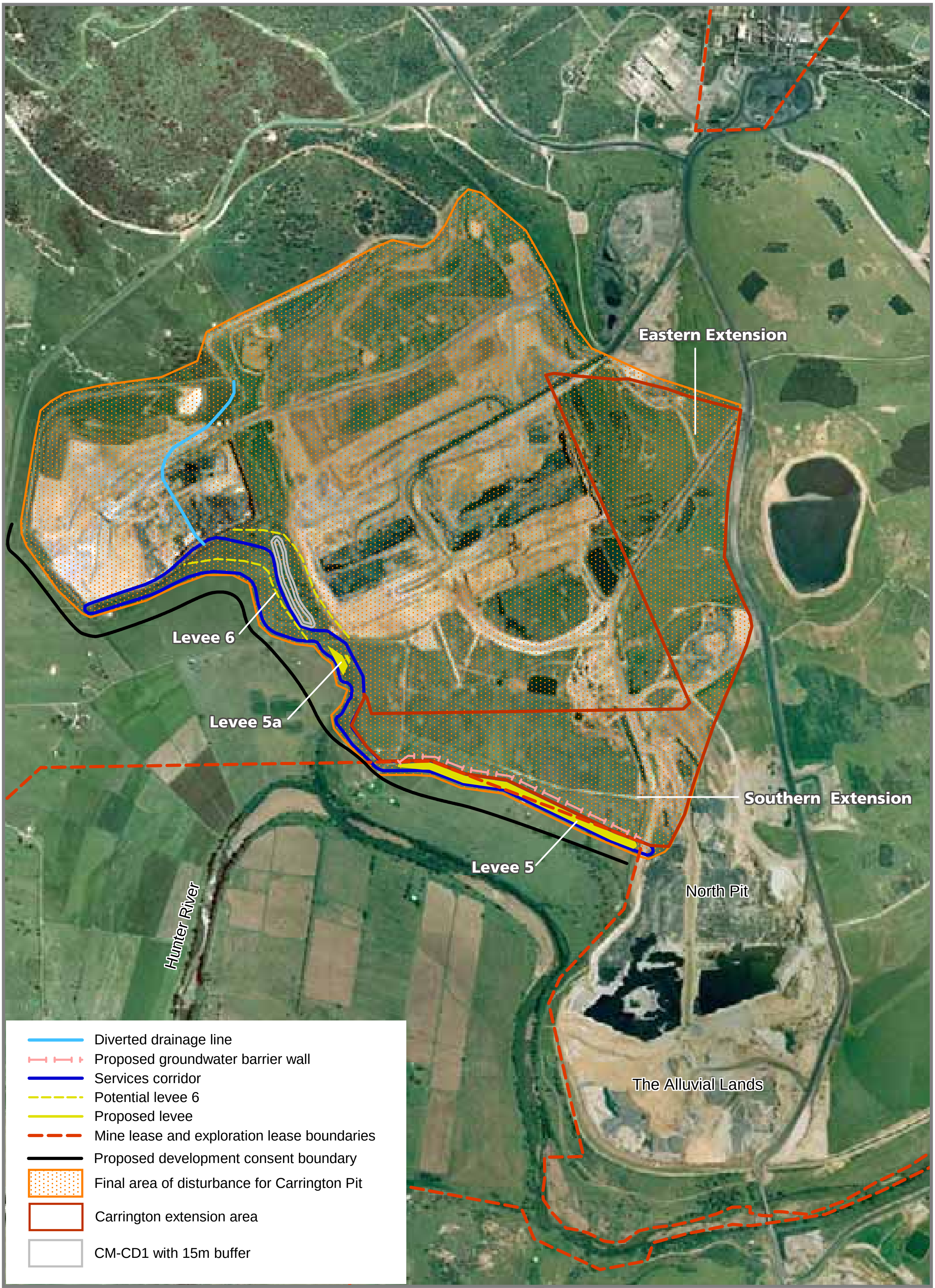

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Figure 2.1 **Proposed Carrington Extension and Features**

Document	Date	Activities
Substation Access Road SEE	1/11/2004	Construction of a new access road from Old Lemington Road to the Energy Australia substation
DA 884/2004	2/02/2005	Construction and use of access road to Energy Australia substation

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Figure 1.1

The Proposed Access Road Site

Licence Number	Type of Works	Purpose or Description	Site
20AL201237	Water Access Licence	Water Access Licence	HVO-N
20AL201254	Water Access Licence	Water Access Licence	HVO-S
20AL201256	Water Access Licence	Water Access Licence	HVO-S
20AL201337	Water Access Licence	Water Access Licence	HVO-S
20AL201500	Water Access Licence	Water Access Licence	HVO-S
20AL201684	Water Access Licence	Water Access Licence	HVO-N
20AL201895	Water Access Licence	Water Access Licence	HVO-N
20BL010847	Bore	Well	HVO-N
20BL030566	Bore	Well	HVO-S
20BL105223	Bore	Well	HVO-C
20BL105224	Bore	Well	HVO-C
20BL120263	Bore	Well	HVO-N
20BL120968	Bore	Well	HVO-N
20BL121565	Bore	Well	HVO-N
20BL143751	Bore	Monitoring Bore	HVO-N
20BL144340	Bore	Monitoring Bore	HVO-N
20BL144341	Bore	Monitoring Bore	HVO-N
20BL144342	Bore	Monitoring Bore	HVO-N
20BL150172	Bore	Monitoring Bore	HVO-S
20BL150179	Bore	Excavation - Test pumping	HVO-N
20BL153705	Bore	Excavation - Dewatering	HVO-N
20BL153705	Bore	Excavation - Dewatering	HVO-N
20BL153705	Bore	Excavation - Dewatering	HVO-N
20BL153705	Bore	Excavation - Dewatering	HVO-N
20BL153705	Bore	Excavation - Dewatering	HVO-N
20BL153705	Bore	Excavation - Dewatering	HVO-N
20BL166175	Bore	Excavation - Dewatering	HVO-N
20BL166176	Bore	Excavation - Re-injection	HVO-N
20BL166637	Bore	Monitoring Bore	HVO-C
20BL166638	Bore	Monitoring Bore	HVO-C
20BL166639	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166640	Bore	Monitoring Bore	HVO-C
20BL166641	Bore	Monitoring Bore	HVO-C
20BL166642	Bore	Monitoring Bore	HVO-C
20BL166735	Bore	Monitoring Bore	HVO-S
20BL166735	Bore	Monitoring Bore	HVO-S
20BL166735	Bore	Monitoring Bore	HVO-S
20BL166735	Bore	Monitoring Bore	HVO-S
20BL166735	Bore	Monitoring Bore	HVO-S
20BL166735	Bore	Monitoring Bore	HVO-S
20BL166735	Bore	Monitoring Bore	HVO-S
20BL166735	Bore	Monitoring Bore	HVO-S
20BL166957	Bore	Monitoring Bore	HVO-C
20BL166957	Bore	Monitoring Bore	HVO-C
20BL166958	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C

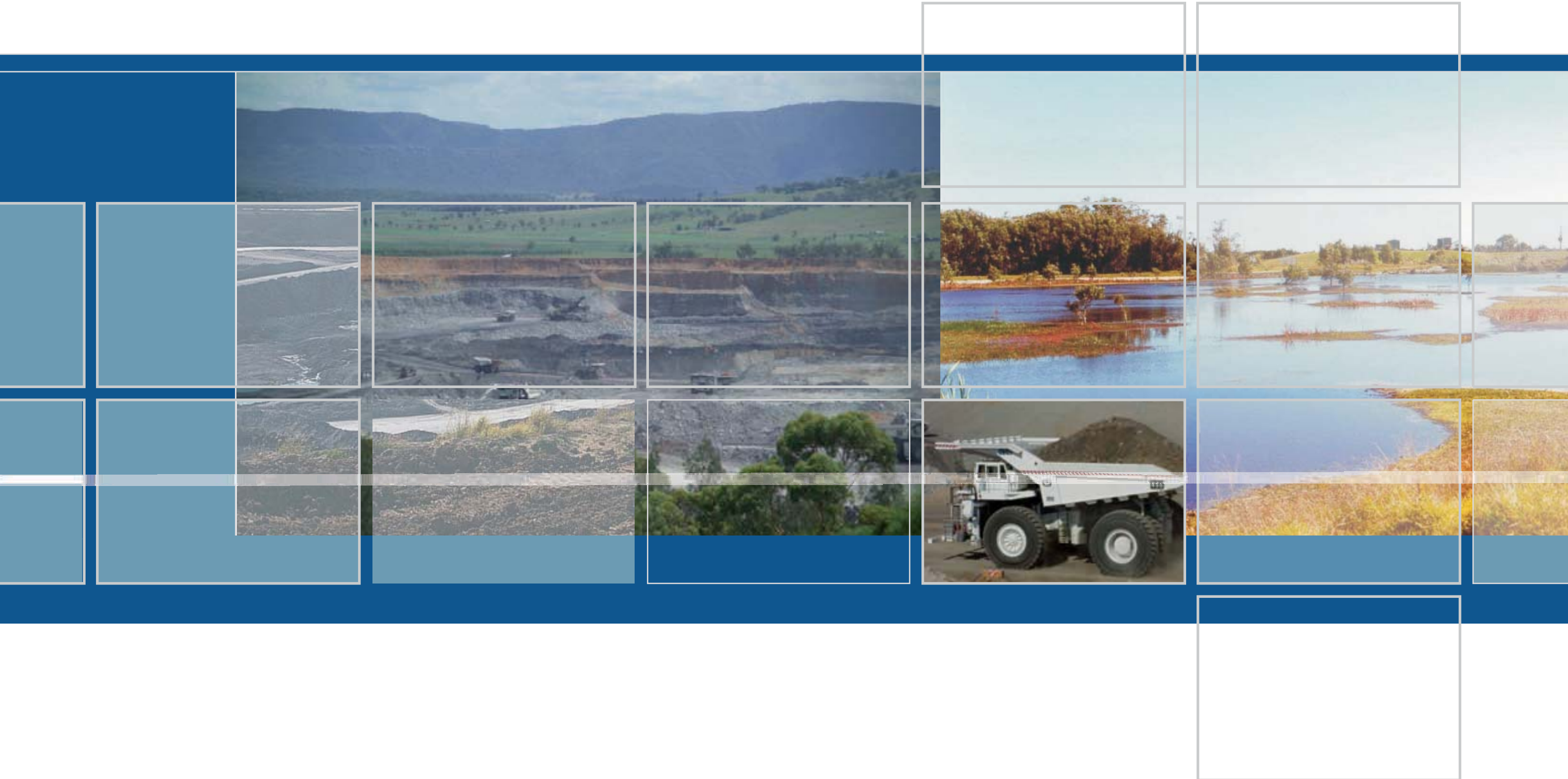
Licence Number	Type of Works	Purpose or Description	Site
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167718	Bore	Monitoring Bore	HVO-C
20BL167799	Bore	Excavation - Dewatering	HVO-C
20BL167799	Bore	Excavation - Dewatering	HVO-C
20BL167799	Bore	Excavation - Dewatering	HVO-C
20BL167860	Bore	Excavation - Mining	HVO-C
20BL167860	Bore	Excavation - Mining	HVO-C
20BL167860	Bore	Excavation - Mining	HVO-C
20BL167860	Bore	Excavation - Mining	HVO-C
20BL167978	Bore	Excavation - Dewatering	HVO-S
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL168820	Bore	Monitoring Bore	HVO-C
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169241	Bore	Monitoring Bore	HVO-N
20BL169641	Bore	Monitoring Bore	HVO-C
20BL169641	Bore	Monitoring Bore	HVO-C
20BL169641	Bore	Monitoring Bore	HVO-C
20BL169641	Bore	Monitoring Bore	HVO-C
20BL169641	Bore	Monitoring Bore	HVO-C
20BL169641	Bore	Monitoring Bore	HVO-C
20BL169641	Bore	Monitoring Bore	HVO-C
20BL169641	Bore	Monitoring Bore	HVO-C
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W

Licence Number	Type of Works	Purpose or Description	Site
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL169962	Bore	Excavation - Mining	HVO-W
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170000	Bore	Excavation - Mining	HVO-N
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S

Licence Number	Type of Works	Purpose or Description	Site
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170010	Bore	Excavation - Mining	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S
20BL170496	Bore	Monitoring Bore	HVO-S

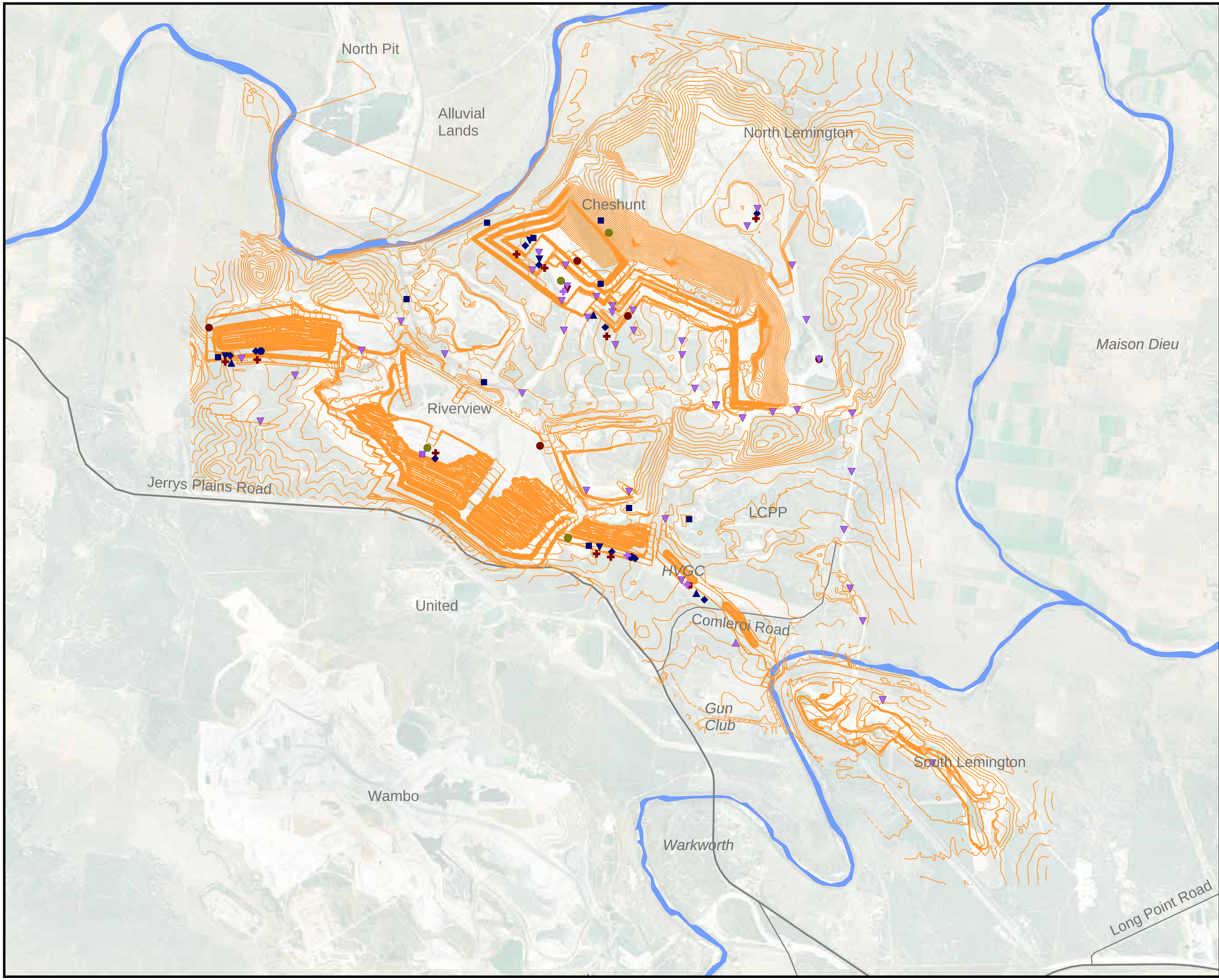
Licence Number	Type of Works	Purpose or Description	Site
20BL170497	Bore	Monitoring Bore	HVO-S
20BL170497	Bore	Monitoring Bore	HVO-S
20BL170497	Bore	Monitoring Bore	HVO-S
20BL170497	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170499	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170498	Bore	Monitoring Bore	HVO-S
20BL170735	Bore	Test Bore	HVO-S
20BL171157	Bore	Dewatering bore	HVO-N
20BL171158	Bore	Dewatering bore	HVO-N
20BL171159	Bore	Dewatering bore	HVO-N
20BL171165	Bore	Test Bore	HVO-S
20BL171240	Bore	Dewatering bore	HVO-N
20BL171423	Bore	Monitoring Bore	HVO-S
20BL171424	Bore	Monitoring Bore	HVO-S
20BL171425	Bore	Monitoring Bore	HVO-S
20BL171425	Bore	Monitoring Bore	HVO-S
20BL171426	Bore	Monitoring Bore	HVO-S
20BL171426	Bore	Monitoring Bore	HVO-S
20BL171427	Bore	Monitoring Bore	HVO-S
20BL171427	Bore	Monitoring Bore	HVO-S
20BL171428	Bore	Monitoring Bore	HVO-S
20BL171429	Bore	Monitoring Bore	HVO-S
20BL171429	Bore	Monitoring Bore	HVO-S
20BL171430	Bore	Monitoring Bore	HVO-S
20BL171430	Bore	Monitoring Bore	HVO-S
20BL171431	Bore	Monitoring Bore	HVO-S
20BL171432	Bore	Monitoring Bore	HVO-S
20BL171433	Bore	Monitoring Bore	HVO-S
20BL171434	Bore	Monitoring Bore	HVO-S
20BL171435	Bore	Monitoring Bore	HVO-S
20BL171435	Bore	Monitoring Bore	HVO-S
20BL171435	Bore	Monitoring Bore	HVO-S
20BL171436	Bore	Monitoring Bore	HVO-S
20BL171436	Bore	Monitoring Bore	HVO-S
20BL171436	Bore	Monitoring Bore	HVO-S
20BL171437	Bore	Monitoring Bore	HVO-W
20BL171437	Bore	Monitoring Bore	HVO-W
20BL171437	Bore	Monitoring Bore	HVO-W
20BL171438	Bore	Monitoring Bore	HVO-C
20BL171439	Bore	Monitoring Bore	HVO-S
20BL171439	Bore	Monitoring Bore	HVO-S
20BL171492	Bore	Monitoring Bore	HVO-S
20BL171492	Bore	Monitoring Bore	HVO-S
20BL171492	Bore	Monitoring Bore	HVO-S
20CA201896	Diversion Works	Irrigation	HVO-N

Licence Number	Type of Works	Purpose or Description	Site
20CA201896	Diversion Works	Irrigation	HVO-N
20CA201896	Diversion Works	Irrigation	HVO-N
20CA201896	Diversion Works	Irrigation	HVO-N
20CA201896	Diversion Works	Irrigation	HVO-N
20CA201896	Diversion Works	Irrigation	HVO-N
20CA201896	Diversion Works	Irrigation	HVO-N
20CA201896	Diversion Works	Irrigation	HVO-N
20CA201896	Diversion Works	Irrigation	HVO-N
20CW800913	Controlled Work	Levee	HVO-N
20CW800973	Controlled Work	Levee	HVO-N
20CW801475	Controlled Work	Levee	HVO-N
20CW801475	Controlled Work	Levee	HVO-N
20CW801475	Controlled Work	Levee	HVO-N
20CW801475	Controlled Work	Levee	HVO-N
20CW801475	Controlled Work	Levee	HVO-N
20CW801475	Controlled Work	Levee	HVO-N
20CW801475	Controlled Work	Levee	HVO-N
20CW801475	Controlled Work	Levee	HVO-N
20CW801475	Controlled Work	Levee	HVO-N
20CW802600	Controlled Work	Levee	HVO-C
20CW802600	Controlled Work	Levee	HVO-C
20CW802603	Controlled Work	Levee	HVO-S
20CW802604	Controlled Work	Levee	HVO-N
20CW802604	Controlled Work	Levee	HVO-N
20CW802606	Controlled Work	Levee	HVO-C
20CW802606	Controlled Work	Levee	HVO-C
20CW802606	Controlled Work	Levee	HVO-C
20CW802611	Controlled Work	Levee	HVO-C
20CW802612	Controlled Work	Levee	HVO-C
20CW802613	Controlled Work	Levee	HVO-S
20CW802613	Controlled Work	Levee	HVO-S
20SL028736	Diversion Works	Pumping Plant	HVO-S
20SL029752	Diversion Works	Irrigation	HVO-N
20SL033624	Diversion Works	Irrigation	HVO-N
20SL035311	Diversion Works	Industrial	HVO-S
20SL039176	Diversion Works	Industrial	HVO-S
20SL042662	Diversion Works	Industrial	HVO-S
20SL042746	Diversion Works	Industrial	HVO-N
20SL050903	Stream Diversion	Bywash Dams	HVO-W
20SL050903	Stream Diversion	Pumping Plant	HVO-W
20SL050995	Diversion Works	Pumping Plant	HVO-N
20SL050996	Diversion Works	Pumping Plant	HVO-N
20SL060499	Stream Diversion	Bywash Dams	HVO-W
20SL060499	Stream Diversion	Pumping Plant	HVO-W
20SL060514	Diversion Works	Pumping Plant	HVO-W
20SL061104	Stream Diversion	Cutting (Diversion Drain)	HVO-C
20SL061155	Diversion Works	Irrigation	HVO-N
20SL061290	Stream Diversion	Cutting (Diversion Drain)	HVO-W
20SL061594	Stream Diversion	Cutting (Diversion Drain)	HVO-C
20SL061594	Stream Diversion	Cutting (Diversion Drain)	HVO-C
20SL061594	Stream Diversion	Cutting (Diversion Drain)	HVO-C
20SL061594	Stream Diversion	Cutting (Diversion Drain)	HVO-C
20WA201238	Diversion Works	Pumping Plant	HVO-N
20WA201257	Diversion Works	Pumping Plant	HVO-S
20WA201338	Diversion Works	Pumping Plant	HVO-S
20WA201501	Diversion Works	Pumping Plant	HVO-S
20WA201685	Diversion Works	Pumping Plant	HVO-N
WAL 13387	Certificate of Title	Certificate of Title	HVO-W
WAL 969	Certificate of Title	Certificate of Title	HVO-S
WAL1006	Certificate of Title	Certificate of Title	HVO-S
WAL1070	Certificate of Title	Certificate of Title	HVO-S
WAL13391	Certificate of Title	Certificate of Title	HVO-N
WAL962	Certificate of Title	Certificate of Title	HVO-N
WAL970	Certificate of Title	Certificate of Title	HVO-S



Annex E

Indicative Mine Plans (2006)



Legend

- BE 1370 Dragline
- CAT D11 Dozer
- Coal Truck - 240T
- Drill
- Front End Loader
- Grader
- Lighting Plant
- P&H 2800 Shovel
- P&H 4100 XPB Shovel
- Reject Truck - 240T
- Rubber Tyred Dozer
- Scraper
- Waste Truck - 240T
- Water Cart
- Mine Plan

Figure 1

Indicative Mine Plan and Equipment Locations - Scenario A

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_ANX_01
Date:	04.10.2007 Drawing Size: A3
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

N

0 500 1000m

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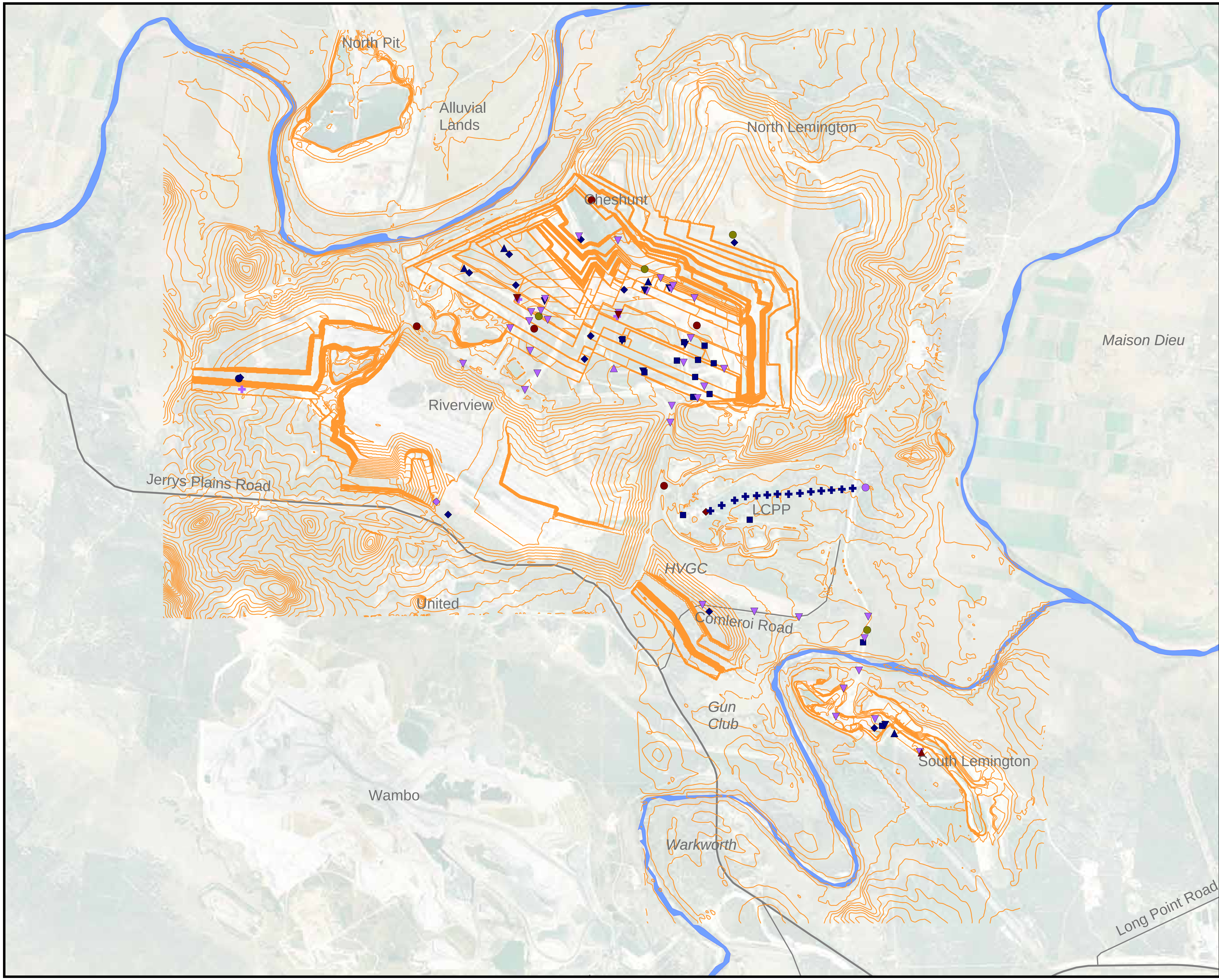
Building C, 33 Saunders St, Pyrmont, NSW 2009
Telephone +61 2 8584 8888

ERM



Legend

- BE 1370 Dragline
- CAT D11 Dozer
- Coal Truck - 240T
- Conveyor
- Drill
- Front End Loader
- Grader
- LCPP
- Lighting Plant
- P&H 2800 Shovel
- P&H 4100 Shovel
- P&H 4100 XPB Shovel
- Rail Loader and Locomotive
- Reject Truck
- Reject Truck - 240T
- Rubber Tyred Dozer
- Scraper
- Waste Truck - 240T
- Water Cart
- Mine Plan

Figure 2

Indicative Mine Plan and Equipment Locations - Scenario B2

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_ANX_02		
Date:	04.10.2007	Drawing Size:	A3
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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ERM

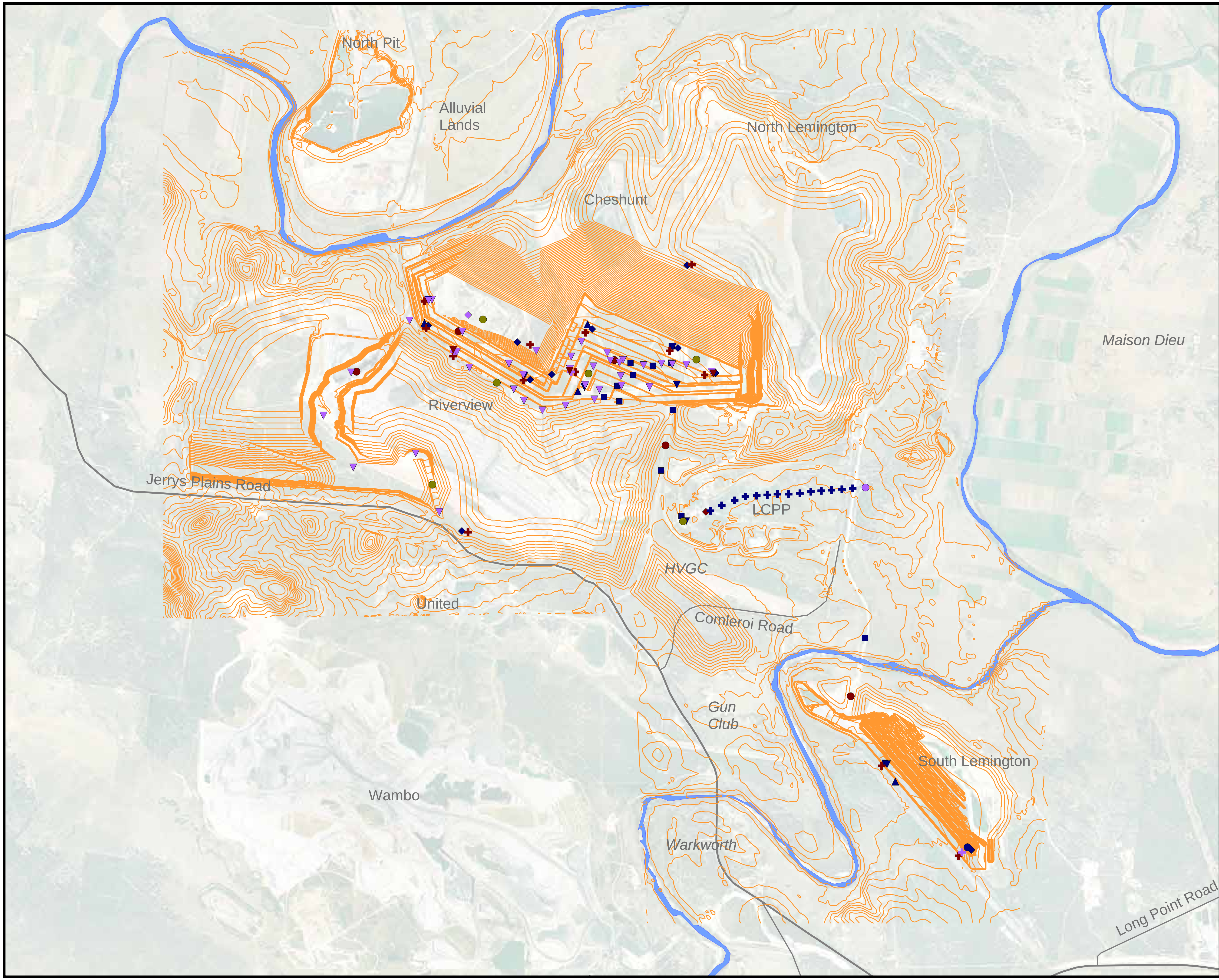

Figure 3

Indicative Mine Plan and Equipment Locations - Scenario C2

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_ANX_03
Date:	04.10.2007 — Drawing Size: A3
Drawn By:	DH — Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

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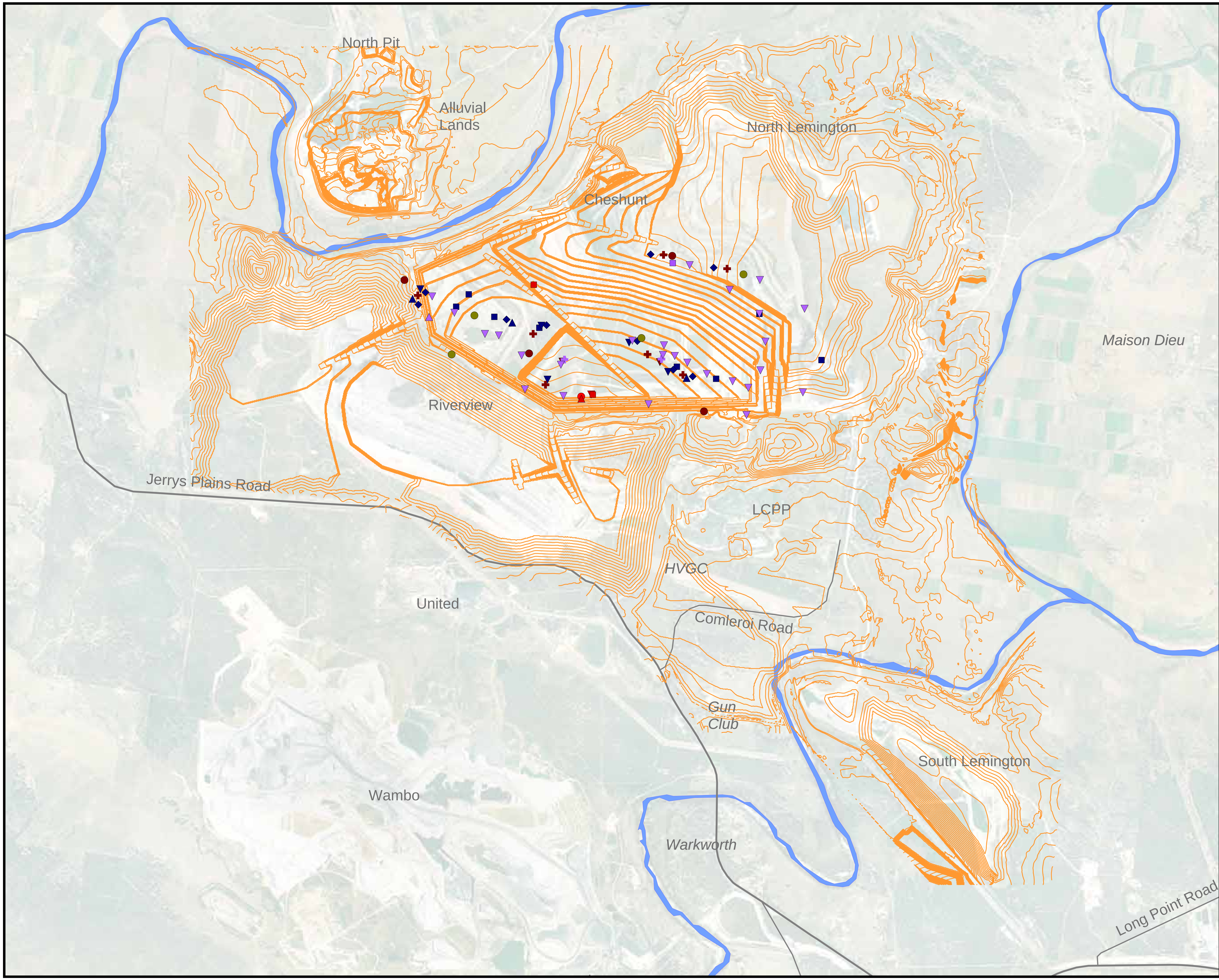

Legend

- CAT D11 Dozer
- Coal Truck - 240T
- Drill
- Front End Loader
- Grader
- Lighting Plant
- P&H 4100 XPB Shovel
- Reject Truck - 240T
- Rubber Tyred Dozer
- Scraper
- Waste Truck - 240T
- Water Cart

HWM

- Coal Truck - 240T
- Front End Loader
- Highwall Mining
- Lighting Plant

Mine Plan

Figure 4

Indicative Mine Plan and Equipment Locations - Scenario D

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_ANX_04		
Date:	04.10.2007	Drawing Size:	A3
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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ERM

Annex F

Preliminary Assessment of Highwall Mining Extraction Layouts at Riverview (North and South Sections), Cheshunt and Lemington South Pits, Hunter Valley Operation, Strata Engineering 2007

STRATA ENGINEERING (Australia) Pty Ltd
Consulting and Research Engineering

A.B.N. 26 074 096 263

2 May 2007

Mr Gregor Carr
Senior Mining Engineer
Rio Tinto Coal Australia Pty Ltd
GPO Box 391
BRISBANE
QLD 4001

Final Report No. 06-001-RTC/1

Dear Gregor,

RE: Preliminary Assessment of Highwall Mining Extraction Layouts at Riverview (North and South Sections), Cheshunt and Lemington South Pits, Hunter Valley Operations

1.0 Introduction

As part of an overall Environment Impact Assessment (EIA), this preliminary report evaluates the potential for continuous miner highwall mining extraction (termed "highwall mining" from hereon) within the following areas of the Riverview South, Riverview North, Cheshunt and Lemington South Pits of Hunter Valley Operations:

(i) **Riverview South Pit (Golden Highway):** south of the highwall along line 309200E, 6398150N to 311000E, 6398000N, in the Bowfield Seam (BF2)

(ii) **Riverview North Pit:** north of the highwall along line 309450E, 6400400N to 309850E, 6400400N, in the Bowfield Seam (BF2)

(iii) **Cheshunt Pit:** north-east of the low-wall along line 313400E, 6400300N to 314500E, 6399700N, in the Broonie and Bayswater Seams (BR6 to BY3)

(iv) **Lemington South Pit:** south-west of the highwall along line 315700E, 6395600N to 317000E, 6394100N, in the Bowfield Seam (BF2)

Figure 1 shows the proposed mining areas and depth contours of the relevant seams.

2.0 Design Standard

It is understood that in all four areas long-term stable layouts are required, with a maximum allowable surface subsidence of ≤20 mm.

3.0 Design Methodology

The design methodology used in this assessment will consider each of the following:

i) Pillar strength.
ii) Pillar loading.
iii) Pillar FoS.
iv) Likely and worse-case surface subsidence.

3.1 Pillar Strength

The general strength formula for pillars with w/h ratios <5 is defined by **Salamon *et al*, 1996** as:

$$\sigma_p = 8.6\frac{(w_p\Theta)^{0.51}}{h^{0.84}} \qquad [1]$$

For pillars with w/h ratios ≥5, the following formula is recommended:

$$\sigma_p = \frac{27.63\Theta^{0.51}}{w_p^{0.22}h^{0.11}}\left\{0.29\left[\left(\frac{w_m}{5h}\right)^{2.5}-1\right]+1\right\} \qquad [2]$$

where w_m = minimum pillar width (m)
h = mining height (m)
Θ = is a dimensionless 'aspect ratio' factor

3.2 Pillar Loading

The pillars considered in this assessment will be subjected to tributary area loading, which assumes that each pillar carries a proportionate share of the full overburden load.

The tributary area load acting on the pillars can be calculated using the following formula:

$$T = \frac{(w_p + w_r)(l_p + w_r)\rho g H}{w_p l_p} \qquad [3]$$

where T = pillar load (MPa)
w_p = pillar width (m)
l_p = pillar length (m)
w_r = roadway width (m)
H = cover depth (m)
ρ = density of rock (taken as 2.5 t/m^3)
g = gravitational constant (10 m/s^2)

The Factor of Safety (FoS) of pillars is then:

$$\text{FoS} = \frac{\text{Pillar Strength}}{\text{Pillar Load}} \qquad [4]$$

3.3 Pillar Width to Height Ratio

From the Australian and South African bord-and-pillar and highwall mining pillar collapse database shown in **Figure 2**, the following points are of note (**Hill, 2005**):

- There are no failed cases with a w/h ratio of >8 and there is only one failed case with a w/h ratio of >5.
- The highest FoS associated with a pillar collapse is 2.1 and this was associated with a w/h ratio of only 2.2.
- There are several failed highwall mining cases with a FoS of >2 and w/h ratios of <2.
- A “limit line for failed cases” can be defined.
- Although not shown, stable pillars have been formed up within the limit line of failed cases.

Although it is generally considered appropriate to design on the basis that the combined FoS and w/h ratio of the pillar lies outside the “limit line of failed cases”, the resulting FoS and w/h ratio of strategically important or long-life pillars should exceed a “design limit line” of failed cases, which as a means of conservatism adds a 20% “buffer” to the limit line of the failed cases, referring again to **Figure 2**.

3.4 Estimation of Likely Surface Subsidence Due to Compression of the Pillars, Immediate Roof and Floor Materials

The subsidence at the surface above the pillars is estimated to equal the expected elastic compression of the pillars, immediate roof and floor strata.

The elastic compression of the pillars can be estimated based on solid mechanics principals and Boussinesq's stress bulb theory as follows (**Das, 1998**):

For pillar compression, the following is assumed:

$$P_{pillar} = \frac{\sigma_{ch} h}{E} \qquad [5]$$

where σ_{ch} = vertical stress change (MPa)
h = pillar height (m)
E = Young's Modulus of pillars (MPa)

For floor/roof compression, the following is assumed:

$$P_{floor/roof} = \frac{\sigma_{ch} w_m \iota (1-\nu^2)}{E} \qquad [6]$$

where w_m = proposed pillar width (m)
ι = influence function based on width/length (w/l) ratio (varies from 2.3 to 3.0)
E = Young's Modulus of roof and floor (MPa)
υ = Poisson’s ratio (assumed 0.3)

The resulting change in vertical stress on the pillars can be estimated as follows:

$$\sigma_{ch} = \text{Tributary Area Stress} - \text{Virgin Stress} \quad [7]$$

3.5 Estimation of Worse-Case Subsidence Due to Failure of Pillars

In contrast to high-extraction (eg longwall) mining, areas of failure involving pillars are not devoid of support. The pillars tend to resist formation of a goaf with significant voids; instead the overburden has a propensity to 'sit' *en masse* on the failing pillars. The result, particularly at shallow depths, is a magnitude of subsidence that can be high in comparison to the volumetric extraction.

In the event of pillar failures, the subsidence can be predicted using an 'effective extraction height', refer to **MacCourt *et al*, 1986**. This has been estimated by multiplying the pillar extraction ratio with the mining height and represents the maximum possible void or volume in which the pillars can crush into.

MacCourt *et al* (1986) suggest the following formula to calculate the surface subsidence in the case of failure of pillars at cover depths ≤80 m:

$$S_m = 0.8h_e \quad [8]$$

where $h_e = eh$ and e is the extraction ratio.

Studies of surface subsidence over Australian collieries showed that at greater cover depths (>80 m), maximum surface subsidence is approximately equal to 60% of the effective mining height (**Holla, 1987**):

$$S_m = 0.6h_e \quad [9]$$

4.0 Inputs Used

As part of this assessment, the following general inputs are used:

- Roadway width is 3.5 m.
- Pillar length is assumed to be 100 m
- The maximum extractable mining heights are:
  - Riverview South 3.1 m
  - Riverview North 3.0 m
  - Cheshunt 4.0 m
  - Lemington South 4.0 m

Regarding the pillar length, it is noted that most highwall mining equipment is capable of mining ("punching") to approximately 500 m. The assumption of a 100 m pillar length is therefore likely to be marginally conservative in terms of pillar design and strength.

For estimates of subsidence, the following material properties are assumed:

Material	Young's Modulus (GPa)
Coal	2.0
Floor	5.0
Roof	5.0

5.0 Proposed Panel and Pillar Dimensions

The proposed pillar dimensions for each panel for different cover depths are presented in **Table 1**. The main points of note are as follows:

- Likely surface subsidence due to elastic deformations of pillar, floor and roof increases with increasing cover depth and varies from 2.9 mm to 16.2 mm.
- As depth increases, larger pillars are required to meet the suggested minimum design requirement. Therefore, areal extraction ratio decreases as depth increases.
- The pillar Factors of Safety are ≥2.1, equating to nominal probabilities of panel failure of ≤1 in a million.
- In the unlikely (practically impossible) event of pillar failure, the worst-case subsidence would vary from 0.5 to 0.6 m for Riverview South, 1.1 to 1.3 m for Riverview North, 0.4 to 0.6 m for Cheshunt and 0.7 to 1.3 m for Lemington South.

Note that the design dimensions presented in **Table 1** are based on a requirement for ≤20 mm of surface subsidence. In areas with no surface restrictions, extraction ratios greater than stipulated in **Table 1** could be achieved by modifying the layouts.

Table 1. Recommended Highwall Mining Pillar Layouts at Riverview, Cheshunt and Lemington South Pits for Different Cover Depths

Riverview Pit South

Depth Range (m)	Pillar Width (m)	Pillar Length (m)	e%	FoS	Elastic Smax (mm)	Worst-case Smax (Pillar Failure) (m)	w/h
95	7.1	100	32.3	2.5	10.2	0.6	2.3
100	7.4	100	31.4	2.5	10.6	0.6	2.4
105	7.8	100	30.3	2.5	10.9	0.6	2.5
110	8.0	100	29.7	2.4	11.3	0.6	2.6
115	8.3	100	29.0	2.4	11.7	0.5	2.7
120	8.6	100	28.2	2.4	12.0	0.5	2.8
125	8.9	100	27.5	2.3	12.4	0.5	2.9
130	9.2	100	26.8	2.3	12.7	0.5	3.0
135	9.4	100	26.4	2.3	13.1	0.5	3.0

***Riverview Pit North**

Depth Range (m)	Pillar Width (m)	Pillar Length (m)	e%	FoS	Elastic Smax (mm)	Worst-case Smax (Pillar Failure) (m)	w/h ratio
20	3.1	100	52.6	5.72	2.94	1.3	1.03
25	3.1	100	52.6	4.57	3.68	1.3	1.03
30	3.1	100	52.6	3.81	4.41	1.3	1.03
35	3.3	100	51.0	3.48	5.01	1.2	1.10
40	3.7	100	48.4	3.38	5.50	1.2	1.22
45	4.0	100	46.1	3.29	5.96	1.1	1.33

Cheshunt Pit

Depth Range (m)	Pillar Width (m)	Pillar Length (m)	e%	FoS	Elastic Smax (mm)	Worst-case Smax (Pillar Failure) (m)	w/h ratio
120	11.2	100	23.0	2.3	11.4	0.6	2.8
130	11.9	100	21.9	2.3	12.0	0.5	3.0
140	12.6	100	20.9	2.2	12.7	0.5	3.2
150	13.3	100	20.0	2.2	13.3	0.5	3.3
160	13.8	100	19.4	2.1	14.0	0.5	3.5
170	14.5	100	18.6	2.1	14.6	0.4	3.6
180	15.4	100	17.7	2.1	15.1	0.4	3.9
190	16.1	100	17.0	2.1	15.7	0.4	4.0
200	17.0	100	16.3	2.1	16.2	0.4	4.2

Lemington South Pit

Depth Range (m)	Pillar Width (m)	Pillar Length (m)	e%	FoS	Elastic Smax (mm)	Worst-case Smax (Pillar Failure) (m)	w/h ratio
45	5.0	100	40.6	3.2	5.9	1.3	1.3
50	5.5	100	38.3	3.1	6.3	1.2	1.4
55	6.0	100	36.2	3.1	6.6	1.2	1.5
60	6.5	100	34.3	3.0	7.0	1.1	1.6
65	6.9	100	33.0	2.9	7.4	1.1	1.7
70	7.3	100	31.7	2.9	7.8	1.0	1.8
75	7.7	100	30.6	2.8	8.2	1.0	1.9
80	8.1	100	29.5	2.7	8.6	0.9	2.0
85	8.5	100	28.5	2.7	8.9	0.7	2.1

*Note the depth of weathering in the Riverview North Pit is approximately 13 m, based on the available borehole logs. It is suggested that prior to any extraction in this area, additional boreholes should be drilled and the exact depth of weathering determined.

6.0 Limitations of Assessment and Recommendations

This study should be regarded as preliminary. Detailed design would be required prior to any extraction approval application, to evaluate specific local issues. Particular attention would need to be given to overburden geology and the potential for roof instability. This could, for example, necessitate the maintenance of a top coal beam to prevent premature roof failure.

Although regarded as only a secondary geotechnical threat, the nature of the floor would also require further assessment.

Regarding pillar stability, it should also be noted that the protection of surface structures or natural features would also require specific consideration and in recent times the relevant authorities have tended to adopt a highly conservative approach to the protection of surface infrastructure and features (including prohibiting mining).

If you require any further information or wish to discuss the contents of this draft report then please do not hesitate to contact me.

Yours sincerely,

STRATA ENGINEERING (Australia) Pty Ltd

Ismet Canbulat
Principal

References

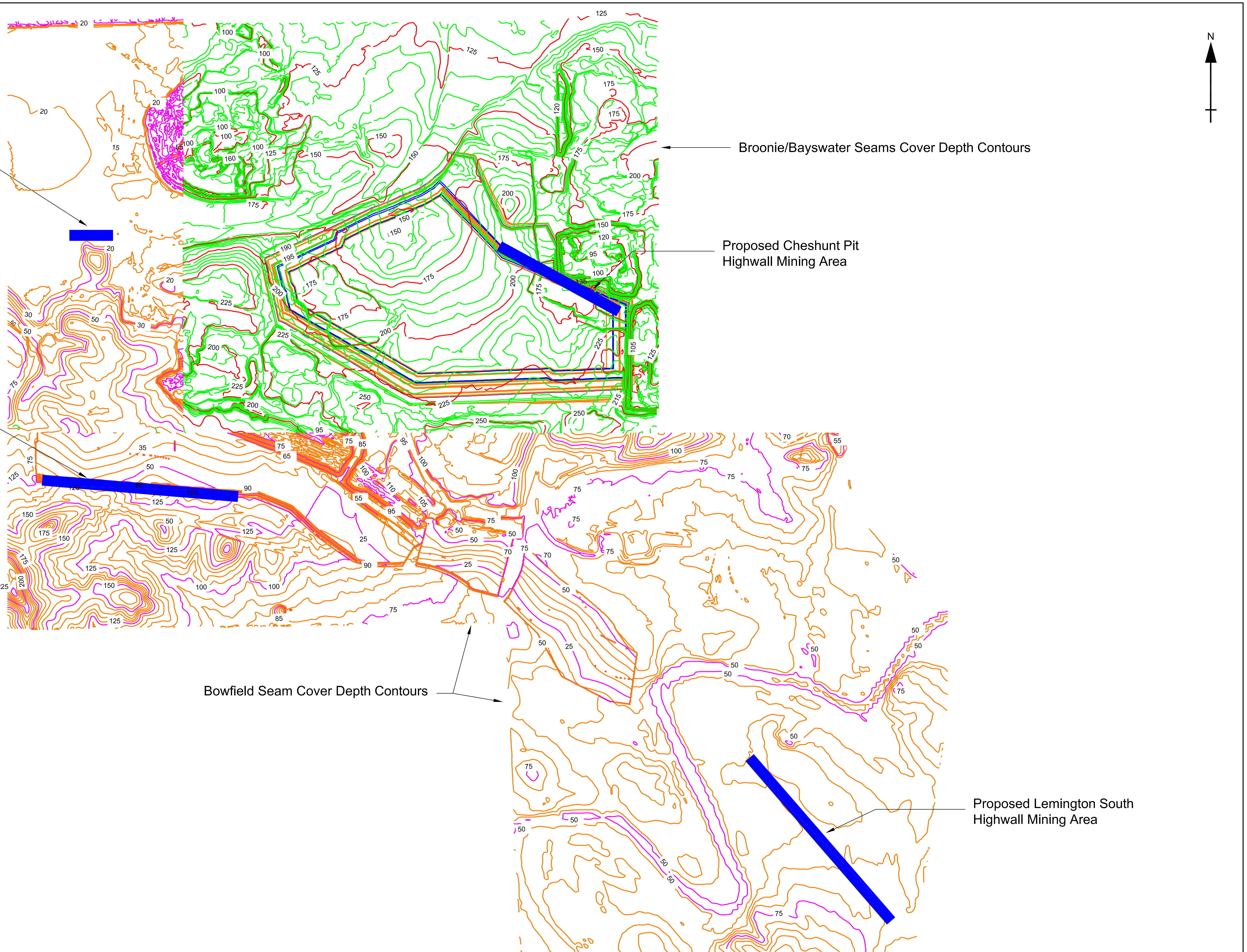
Das, B.M. (1998). **Principles of Geotechnical Engineering** (4th Edition), PWS Publishing Company Inc.

Hill, D. (2005). **Coal Pillar Design Criteria for Surface Protection**. Coal 2005, Brisbane April 2005.

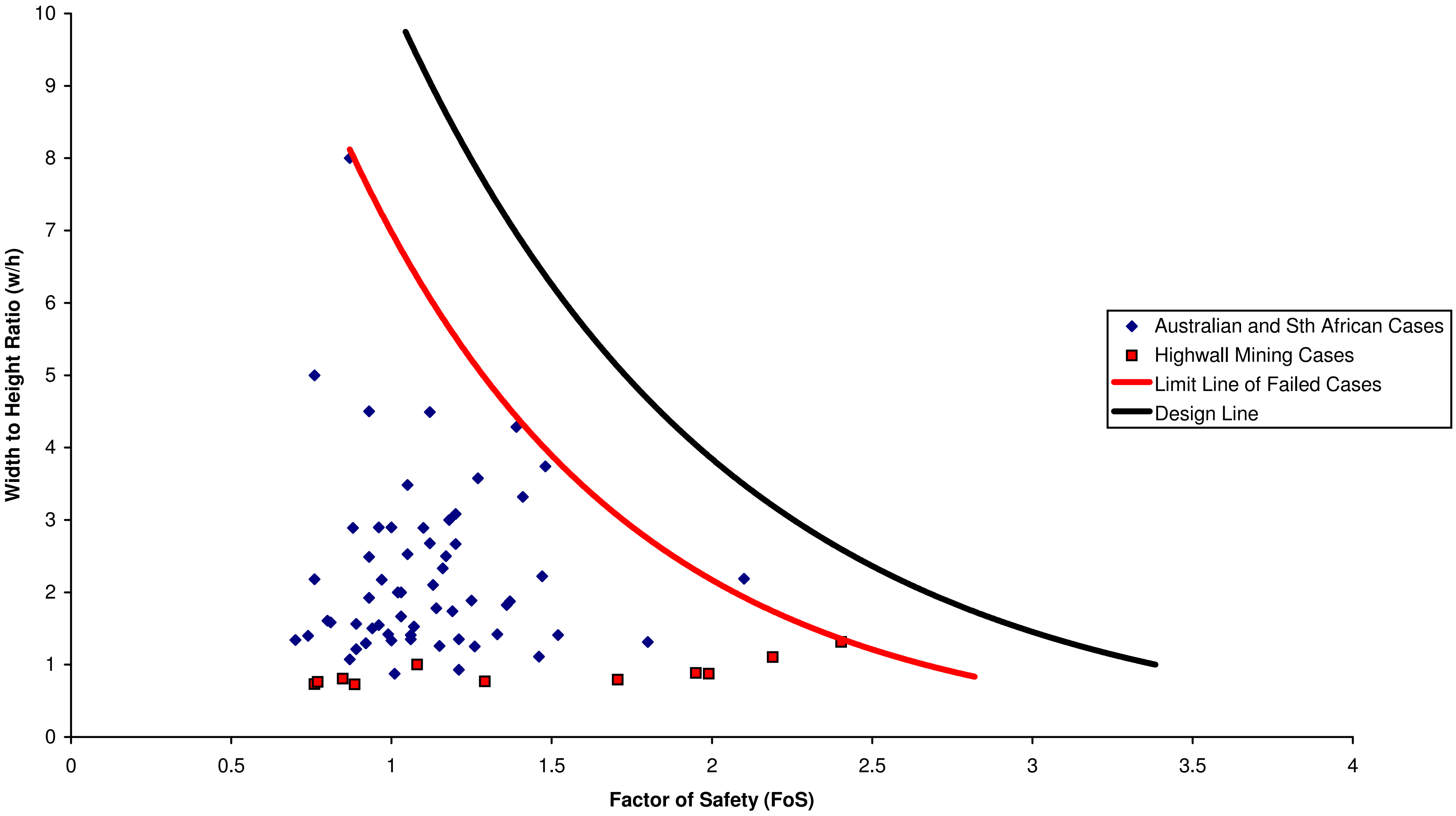
Holla, L. (1987). **Surface Subsidence Prediction in the Newcastle Coalfield**. Department of Mineral Resources.

MacCourt, L., Madden, B. and Schümann, E. (1986). **Case Studies of Surface Subsidence over Collapsed Bord and Pillar Workings in South Africa**. SANGORM Symposium : The effect of Underground Mining on Surface. Johannesburg. pp. 25-32.

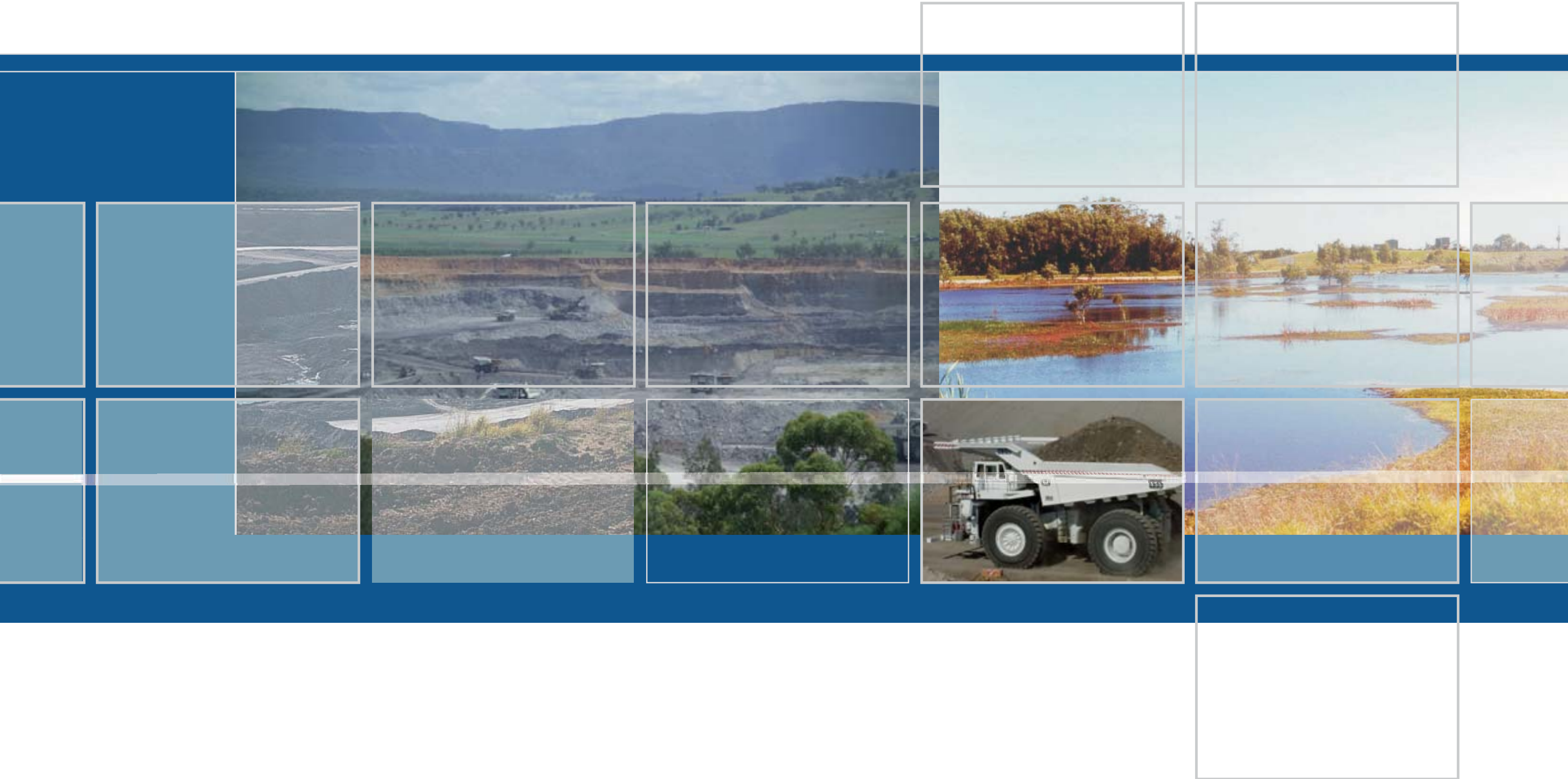
Salamon, M.D.G., Galvin, J.M., Hocking, G. and Anderson, I. (1996). **Coal Pillar Strength from Back-Calculation**. Strata Control for Coal Mine Design, UNSW. Final Project Report, No: RP 1/96. Joint Coal Board.



Engineer:	I. Canbulat	Client:	Rio Tinto Coal Australia
Drawn:	T. Jonson		
Date:	02.05.07	Title:	Proposed Highwall Mining Areas in Riverview, Cheshunt and Lemington South Pits
STRATA ENGINEERING (Australia) Pty Ltd		Scale:	NTS
		Figure No:	1



Engineer:	I. Canbulat	Client:	Rio Tinto Coal Australia
Drawn:	D. Hill	Title:	Database of Failed Pillar Cases Showing Proposed Design Line (Hill, 2005)
Date:	02.05.07		
STRATA ENGINEERING (Australia) Pty Ltd		Scale:	NTS
		Figure No:	2



Annex G

Sample Consultation Material

COAL & ALLIED

Managed by Rio Tinto Coal Australia

HVO – SOUTH: INTEGRATION AND CONSOLIDATION

PROJECT INFORMATION SESSIONS

Coal & Allied Marquee
Maison Dieu Community Hall,
Knodlers Lane, Cnr Maison Dieu Rd
Maison Dieu
Saturday 29 July from 10.30 am to midday

Warkworth Community Hall,
High Road
Warkworth Village
Saturday 29 July from 3.00 pm to 4.30pm

Coal & Allied is proposing to extend and consolidate its existing mining activities at Hunter Valley Operations – in particular the operations south of the Hunter River.

A project application requesting approval for these changes is currently being prepared for the Department of Planning.

Coal & Allied is seeking community input to be included in the Environmental Assessment, to be submitted with the project application.

Coal & Allied invite you to attend project information sessions **being held at Maison Dieu and Warkworth on Saturday 29 July.**

Information about the proposal including modifications, extensions and reference maps will be on display.

Representatives from Coal & Allied and ERM Australia who have been engaged to prepare the Environmental Assessment will be available to answer any questions.

For further information, please contact: Ruth Kinal on 6570 0301.

Integration & Consolidation

Hunter Valley Operations South

COAL & ALLIED
Managed by Rio Tinto Coal Australia

Newsletter One, July 2006

Background

Coal & Allied Operations Pty Ltd manage the Hunter Valley Operations (HVO) mining complex located in the Hunter Valley. The HVO mine employs approximately 680 people and produces more than 10 million tonnes of thermal coal and two million tonnes of metallurgical coal annually.

The mining and processing activities at HVO are managed by Coal & Allied as one operation and geographically divided by the Hunter River, with general nomenclature for the two areas being HVO North and HVO South. HVO South comprises the Cheshunt Pit, Riverview Pit, Lemington Pits and the Lemington Coal Preparation Plant (LCPP). HVO North comprises West Pit, Carrington Pit, the mined out North Pit and Alluvial Lands Pit and three coal preparation plants. HVO South in its local setting is depicted in Figure 1.

Current HVO South Operations

Activities that are currently approved within 36 development consents include:

- Mining by open cut methods in Riverview Pit, Cheshunt Pit and South Lemington Pit 1
- Approval to mine South Lemington Pit 2, and associated scraper slots and trench mines
- Approval for highwall mining within all South Lemington Mine areas
- Current combined approved mining rates of approximately 16 million tonnes per annum (Mtpa)
- Current approved area for mining disturbance of 2980 hectares
- Processing of approximately 5.5 Mtpa ROM coal in the LCPP

Project Proposal

Consolidation of Consents

The activities undertaken at HVO South are currently managed under multiple approvals, some granted by the Singleton Shire Council and others by the Minister for Planning.

Many of the approvals have different or potentially conflicting conditions and approval periods.

The NSW Government has introduced a new process (Part 3A) within the Environmental Planning and Assessment Act 1979. Coal & Allied will be preparing the application for a new consolidated consent under this legislation. If the application is successful, the new consent will provide one set of conditions, one consent authority and a single consent period, which will streamline administration for both Coal & Allied and the Department of Planning.

In preparing this application, Coal & Allied has also taken the opportunity to review and plan future mining activities and is preparing an Environmental Assessment considering future requirements in:

- Mining and processing
- Infrastructure
- General operational efficiency
- Land access

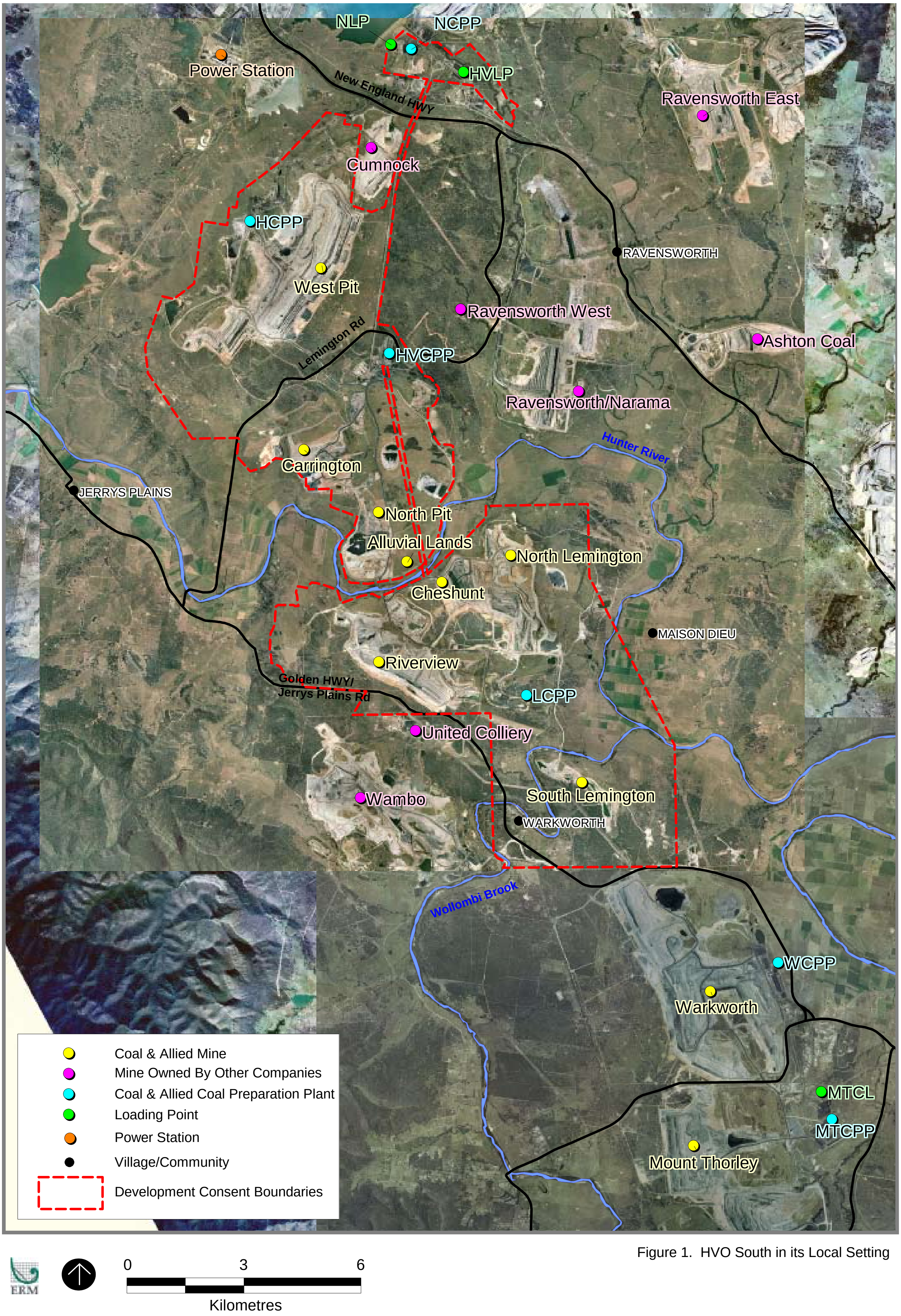


Figure 1. HVO South in its Local Setting

Continuation of Mining

Coal & Allied currently hold consents to mine Cheshunt, Riverview and Lemington Pits within the HVO South area. The application will request the following modifications (Figure 2) to the existing mining operations:

- Mine deeper seams in Cheshunt Pit (approximately 80 m additional depth to a final depth of RL150 m (below sea level)). The area of surface disturbance will remain largely unchanged as the approved footprint in existing plans.
- Extend Riverview Pit to the south west
- Extend Riverview Pit to the south east (to join the approved South Lemington Pit 2)
- Extend South Lemington Pit 1 to south west
- Further potential highwall and/or punch longwall-mining areas across HVO South Mine Lease area
- Ability to use up to two draglines and three large shovels across HVO South
- In-pit crushing and associated conveyors for coal and overburden

The open cut extension areas will access approximately 85 Mt of coal. Life of mine plans had identified these areas but they were not part of the 21 year consents that have been previously granted. This approval will help secure the long term future of the operation and it's employees.

Infrastructure Changes

The proposal would also allow for the upgrades and modification of existing infrastructure including:

- Upgrade of the LCPP from 5.5 Mtpa to 16 Mtpa ROM
- Transport of coal via haul road or conveyor to link into existing Wambo rail spur; alternatively via a newly constructed rail spur adjacent to LCPP
- Relocation of administration and services infrastructure located within the HVO South area
- Potential relocation or reconfiguration of the Hunter Valley Gliding Club airstrip and facilities following agreement from the Club

Operational Efficiencies

Review of operations has identified areas that can be integrated or improved across HVO North and South:

- Consolidate existing mining rate to 16 Mtpa; and align and upgrade LCPP throughput rates with this production rate
- Full integration of HVO North and South operations (for example personnel, equipment, coal, overburden, rejects and water)
- Interaction with Mount Thorley Warkworth (equipment movements and water)
- Consolidate HVO South Mine Leases

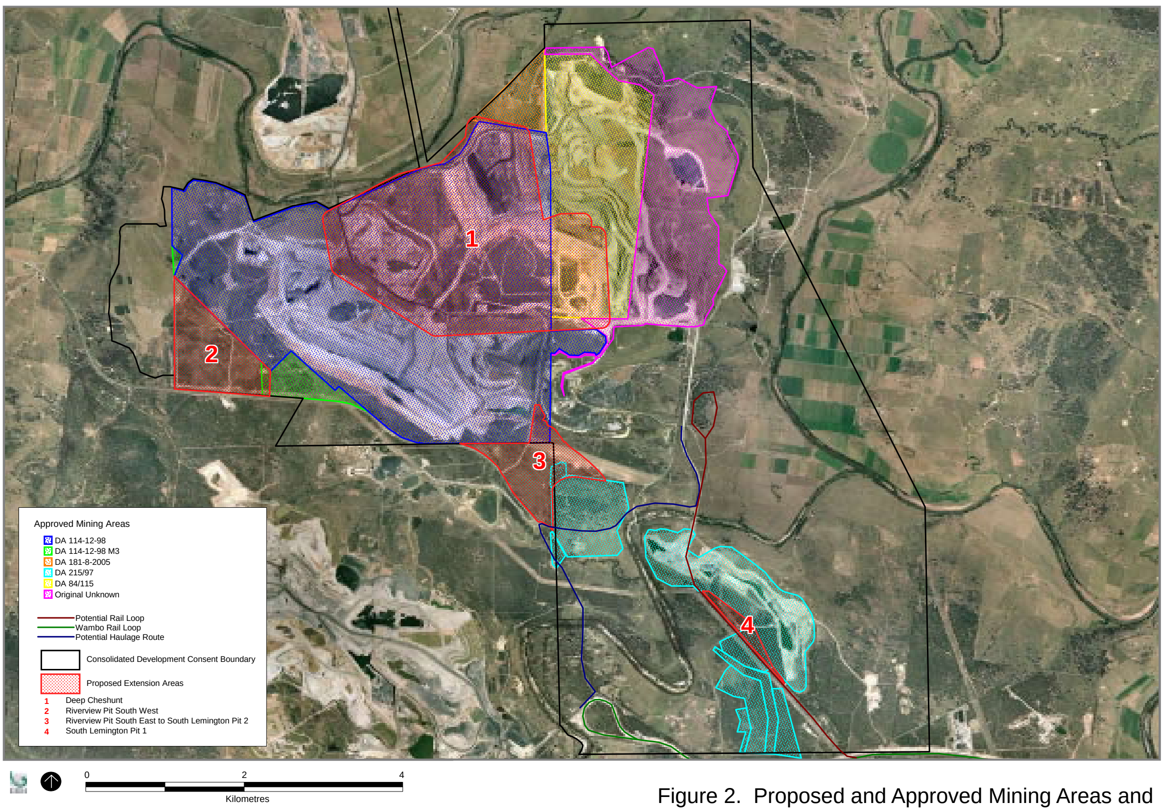


Figure 2. Proposed and Approved Mining Areas and Modifications within HVO South

Integration & Consolidation

Hunter Valley Operations South

COAL & ALLIED

Managed by Rio Tinto Coal Australia

Project Application Process and Timing

Planning Process

- Environmental Assessment Completed
- Lodgement of DA and EA (Nov 2006)
- Public Exhibition (Dec 2006)
- Assessment of DA and EA by DoP
- Determination by mid 2007

Community Consultation

Face to face meetings
Newsletters
Project Information Sessions
Consideration of submissions

Notification of DA to surrounding residents
Advertisement of DA
Consideration of submissions

Land Access

The application area includes parcels of land not owned by Coal & Allied. The parties potentially affected by the proposal include Hunter Valley Gliding Club, the Construction, Forestry, Mining and Energy Union (CFMEU), United Mine, Xstrata, Wambo (rail spur), Singleton Shire Council and Rural Lands Protection Board. Discussions in progress include:

- Formalising existing Coal & Allied's entitlements to access land areas
- Seeking commercial options with the parties to allow access, or purchase, of land

Project Information Sessions

Two Project Information Sessions will be held to ensure Coal & Allied neighbours and the local community have the opportunity to discuss the proposal in detail with members of the project team. In addition, neighbours within a five kilometre radius of HVO South will be contacted directly by Coal & Allied representatives to allow discussion about the proposal.

Coal and Allied invites you to attend a Project Information Session, over morning or afternoon tea, at the following locations:

Maison Dieu:
Saturday 29th July 2006
10.30 am - 12:00 noon
Under the marquee on the lawns of Maison Dieu Community Hall

Warkworth:
Saturday 29th July 2006
3.00 pm – 4:30pm
Warkworth Community Hall

Further Information

If you would like further information or would like to discuss the project further please contact Anna McMullen or Ruth Kinal on 6570 0301.

QUESTIONS & ANSWERS

Will the proposal require any further land clearing?

Approximately 250 ha outside of existing approved mining limits will be required for mining purposes. The previous land use in this area was grazing. The majority of land to be affected by mining is currently owned by Coal & Allied, with the remainder owned by the Construction, Forestry, Mining and Energy Union (CFMEU), United Mine, Xstrata and the Hunter Valley Gliding Club. A conceptual landscape management strategy will be prepared as part of this proposal and will include rehabilitation to pre-mining land capability, wildlife corridors, final voids and final landform ensuring that approved fundamentals are in place for mine closure.

Will the proposal result in changes to air quality for nearby residents?

No changes to open cut mining methods are proposed. Minor extensions have been identified in existing mining areas including the further extension of mining towards Jerrys Plains Road.

Potential impacts to air quality will be assessed and reported as part of the environmental assessment process. All Coal & Allied operations are guided by detailed environmental management procedures including dust management for mobile equipment. Dust management on-site includes the use of water carts and the management of mining equipment and operational areas to minimise dust generation. In addition Coal & Allied has comprehensive air quality monitoring systems to monitor performance.

Will the integration of operations result in increased mining activity and therefore increases in noise and vibration?

The current equipment including two draglines and three large shovels, will largely be drawn from the existing HVO fleet. The proposal allows for the efficient use of that equipment across all of HVO North and South operations.

A review of noise impacts will be conducted during the environmental assessment for the current proposal. All Coal & Allied operations are guided by detailed environmental management procedures including noise and blasting, this includes regular monitoring of equipment noise, background noise and blast and vibration.

What does the Environmental Assessment involve and how long will this take before we are made aware of the outcomes?

The Environmental Assessment will identify any environmental, social or economic impacts that occur as a result of the proposal. Environmental studies will review current practice and assess proposed changes that have been identified. These studies will focus on changes to the operations and identified key issues. Assessments will be undertaken for noise, air quality, ecology, surface and groundwater and heritage. The community are invited to participate in the process by attending the Project Information Sessions or contacting the project team directly. During the assessment process opportunities to mitigate potential impacts will be identified. The Environmental Assessment is currently under way. A second community newsletter will provide an update and overview of outcomes of the Environmental Assessment outcomes.

Will there be any change to water use, water quality and management processes as a result of the proposal?

Water management processes and water quality at HVO are unlikely to be altered by the proposal. Water management processes and systems are already common across all of Hunter Valley Operations. Resumption of coal processing south of the Hunter River will reduce and, in some cases, reverse water flow to the north.

Currently, Coal & Allied water management strategies use recycled water as the first priority. The integration and consolidation will continue current successful strategies to drive down fresh water use and to reduce the total water demand per tonne of coal for the consolidated mines. Reductions in fresh water usage are achieved by maximising recycling, optimising on site storage, controlling evaporation losses and exploring water use efficiencies such as sharing water with other mines. Optimising water use on site decreases the amount of discharge from the site. Any water discharges from the site will be managed in accordance with strict environmental guidelines (ANZECC and DEC). All of the mine works and facilities will not affect the function of the Hunter River and Wollombi Brook floodplains.

How will the integration and proposed modifications alter the current visual amenity of the site?

Ongoing mining in the Riverview Pit will continue to be visible along Jerrys Plain Road.

Warkworth residents will view the recommencement of mining in the South Lemington Pit along with mining of the extension to the Riverview Pit.

Maison Dieu residents will observe the proposed infrastructure modifications occurring on the western side of Wollombi Brook including the construction and operation of the rail loop or conveyor to the southwest of Maison Dieu. Rail movements along the loop may be visible from the Maison Dieu area.

In general the proposal keeps within the existing visual character of the region which consists of mining and related infrastructure and farming.

All areas to be mined will be rehabilitated progressively throughout the life of the mine in accordance with current requirements and Coal & Allied practices.

Integration & Consolidation

Hunter Valley Operations South

COAL & ALLIED
Managed by Rio Tinto Coal Australia

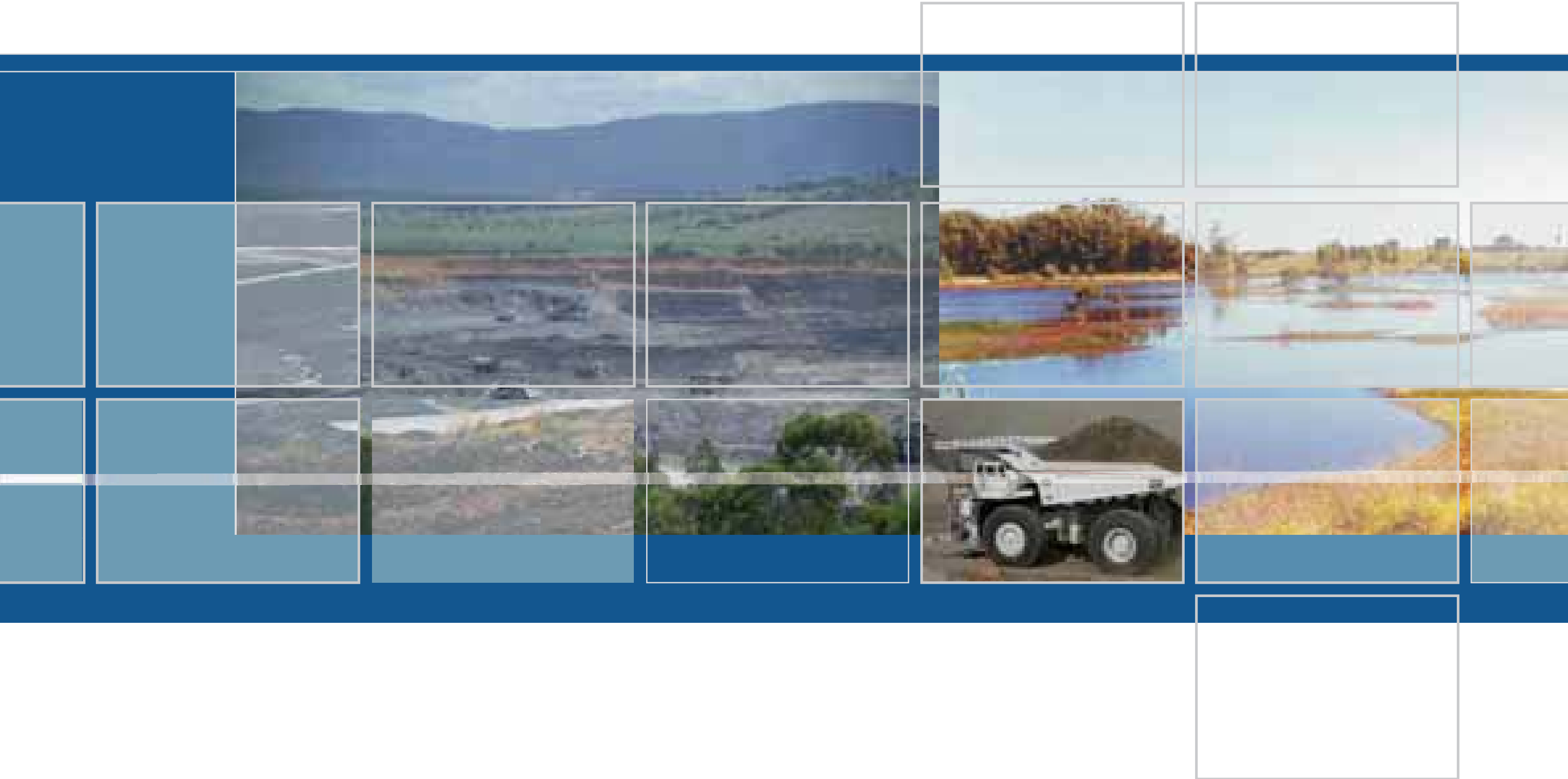
How can I find out more about the proposal?

Coal & Allied invites you to attend a Project Information Session, over morning or afternoon tea at the location most convenient for you:

- Maison Dieu:
  Saturday 29th July 2006
  10.30 am – 12:00 noon
  Under the marquee on the lawns of
  Maison Dieu Community Hall

- Warkworth:
  Saturday 29th July 2006
  3.00 pm – 4:30pm
  Warkworth Community Hall

Alternatively, for further information or to request a face to face interview with a project team member you can contact Ruth Kinal on 6570 0301.



Annex H

HVO South Coal Project, Noise and Vibration Assessment Report, ERM 2008

FINAL REPORT

Coal & Allied Operations Pty Limited

Hunter Valley Operations South Coal Project *Noise and Vibration Assessment*

January 2008

Environmental Resources Management Australia
Building C, 33 Saunders Street
Pyrmont, NSW 2009
Telephone +61 2 8584 8888
Facsimile +61 2 8584 8800
www.erm.com

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EXECUTIVE SUMMARY

Coal & Allied Operations Pty Limited (CNA) wants to continue mining operations South of Hunter River at Hunter Valley Operations (HVO) beyond the currently approved mining limit. Additionally, CNA wish to simplify the planning approvals platform for all of the HVO South mining activities. This study assesses the noise and vibration effects from all of CNA's operations at HVO South.

A thorough investigation of existing noise levels shows that mining operations contribute to the noise climate at several representative residential locations in surrounding areas. A verification exercise was undertaken whereby quarterly attended noise measurements, part of CNA's environmental management plans and procedures, were compared to Environmental Noise Model (ENM) software calculations. This demonstrated good correlation at some assessment locations and generally that ENM provides conservative representation of mining noise during adverse winds.

ENM takes into account distance, ground effect, atmospheric absorption and topographic detail. ENM is a DECC accepted noise prediction model as it gives consistently reliable predictions of environmental noise. Initial calculations were performed with no wind or temperature gradients, which are termed calm weather conditions. Assumed night air temperature and relative humidity were 10 °C and 90% respectively.

The model incorporates three-dimensional digitised ground contours for the surrounding land and mine plans. Contours of the mine for each mining stage were superimposed on surrounding base topography. Equipment was placed at various locations and heights, representing potential operating conditions that could result in the greatest noise impacts for the life of the mine.

An extensive on-site validation of the ENM software for three proposed mining areas also demonstrated the conservative estimation of noise under adverse wind conditions.

CNA provided years of on site meteorological data which ERM analysed in accordance with the Industrial Noise Policy (INP). This demonstrates that easterly, southerly and south westerly winds are a 'feature' of the area.

The noise modelling incorporated measured equipment emission data used to produce an outer envelope noise affectation area based on worst case operations and INP weather conditions.

The noise modelling has shown that under calm weather conditions, all private residential properties located outside the current zone of affectation, experience noise levels below the operational noise limits.

For private residences not in a zone of affectation, during INP weather conditions, exceedances of the operational limits are predicted at Maison Dieu Location No's 5, 16, 17, 24, 32, 34, 47 and 61. Exceedances are also predicted to occur at Location No. 36, located towards Jerrys Plains. The noise management measure of ceasing mining in South Lemington Pit 1 during westerly winds ranging from 202.5 to 225 degrees and up to 3 m/s at night will ensure all assessment locations are below the likely acquisition criteria. At most locations, predicted future HVO South mining noise levels are marginally below or marginally above existing noise levels, depending on the operating scenario.

CNA's current modified environmental management plan and procedures, which include on-going noise monitoring, will be used to assess the performance of the mining operations against the predicted noise levels.

Blast design will incorporate control on the MIC as described in this study and CNA's environmental plans and procedures to ensure acceptable limits are maintained. This will include monitoring of all blasts.

The cumulative industrial noise assessment demonstrates that the proposal is a significant contributor at Maison Dieu residences during westerly winds as expected, although it is noted that HVO activities are not the sole industrial source of noise in the area. For Warkworth Village the proposal becomes significant at one of five of the nominated residences under adverse easterly winds. However, noise levels are only marginally above INP cumulative amenity targets under such winds.

The relocation of the Hunter Valley Gliding Club is expected to result in a negligible change in noise for residences.

1 INTRODUCTION

1.1 BACKGROUND

This report was prepared for Coal & Allied Operations Pty Limited to assess environmental noise associated with proposed extension of operations within Hunter Valley Operations south of the Hunter River (HVO South).

CNA proposes to undertake an environmental assessment and prepare a Project Application under Part 3A of the *Environmental Planning and Assessment Act 1979* to allow for the replacement of the existing 35 approvals that currently apply to HVO South, infrastructure upgrades, modifications and extension to mining at HVO South and ultimately obtain a single Project Approval. The proposal will allow for the following activities:

- ongoing opencut and highwall mining of coal reserves as currently approved and the extension of opencut and highwall mining in areas described in *Section 5.3* of *Volume 1*;

- mining of all coal seams accessible by opencut and highwall mining methods within the mining areas with mining and infrastructure disturbance as depicted in *Figure 5.1* and described in *Section 5.5* of *Volume 1*;

- integration of operations allowing for operational efficiencies and improved economies of scale. These relate to mining and processing rates, equipment use and relocation, rejects and tailings disposal and coal handling;

- modification, upgrades and /or reconstruction of existing infrastructure including the LCPP and relocation of Comleroi Road and other infrastructure across HVO South;

- construction of new coal loading infrastructure to facilitate transfer of product coal to the Wambo rail spur;

- transportation of product coal to the Wambo rail spur via either a rail loop, conveyor or trucks; and

- relocation or reconfiguration of the HVGC airstrip and facilities, to accommodate the integration of the Riverview Pit with the South Lemington Pit 2.

The above constitutes the proposal and all major noise producing activities south of the Hunter River. This noise assessment conservatively assumed concurrent occurrence of all or most of such operations and includes four worst case mining stages in terms of noise generation which are representative of 21 years of future operations.

This assessment has been prepared in accordance with the NSW Department of Environment and Climate Change's (DECC) *Industrial Noise Policy,* which was published in January 2000.

The location of HVO South can be seen in *Figure 1.1*.

1.2 GLOSSARY

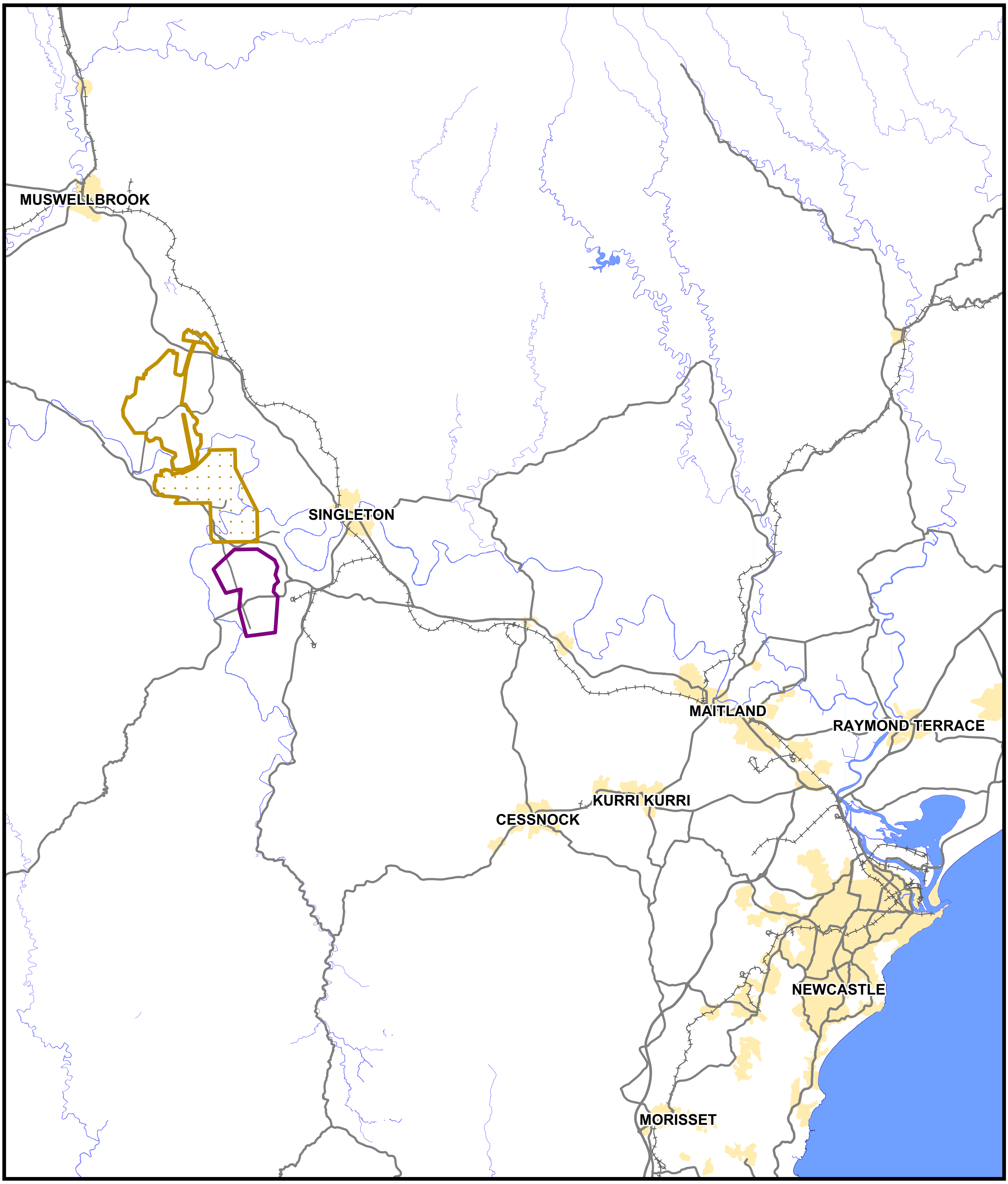
Table 1.1 provides a glossary of noise related terms used in this assessment.

Table 1.1 Glossary of Terms

Term	Description
ABL	Assessment Background Level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L_{90} statistical noise levels.
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(LinPeak)	The peak sound pressure level (not RMS) expressed as decibels with no frequency weighting.
INP	Industrial Noise Policy.
L_1	The noise level exceeded for 1% of a measurement period.
L_{10}	A noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise levels.
L_{90}	Commonly referred to as the background noise, this is the level exceeded 90% of the time.
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.
L_{max}	The maximum root mean squared (RMS) sound pressure level received at the microphone during a measuring interval.
MIC_{8MS}	Maximum Instantaneous Charge (with a minimum 8 milli-sec delay).
Peak Particle Velocity (ppv)	The maximum velocity of a particle of the transmission medium, used in assessment of vibration.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
RMS	Root Mean Square which is a measure of the mean displacement (velocity or acceleration) of a vibrating particle.
SI	Still isothermal (SI) refers to calm weather conditions (defined as no wind and standard temperature gradients).
sigma-theta (σ_θ)	The standard deviation of horizontal wind fluctuation.
Sound power level	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment.
Temperature inversion	A positive temperature gradient. A meteorological condition where atmospheric temperature increases with altitude to some height.

The following indicates what an average person perceives about noise levels in practice:

- noise differences of less than approximately 2 dB are generally imperceptible; and
- a difference of around 10 dB seems to be a doubling or halving of loudness.



Legend

HVO North

HVO South

MTW

Client:	Caol & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_01 Suffix No: R3
Date:	24.08.2007 Drawing Size: A4
Drawn By:	DH Reviewed By: LS
Source:	MapInfo Aus Ltd Pty
Scale:	Refer to Scale Bar

N

0 5 10km

Figure 1.1

Location of HVO South in its Regional Setting

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Telephone +61 2 8584 8888

2 EXISTING NOISE ENVIRONMENT

2.1 REPRESENTATIVE ASSESSMENT LOCATIONS

Representative residential properties around HVO have been identified and numbered from 1 to 61, as listed in the *West Pit Extension and Minor Modifications EIS 2003*.

The nominated noise assessment locations for the current study were selected to represent the impacts at the potentially most affected areas. These locations are shown in *Figure 2.1*. *Table 2.1* provides resident names, and where available, the property name and coordinates. For ease of identifying the assessment locations, these have been grouped into localities. The general direction of these areas from HVO South is also included in the table.

The assessment locations adopted for modelling were selected for the following broad reasons:

- they are generally those closest to the mine to ensure that potential worst case impacts are captured. Additional specific properties were not included as these are located further away, or otherwise are equally or less impacted, from the active mining areas (than the nominated locations). It can therefore be assumed, that noise at nominated assessment locations will be equal to or higher than noise at other private properties. To that end, noise contours also demonstrate this and provide a graphic of expected noise levels on a broader scale;

- modelling all individual properties in the locality would not provide any additional information shown by the noise contours

- the numbering systems adopted for past HVO South and HVO North assessment locations and resulting consents have not been consistent. This Project Application presented an opportunity to adopt a single numbering system for both areas and therefore improve administration and management of potential acoustic impacts. As listed in the *West Pit Extension and Minor Modifications EIS 2003*, residential properties around HVO have been identified and numbered from 1 to 61. Of these, a total of 22 locations were considered to be representative of the most exposed surrounding HVO South and have therefore been selected for this assessment.

Table 2.1 Surrounding Assessment Locations used for Modelling Purposes

Location No.	Location and Name	MGA56 Coordinates Easting	Northing
Locations at Maison Dieu (East)			
5	Bowman	317887	6399172
16	Algie	318128	6397347
17	Algie	318352	6398192
24	Clifton and Edwards	318153	6398497
32	Algie (Curlewis)	317982	6397802
34	Ernst	318530	6397994
47	Moxey	317979	6399821
61	Shearer	318014	6399408
Locations at Warkworth (South)			
23	Hawkes (Springwood)	313989	6392994
33	Edward and Haynes	314699	6394353
38	Henderson	315584	6393898
43	Kannar	314648	6394680
45	Kelly	314149	6394563
Locations west along Jerrys Plains Road (West)			
3	Elisnore	305416	6401053
4	Muller	305950	6399615
13	Jerrys Plains Centre	303535	6402851
19	Birralee Feeds Pty Ltd	305655	6400600
31	Cooper (Kilburnie)	305953	6399990
36	Garland	306139	6399895
Isolated Locations			
7	Stapleton (Cheshunt) – North East	315919	6403004
8	Holz (Oaklands) - North	313711	6403979
10	Moses (Wandewoi) – North West	306970	6402069

- **Location** No. is consistent with the HVO North consent (DA 450-10-2003).
- **Location** No.s 33 and 43 has been purchased by Wambo Mine
- **Location** No. 8 has been purchased by Xstrata.

2.2 *BACKGROUND AND AMBIENT NOISE*

INP based noise limits have been stipulated in previous HVO South consents and these are used for the current assessment.

Attended noise monitoring is conducted on a quarterly basis for CNA as part of the HVO monitoring programme. This data was required to allow assessment of the current noise environment without the activities identified as part of the proposal. This included quantification of the noise levels from HVO on typical days of operation. Measurements were conducted at 15 minute time periods at nine locations during each quarter. The range of noise levels measured over the five quarters reviewed (2005 and quarter 1 2006) are presented in *Table 2.2*.

Table 2.2 Summary of Existing Noise Levels

Location		Total Measured Noise Levels, dB(A)				HVO South Pit Contribution[1], L_{Aeq}, dB(A)		HVO West Pit Contribution[1], L_{Aeq}, dB(A)		Total HVO Contribution, L_{Aeq}, dB(A)	
Location No.	Location Name	Day		Night		Day	Night	Day	Night	Day	Night
		L_{eq}	L_{90}	L_{eq}	L_{90}						
7	Stapleton[2]	35-54	23-34	30-45	28-41	IA	IA-38	IA	IA	IA	IA-38
8	Holz (Oaklands)[3]	35-48	27-41	38-48	34-38	IA	IA-39	IA	IA	IA	IA-39
10	Moses (Wandewoi)[2]	38-49	31-39	38-45	30-41	IA	IA	37-38	35-43	37-38	35-43
11	Fisher	45-52	30-39	35-48	32-39	IA	32-40	IA-31	32-36	IA-31	32-41
13	Jerrys Plains Centre	57-66	35-45	36-42	27-38	IA	IA-28	IA	28-35	IA	28-35
31	Cooper (Kilburnie)	50-55	35-46	30-50	27-45	IA	22-38	IA	IA	IA	22-38
32	Algie (Curlewis)	38-55	29-35	31-78	27-41	26-37	IA-36	IA	IA	26-37	IA-36
43	Kannar[3]	52-59	36-50	40-45	37-41	IA	IA	IA	IA	IA	IA
47	Moxey	36-41	30-33	29-51	27-47	IA-38	IA-36	IA-25	IA-36	25-38	IA-36

1. Data sourced from HVO 2005 and Quarter 1, 2006 Environmental Noise Monitoring Report by Global Acoustics prepared for Ecowise Environmental Pty Ltd.
2. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
3. These residences are owned by mining companies other than CNA.

General:

- Location No. 43, Kannar was selected as the property representing Warkworth Village in the above mentioned report.
- Day is defined to be from 7am to 6pm and night is defined to be from 10pm to 7am according to the INP.
- 'IA' – Inaudible.
- Location No. 11 (Fisher) is located west of the mine towards Jerrys Plains (E 307019 N 6399079). It was modelled for validation purposes only.

The measured noise levels may have been influenced by the HVO pits, Wambo Mine, Warkworth Mine, road traffic, animals, insects and the weather conditions present during the measurement period. These levels provide an indication of the existing total noise levels in the area surrounding the mines. From these measurements, Global Acoustics evaluated the individual contribution of HVO South and HVO West Pit (the southern most active pit within HVO North Mine Lease area) in the absence of all other noise sources. ERM cannot completely validate this process as we were not present during the measurements.

HVO South's current noise contribution was used for validating noise modelling results in this report as described in the following section.

2.3 *MODELLED EXISTING NOISE*

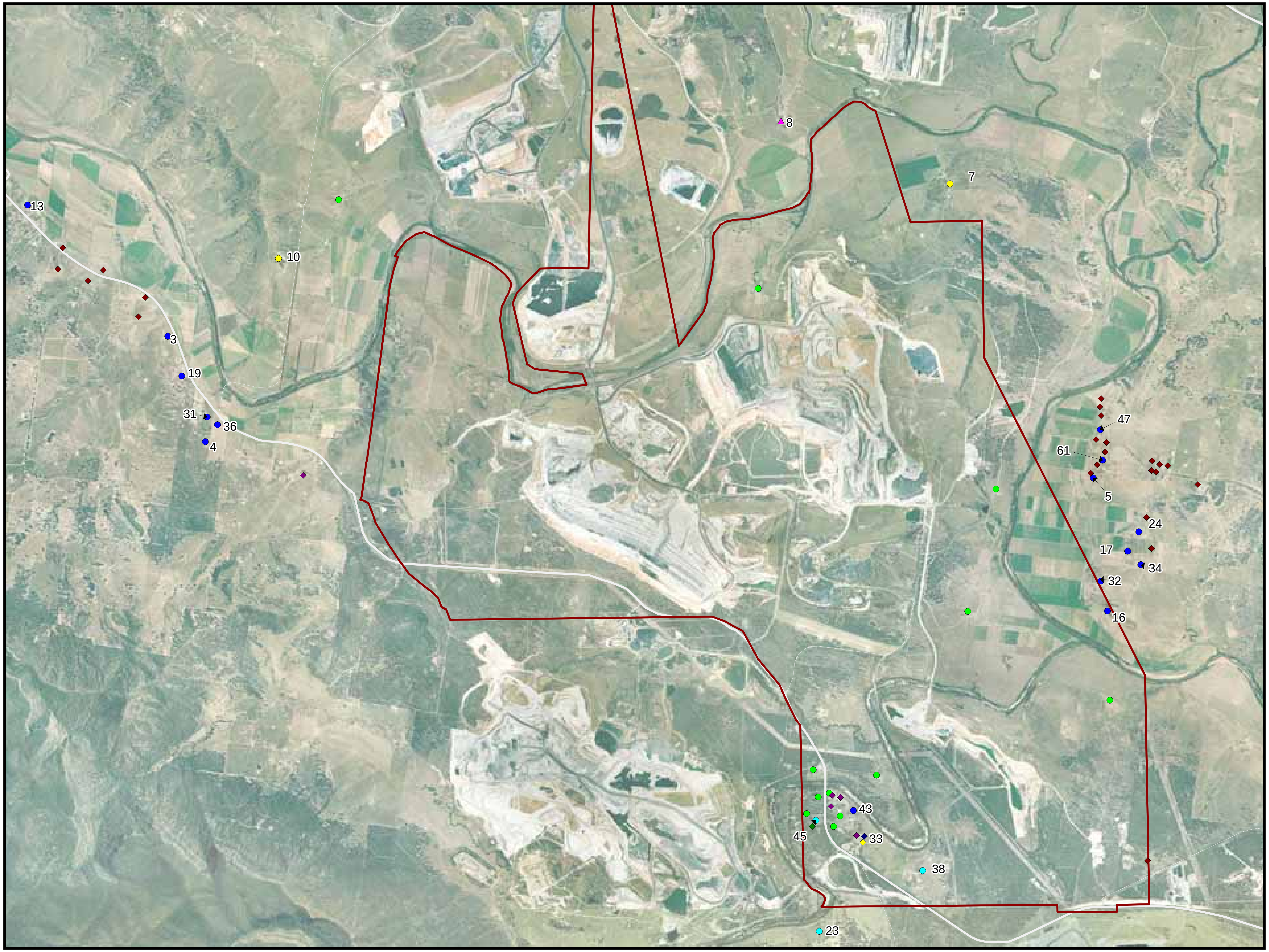
Existing noise levels were modelled based on the meteorological conditions at the time of the quarterly attended noise monitoring conducted in December 2005 and January 2006 Environmental Noise Monitoring Reports. The meteorological condition was identified along with the equipment present at HVO South, as provided by CNA based mostly on plant GPS records. The modelling results represent the noise level contribution solely due to the operations at HVO South. The noise modelling procedure is described later in *Section 4.1* and the Sound Power Levels attributed to each type of equipment is provided in *Section 4.3*. The modelled results are presented below in *Table 2.3*.

From the modelling results, it can be seen that the different meteorological conditions influenced the noise levels modelled at each location. The measured HVO South contribution evaluated during quarterly monitoring included corresponding meteorological conditions for each measurement. However, the meteorological station where wind speed and wind direction were obtained may not always be representative of the parameters at the source or assessment location position. Notwithstanding, it can be seen that results at Location No's 13 and 32 show good correlation between measured and modelled noise levels. The highest modelled noise level for the five prevailing meteorological conditions correlated well with that of the INP weather condition (last column). The highest modelled levels (for either the five prevailing winds or INP wind) are above the measured levels at all the assessment locations except Location No. 31. Hence, the ENM noise model and the adopted modelling approach can be deemed to be conservative under adverse wind conditions most of the time.

Table 2.3 Summary of Modelled Existing Noise Levels

No.	Locations	Modelled (Measured) Noise Levels, dB(A) 02/12/05 0:04 5.2m/s, 298 deg	02/12/05 1:27 4.4m/s, 308 deg	02/12/05 3:08 4.9m/s, 326 deg	10/01/06 10:57 1.5m/s, 106 deg	10/01/06 0:52 2.4m/s, 133 deg	10/01/06 1:42 1.8m/s, 137 deg	Highest Existing Noise Level Modelled/ INP Weather
3	Elisnore	5	6	7	32	31	30	32
4	Muller	4	6	7	33	32	26	33
5	Bowman	49	47	46	21	12	14	48
7	Stapleton[1]	43	40	27**(38)**	25	20	33	47
8	Holz[4]	26**(39)**	24	21	39	40	41	48
10	Moses[1]	15	14	14	36	34	34	36
11	Fisher[3]	8	8	10	33	31	27**(33)**	37
13	Jerrys Plains Centre	0	0	0	28	26**(28)**	26	28
16	Algie	45	43	44	20	12	13	44
17	Algie	46	44	44	23	12	13	45
19	Birralee Feeds Pty Ltd	3	4	5	33	31	30	33
23	Cec M Hawkes Pty Ltd[1]	37	36	40	21	12	12	39
24	Clifton and Edwards	47	46	45	20	12	13	46
31	Cooper (Kilburnie)	3	4**(38)**	5	33	32	27	33
32	Algie (Curlewis)	47	44	44	25**(26)**	13	14	46
33	Edward & Haynes[4]	42	40	44	22	15	14	43
34	Ernst	45	43	43	23	11	13	45
36	Garland	2	3	5	33	33	27	34
38	Henderson[1]	33	33	31	15	8	9	32
43	Kannar[4]	43	41	45	23	18	18	45
45	Kelly[1]	42	41	45	24	16	15	44
47	Moxey	50	48	46	18	11	13	49
61	Shearer	49	47	46	18	11	14	48

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. Values in brackets are actual measured HVO South noise contribution levels provided in the HVO Monitoring reports for the corresponding meteorological condition listed.
3. Location No. 11 was modelled for validation purposes only.
4. These residences are owned by mining companies other than CNA.
5. Maison Dieu residences are Location No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village Residences are Location No's 23, 33, 38, 43 and 45 and Jerrys Plains residences are Location No's 3, 4, 13, 19, 31 and 36. Isolated residences are Location No's 7, 8, 10.



Legend

Model Status

- CNA Owned, Not Modelled
- Private, Modelled
- Private, Modelled, CNA ZOA
- Private, Modelled, Wambo ZOA
- Private, Not Modelled
- Private, Not Modelled, Wambo ZOA
- Private, Not Residential, Not Modelled
- Wambo Owned, Modelled
- Wambo Owned, Not Modelled
- Xstrata Owned, Modelled

Notes:

ZOA = Zone of Affectation

Figure 2.1

Property Ownership and Assessment Locations

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_GIS01_R1
Date:	21/01/2008 Drawing Size: A3
Drawn By:	JS Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

0 500 1,000
N
metres

Environmental Resources Management Australia Pty Ltd
Building C, 33 Saunders St, Pyrmont, NSW 2009
Telephone +61 2 8584 8888

2.4 PREVAILING WEATHER CONDITIONS

The efficiency of noise propagation over long distances can be significantly affected by the weather conditions. Of most interest, are source to assessment location winds and the presence of temperature inversions as both these conditions can enhance received noise levels. To account for these phenomena, the DECC in their INP, specify weather analysis procedures to determine the prevalent weather conditions that enhance noise propagation. This is to determine whether they can be described as a feature of the area.

In this study a comprehensive set of hourly weather data was analysed, consisting of approximately four years data obtained from the weather station at HVO. This was done in accordance with the procedures defined in the INP, and as otherwise advised by the DECC. For the purposes of this report, weather conditions modelled as a result of this analysis are referred to as INP weather conditions.

2.4.1 Temperature Inversions

Records of the Pasquill Stability Class, a parameter representing the degree of mixing in the atmosphere, can gauge the prevalence and magnitude of temperature inversions. Stability classes are categorised as A to G as shown in the Air Quality Report. Stability Class A applies under sunny conditions with light winds when dispersion is most rapid. Stability Class D applies under windy and/or overcast conditions when dispersion is moderately rapid. Stability Class F and G can occur at night when winds are light and the sky is clear. Stability Classes B, C and E are intermediate conditions between those described above. Temperature inversions may occur during stability classes E, F and G. In particular, stability class F generally represents a range of temperature gradients from 1.5 ºC/100 m to less than 4 ºC/100 m.

Records of wind speed, wind direction and sigma-theta ($\sigma\theta$ - used to calculate Pasquill Stability Classes) were available from HVO's Cheshunt weather station. Almost four years of hourly data were used, including the periods 1 July 1996 to 1 July 1997, 9 January 1999 to 6 October 2000 and 1 January 2002 to 28 February 2003. Comprehensive data from 1998, 2001 and 2004 was not available.

The frequency of each stability class occurrence is shown in *Table 2.4* based on the aforementioned hourly data. Combining the atmospheric Stability Class F and G data indicates that temperature inversions having potential to enhance noise propagation are marginally above the DECC's 30% occurrence threshold for autumn nights only. Hence, temperature inversions are considered to be a feature of the area in autumn according to the INP. This analysis is consistent with the DECC's INP which shows that the percentage of atmospheric stability Class F is 25 to 30 % for the area encompassing the proposal and surrounds. A calculation for noise impact under the INP's suggested 3 ºC/100 m temperature inversion parameter is provided in noise modelling results.

Table 2.4 Stability Class Frequency

Stability Class	Percentage of Occurrence			
	Summer	**Autumn**	**Winter**	**Spring**
A	1.10	0.00	0.43	1.19
B	0.59	0.00	0.05	0.47
C	2.08	0.00	0.19	4.53
D	41.58	29.48	29.38	43.26
E	35.62	39.24	45.14	29.85
F	11.48	13.66	16.14	11.36
G	7.56	17.61	8.69	9.35
TOTAL	**100**	**100**	**100**	**100**

Source: Holmes Air Sciences (2003)

Note: Stability Class E does not include inversion strengths that can significantly enhance noise propagation.

2.4.2 Prevailing Winds

The prevailing wind directions to be used in the noise model were determined in accordance with the INP which requires that winds with an occurrence greater than 30% be assessed. Records of wind speed and wind direction were available from HVO's Cheshunt weather station. Almost seven years of hourly data were used (1 July 1996 to 3 July 2006, excluding 1998, 2001 and 2004).

A thorough review of the vector components of the hourly wind data described above was undertaken. The DECC assessable wind direction is graphically demonstrated in *Appendix A*, where the windrose arm exceeds the 30% threshold as indicated by the rose. The assessable wind speed was also determined in accordance with the intent of the INP, and is the upper tenth percentile speed for each of the assessable directions. The wind directions and wind speed determined to be a feature of the area are summarised in *Table 2.5*.

Table 2.5 Assessable INP Wind Conditions

Wind (Origin) Direction, degrees	Upper 10% Night Wind Speed, m/s
90	1.9
112.5	2.4
135	2.7
157.5	2.7
180	2.6
202.5	2.3
225	2.1

It is demonstrated that the assessable winds occur during evening and night time, and that daytime winds are not considered a feature of the area according to the INP. The evening and night mine operations are the same and the night time wind data set provides a more statistically valid analysis as it is based on averages for nine hours as opposed to four hours for the evening. Hence, the feature winds occurring during the night are used for noise assessment. The wind roses in *Appendix A* also demonstrate that a combined wind and temperature inversion occur significantly less than the DECC's 30% threshold. Therefore, a combined wind and temperature inversion calculation was not produced.

The results are consistent with the well documented north west to south east dominant wind axis found in the Hunter Valley, however, north westerly winds are excluded as a large proportion exceed 3 m/s, which the INP excludes for noise assessment purposes.

These wind conditions together with a temperature inversion of $3^{o}C/100$ m are defined as INP weather conditions.

3 OPERATIONAL NOISE CRITERIA

3.1 EXISTING CONSENT LIMITS

The development of HVO has occurred through a process of extension and acquisition. This included the purchase of Lemington Mine in December 2000. As a result, there are a number of separate approvals that apply to the operation. The key approval governing operations within the Cheshunt and Riverview Pit areas is DA 114-12-98. The key approval governing South Lemington Pits operations is DA 215/97. Consent limits associated with these DA's are discussed in the following sections.

3.1.1 HVO South Consent DA 114-12-98 Noise Limits

INP based operational noise limits for HVO South have been set in Hunter Valley South Pit (Cheshunt and Riverview Pits), DA 114-12-98. Summaries are provided in *Tables 3.1* and *3.2*.

Table 3.1 Operational Noise Limits from Consent DA 114-12-98 –Cheshunt and Riverview Pits

Location	Relevant Locations	Day $L_{Aeq(15\ min)}$, dB(A)	Evening $L_{Aeq(15\ min)}$, dB(A)	Night $L_{Aeq(15\ min)}$, dB(A)	Night $L_{A1(1\ min)}$, dB(A)
Warkworth (closest residence)	23, 33, 38, 43 and 45	36	36	36	45
Jerrys Plains (closest residence)	13	35	35	35	45
Kilburnie	4, 19, 31, 36	39	39	39	49
Elisnore	3	35	35	35	45
Skinner (formerly Winston)	-	35	35	35	45
Maison Dieu (closest residence)	5, 16, 17, 24, 32, 34, 47 and 61	36	36	36	46

1. Daytime (between 7am and 6pm); evening (between 6pm and 10pm) and night time (between 10pm and 7am).

2. The noise emission limits above apply for winds up to 3 metres per second (at a height of 10 metres) and temperature gradients up to 4 degrees Celsius per 100 metres.

Table 3.2 Noise Limits Related to Acquisition from Consent DA 114-12-98

Day $L_{Aeq(15\ min)}$	Evening $L_{Aeq(15\ min)}$	Night $L_{Aeq(15\ min)}$
> 43 dB(A)	>40 dB(A)	> 40 dB(A)

1. Daytime (between 7am and 6pm); evening (between 6pm and 10pm) and night time (between 10pm and 7am).

2. The noise emission limits above apply for winds up to 3 metres per second (at a height of 10 metres) and temperature gradients up to 4 degrees Celcius per 100 metres.

3. The criteria above do not apply if there is a valid private amenity agreement in place between the mine and the property owner.

The noise limits for all the assessment locations were derived based on the proximity of the residences to the locations in *Table 3.1*.

3.1.2 South Lemington Consent DA 215/97 Noise Limits

In addition to the above, noise limits have also been set for the South Lemington Pits in DA 215/97. Noise levels due to mine operations are not to exceed the noise levels stated in *Table 3.3* for the nominated locations.

Table 3.3 Operational Noise Limits from Consent DA 215/97 – South Lemington Pits

Location	Closest Proposal Locations	L_{A10} Noise Level Criteria, dB(A), DECC	
		Day, 7am-10pm	Night, 10pm-7am
(Jerrys Plains Road Warkworth) Service Station Residence[1]	3, 4, 13, 19, 31, 36	42	40
Warkworth Village School[1]	23, 33, 38, 43 and 45	40	40
Warkworth Village Church	23, 33, 38, 43 and 45	40	38
Stafford Residence	-	37	37
Eyriebower Residence (Maison Dieu)	5, 16, 17, 24, 32, 34, 47 and 61	37	35

1. *The Warkworth Village service station no longer exists. The Warkworth Village School is owned by CNA.*

3.1.3 *Noise Limits Applicable to Proposal*

As HVO has operated under a number of consents issued at various times, each consent has different noise limits.

These currently approved noise limits applicable to the proposal have been modified based on consultation with the DECC and DoP.

As discussed in *Chapter 2* of *Volume 1*, prior to CNA purchasing South Lemington in 2000, Cheshunt and Riverview Pits, and South Lemington were separate operations. Each operation has its own consent which details noise limits at surrounding properties. These properties may be impacted by both mining areas simultaneously with a separate limit for operations in Cheshunt and Riverview Pits and a separate limit for operations in South Lemington. For example, Location No.5 (Bowman) located in Maison Dieu, has an operational day time noise limit of 36 dB(A) for the Cheshunt and Riverview Pit areas. As currently approved, Location No.5 also has an operational day time noise limit of 37 dB(A) for operations within the South Lemington area. If the mines operated at these limits, they would not exceed approved limits, although collectively they would produce 40dB(A) at this location.

The consolidation of both the South Pit (DA 114-12-98) and South Lemington Mine (DA 215/97) noise limits would result in two noise limits acting upon the same resident. Rather than adding the two consent limits, a more conservative approach was used. This was to adopt the stricter INP based limits in the South Pit consent for the two operations separately. Hence, South Pit's more conservative noise limits of 35 dB(A) and 36 dB(A) are converted to 38 dB(A) and 39 dB(A) respectively by doubling them logarithmically. For the residences where a noise limit of 39 dB(A) exists in the South Pit consent, the noise limit is left unchanged. In addition, the Night $LA_{1(1\ min)}$ sleep disturbance criteria stated in the South Pit consent remains unaltered.

These currently approved noise limits applicable to the proposal have been modified based on consultation with the DECC and DoP following a meeting on 30 May 2006 and correspondence dated 29 November 2006 (*Section 6.4.2* of *Volume 1*).

Where applicable the noise acquisition limits will be determined by the appropriate authority through the approval process. However, one approach is presented here for consideration. The basis for this includes adopting the existing South Pit (DA 114-12-98) acquisition limits of 43dB(A) $L_{Aeq(15\ min)}$ for the daytime and 40 dB(A) $L_{Aeq(15\ min)}$ for the evening and night. However, where comparable noise levels can be expected from both South Pit and South Lemington at the same property, then a consolidated acquisition value could apply such as 46dB(A) $L_{Aeq(15\ min)}$ for the daytime and 43 dB(A) $L_{Aeq(15\ min)}$ for the evening and night. The relative location of the two pits to assessment locations suggests that the latter acquisition limits could reasonably apply to properties in Warkworth Village and Maison Dieu. This considers prevailing wind effects and is supported by noise modelling results, where a comparable contribution of noise is calculated from each of the two mining areas to the one assessment location.

Table 3.4 summarises all the criteria applicable to this proposal. It demonstrates that the proposed operational noise criteria are conservatively lower than or equal to the two existing DA noise limits combined.

Location No.	Name	Day Limits				Evening Limits				Night Limits					Likely Acquisition Limits, $L_{Aeq(15\ min)}$	
		Sth Lem (DA 215/97)	Sth Pit (DA 114-12-98)	Combined DAs	Proposed $L_{Aeq(15\ min)}$	Sth Lem (DA 215/97)	Sth Pit (DA 114-12-98)	Combined DAs	Proposed $L_{Aeq(15\ min)}$	Sth Lem (DA 215/97)	Sth Pit (DA 114-12-98)	Combined DAs	Proposed $L_{Aeq(15\ min)}$	$L_{1(1\ min)}$	Day	Evening & Night
3	Elisnore	42	35	43	38	42	35	43	38	40	35	41	38	45	*43*	*40*
4	Muller	42	39	44	38	42	39	44	38	40	39	43	38	45	*43*	*40*
5	Bowman	37	36	40	39	37	36	40	39	35	36	39	39	46	46	*43*
7	Stapleton (Cheshunt)[1]	35	Acq	NA	38	35	Acq	NA	38	35	Acq	NA	38	45	*N/A*	*N/A*
8	Holz (Oaklands)[2]	35	Acq	NA	38	35	Acq	NA	38	35	Acq	NA	38	45	*N/A*	*N/A*
10	Moses (Wandewoi)[1]	35	Acq	NA	38	35	Acq	NA	38	35	Acq	NA	38	45	*N/A*	*N/A*
13	Jerrys Plains Centre	42	35	43	38	42	35	43	38	40	35	41	38	45	*43*	*40*
16	Algie	37	36	40	39	37	36	40	39	35	36	39	39	46	46	*43*
17	Algie	37	36	40	39	37	36	40	39	35	36	39	39	46	46	*43*
19	Birralee Feeds Pty Ltd	42	39	44	38	42	39	44	38	40	39	43	38	45	43	*40*
23	Hawkes (Springwood)[1]	40	36	41	39	40	36	41	39	38	36	40	39	46	*N/A*	*N/A*
24	Clifton and Edwards	37	36	40	39	37	36	40	39	35	36	39	39	46	46	*43*
31	Cooper (Kilburnie)	42	39	44	39	42	39	44	39	40	39	43	39	49	43	*40*
32	Algie (Curlewis)	37	36	40	39	36	36	39	39	35	36	39	39	46	46	*43*
33	Edward and Haynes[2]	40	36	41	39	40	36	41	39	38	36	40	39	46	*N/A*	*N/A*
34	Ernst	37	36	40	39	37	36	40	39	35	36	39	39	46	46	*43*
36	Garland	42	39	44	38	42	39	44	38	40	39	43	38	45	43	*40*
38	Henderson[1]	40	36	41	39	40	36	41	39	38	36	40	39	46	*N/A*	*N/A*
43	Kannar[2]	40	36	41	39	40	36	41	39	38	36	40	39	46	*N/A*	*N/A*
45	Kelly[1]	40	36	41	39	40	36	41	39	38	36	40	39	46	*N/A*	*N/A*
47	Moxey	37	36	40	39	37	36	40	39	35	36	39	39	46	46	*43*
61	Shearer	37	36	40	39	37	36	40	39	35	36	39	39	46	46	*43*

1. These private residences are currently inside a zone of affectation. A private agreement may exist with the land holder.
2. These residences are owned by mining companies other than CNA.

General notes:

a. Daytime (between 7am and 6pm); evening (between 6pm and 10pm); and night time (between 10pm and 7am).

b. The noise emission limits above apply for winds up to 3 metres per second (at a height of 10 metres) and temperature gradients up to 4 degrees Celcius per 100 metres.

c. If there is a valid private amenity agreement with any property owners these criteria may be exceeded.

d. Maison Dieu residences are Location No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village Residences are Location No's 23, 33, 38, 43 and 45 and Jerrys Plains residences are Location No's 3, 4, 13, 19, 31 and 36. Isolated residences are

e. Location No. is consistent with the HVO West Pit consent (DA 450-10-2003).

3.2 CUMULATIVE NOISE

The cumulative impact of more than one development can be compared against the DECC's amenity criteria which has a holistic approach to industrial noise. The more critical night period was used as an assessment period for cumulative noise. The INP stipulates an amenity criteria of 40dB(A) $L_{eq,9\ hour}$ for a rural area for the night period.

3.3 BLASTING

Blasting limits for HVO South have been set in DA 114-12-98 and DA 215-97. They are applicable to two main effects of blasting:

- airblast overpressure; and
- ground vibration.

The consent limits for blasting are the same for both consents and are described below.

3.3.1 Airblast Overpressure

The consents specify that airblast overpressure should not exceed 115 dB(Lpeak) for more than 5% of the total number of blasts over a period of 12 months. However, the maximum level should not exceed 120 dB(Lpeak) at any time. The dB(Lpeak) unit of sound measurement considers the low frequency sounds which are not audible to the human ear but can be 'felt'. Such limits will also ensure damage from blast noise overpressure is avoided.

3.3.2 Ground Vibration

The consents specify that the peak particle velocity (ppv) from ground vibration should not exceed 5 mm/s for more than 5% of the total number of blasts over a period of 12 months. However, the maximum level should not exceed 10 mm/s at any time. These criteria apply to minimise human annoyance and discomfort and were not developed to control possible structural damage. However, if ground vibration peak particle velocities comply with criteria for minimising human annoyance and discomfort, they would also be below levels that may cause structural damage to buildings.

3.3.3 *Time and Frequency of Blasting*

The consents state that blasting should generally be limited to the hours from 7.00 am to 6.00 pm Monday to Saturday and should not take place on Sundays or public holidays without the written approval of DECC.

CNA's ongoing consultation with the rural communities surrounding their operations has found that generally the community supports some flexibility in blast times in response to environmental conditions. These communities are more reactive to dust from blasting and would prefer blasting to be undertaken earlier or later in the day where wind conditions are more suitable and less likely to carry dust.

In addition, existing management measures for noise and vibration were reviewed to identify additional measures required as a result of this proposal.

3.4 *NOISE FROM TRAINS ON THE MAIN RAIL LINE*

The noise from locomotive operations on the spur to the site is included as part of industrial site operations and therefore assessed under the INP.

However, train movements on the main line will be assessed separately. The Australian Rail Track Corporation (ARTC) currently controls the Hunter coal rail network. The noise from the railway is regulated by the ARTC EPL (No.3142). The current criteria applicable are promulgated in section L6.2. This is summarised as follows:

- stationary and idle at 15 metres -70dB(A) Lmax;
- stationary and self load at 15 metres -87dB(A) Lmax, and 95dB(L) Lmax; and
- service condition as per AS2377-2002 - 87dB(A) Lmax, and 95dB(L) Lmax.

Further, the EPL 3142 includes a pollution reduction program (PRP) that includes long term residential targets of:

- Leq,15hour = 65dB(A);
- Leq,9hour = 60 dB(A); and
- Lmax,24hr (passby) = 85dB(A).

It is understood that the main northern rail line does not currently have a PRP, but expect that the ARTC will develop and implement a noise mitigation strategy as part of planned upgrade of the network.

4 NOISE MODELLING

4.1 CALCULATION PROCEDURE

The ENM noise prediction software was used for modelling purposes. ENM takes into account distance, ground effect, atmospheric absorption and topographic detail. ENM is a DECC accepted noise prediction model as it gives consistently reliable predictions of environmental noise. Initial calculations were performed with no wind or temperature gradients, which are termed calm weather conditions. Assumed night air temperature and relative humidity were 10 °C and 90% respectively. Noise levels during other conditions are discussed in *Section 2.4*.

The model incorporates three-dimensional digitised ground contours for the surrounding land and mine plans. Contours of the mine for each mining stage were superimposed on surrounding base topography. Equipment was placed at various locations and heights, representing potential operating conditions that could result in the greatest noise impacts for the life of the mine.

The noise model predicts LAeq noise levels, based on equipment sound power levels determined from measurements conducted at the existing operations as detailed in *Appendix B.* The results assume that all plant and equipment operate simultaneously. In practice, such an operating scenario would be unlikely to occur. The results are therefore considered conservative.

4.2 MODELLING SCENARIOS

To assess potential noise impacts, the expected life and progression of the mine were examined to identify critical scenarios. Representative mine operating scenarios are provided in *Appendix C*. The proposed mining method includes a combination of dragline, truck and shovel and possible high wall operations.

The following scenarios were chosen as representative of potentially the worst in terms of noise at assessment locations:

- Scenario A – is indicative of mining operations in 2010 with mining activities concentrated in the Cheshunt Pit and in the north western and south eastern sections of the Riverview Pit. For this scenario, two draglines and two large shovels with associated trucks are in operation;

- Scenario B2 - is indicative of mining operations in 2014 with mining activities concentrated in the Cheshunt and South Lemington Pits. For this scenario, one dragline and three large shovels with associated trucks are in operation;

- Scenario C2 - is indicative of mining operations in 2019 with mining activities concentrated in the Cheshunt and South Lemington Pits. For this scenario, one dragline and three large shovels with associated trucks are in operation; and

- Scenario D - is indicative of mining operations in 2024 with mining activities concentrated in the Cheshunt Pit only.

Worst case scenarios were selected in terms of potential impacts to surrounding residences. This environmental noise 'envelope' approach was adopted to provide maximum flexibility for mining operations within acceptable noise parameters.

4.3 PLANT NOISE LEVELS

Typical modelled equipment used during earth-moving and associated operations in the pit and overburden emplacement areas is listed in *Table 4.1 and 4.2*. Sound power levels shown in *Table 4.1* are indicative and are based on measurements at the existing operations.

Table 4.1 Equipment Sound Power Levels

Plant	Representative Free-field $L_{eq,15minute}$ Sound Power Level, dB(A)
BE 1370 Dragline	114
Coal Truck - 240T	117
CAT D11 Dozer	110
Drill	119
Front End Loader	110
Grader	113
Scraper	110
Rubber Tyred Dozer	116
Reject Truck	115
Water Cart	116
Waste Truck - 240T	115
P&H 4100 XPB Shovel	118
Lemington Coal Preparation Plant	112
Conveyor	94 per 100m
Rail Loader and Rail Locomotive Idling	110

1. Refer to *Appendix B* for spectral data used for noise modelling.
2. L_{eq} levels are for each individual source.

4.4 MINING EQUIPMENT SCHEDULE

The typical HVO South equipment schedules for the four modelled mining scenarios are described in *Table 4.2.* The specific type of plant used may vary, however, the associated sound emissions will be similar. The existing mining equipment in 2006 is also included in the table.

Table 4.2 *Proposal - Typical Mining Equipment Schedule*

Description	Proposal Year				
	2006	A	B2	C2	D
HVO SOUTH					
Dragline	1	2	1	1	0
Shovel	2	2	3	3	2
Hydraulic Excavator	0	1	1	1	1
Coal Truck	4	10	14	13	8
CAT D11 Dozer	4	10	12	10	9
Drill	2	3	4	4	3
Front End Loader	2	4	7	7	5
Grader	0	5	5	5	4
Scraper	0	1	1	0	1
Rubber Tyred Dozer	1	3	3	3	2
Reject Truck	1	1	1	1	1
Water Cart	1	4	4	6	4
Waste Truck - 240T	11	20	36	37	26
P&H 4100 XPB Shovel	1	1	3	3	2
P&H 2800	0	1	0	0	0
Lighting Plant	0	9	0	13	7
TOTAL	**29**	**74**	**91**	**103**	**72**

Note: List indicates only mining equipment monitored during 2006. This list is not inclusive of total operating equipment at HVO during 2006.

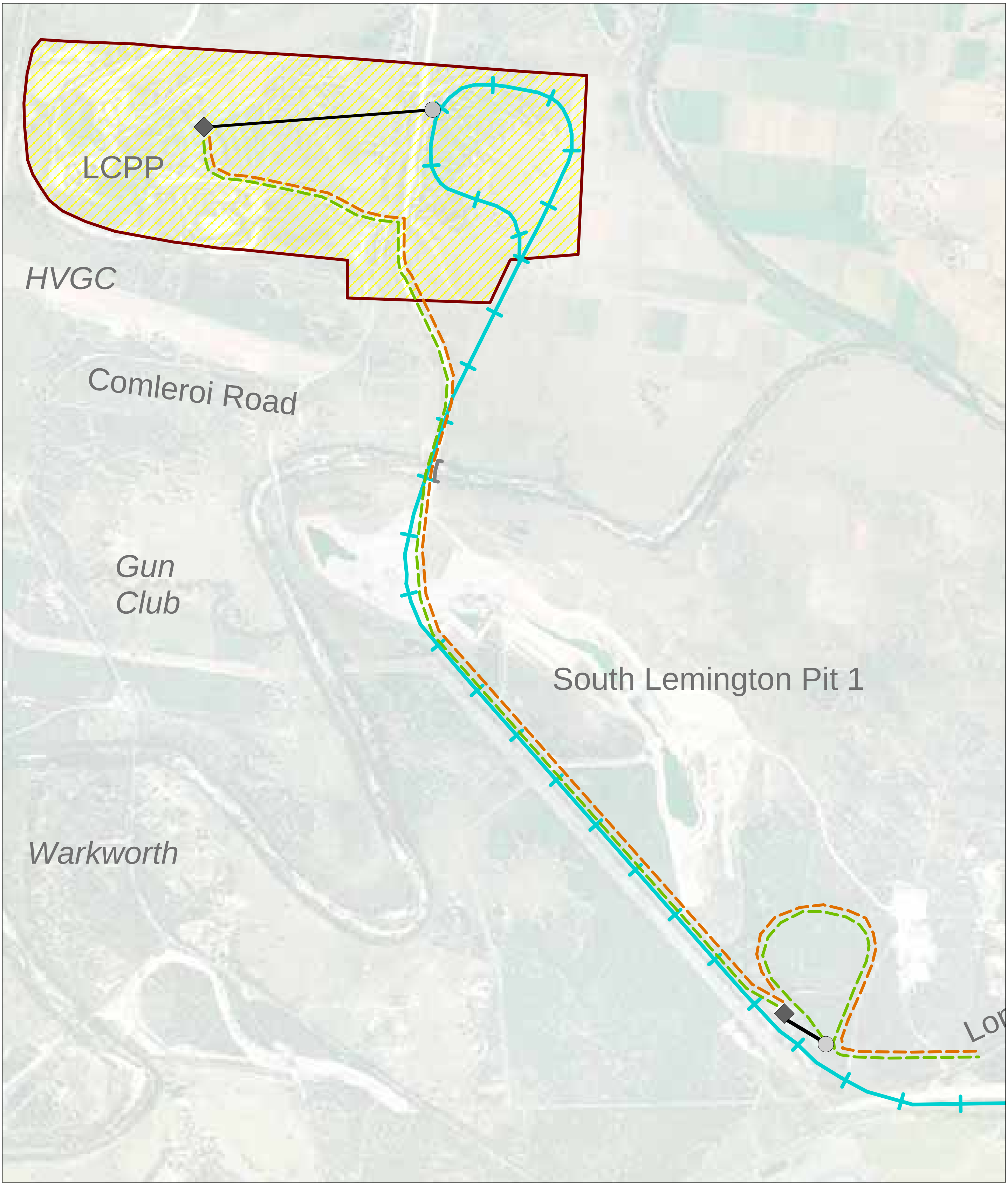
4.5 *LEMINGTON COAL PREPARATION PLANT*

For Scenarios B2 and C2, the LCPP is expected to be operational. As a result, three options were considered to transport product coal from the plant to the main railway line. All three options involve the construction of a rail loop which will link to the main railway line. Noise modelling for these two scenarios (B2 and C2) has incorporated all three options. These options are described in *Table 4.3. Figure 4.1* shows all the options graphically.

Table 4.3 *LCPP Transportation Options*

Option	Description
1	Rail loop adjacent to LCPP; LCPP operating with a conveyor, rail loader and a locomotive idling; Train passes through the rail spur.
2	Rail loop south east of South Lemington Pit 1; LCPP operating with conveyors leading to rail loop with a rail loader and a locomotive idling.
3	Rail loop south east of South Lemington Pit 1; LCPP operating with trucks leading to rail loop with a tunnel re-claimer, dozer, conveyor, rail loader and a locomotive idling.

Noise for train movement along the rail spur was evaluated using a train pass-by noise source represented by a 15 minute Sound Power Level of LAeq 76dB(A). This is based on actual measured data in ERM files. The model included a source at 50 m intervals on the spur with the worst case location for a given location adopted. The headings of the noise modelling results for the two scenarios B2 and C2 are accompanied by the suffixes *op1*, *op2* and *op3*, which indicate the above-mentioned options in *Table 4.3*.



Legend

- Loading Terminal
- Coal Stockpile
- Option 3
- Option 2
- Option 1
- Lemington Coal Preparation Plant
- Existing Bridge

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_AC_06 Suffix No: R2
Date:	27.09.2007 Drawing Size: A4
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

N

0 400 800m

Figure 4.1

Proposed LCPP Footprint and Transport Options from LCPP

Environmental Resources Management Australia Pty Ltd
Building C, 33 Saunders St, Pyrmont, NSW 2009
Telephone +61 2 8584 8888

ERM

5 PREDICTED NOISE LEVELS

The following section provides results of noise modelling for the proposal.

5.1 CALM WEATHER CONDITIONS

Table 5.1 summarises noise modelling results for calm weather conditions. Calm weather noise contours are presented graphically in *Figure 5.1*. The noise contours are the combination of the calm weather contours for all four scenarios described in *Section 4*. These levels typify the noise levels received by the residences surrounding the mine during the day in the absence of adverse INP assessable weather conditions.

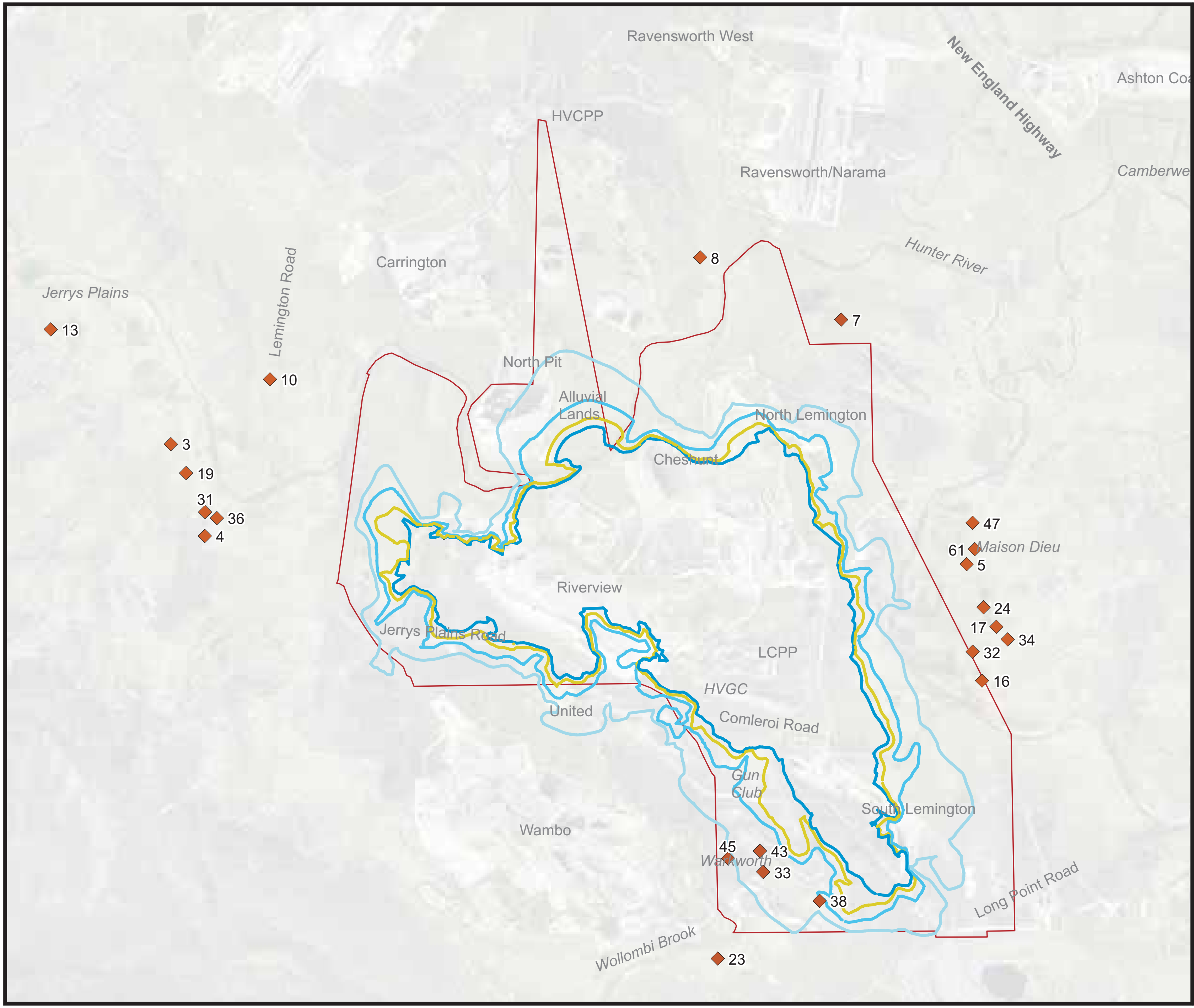
Under calm weather conditions, a noise impact is not likely at most residences. All private residences not within the currently recognised zone of affectation are below the likely acquisition criteria. The operational noise limits are exceeded at Location No's 33, 38, 43 and 45 during particular operating scenarios. However, it should be noted that these locations are situated in Warkworth Village and recognised as being within a zone of affectation or are owned by mines other than HVO.

It is clear that daytime and night time mine operations will satisfy DECC noise goals during calm weather conditions at all private residences not already within a zone of affectation.

Table 5.1 $L_{eq,15minute}$ Noise Under Calm Weather Conditions, dB (A)

No.	Location	A	B2 Op1	B2 Op2	B2 Op3	C2 Op1	C2 Op2	C2 Op3	D	Day Limits	Evening Limits	Night Limits	Likely Acquisition Limits
3	Elisnore	18	16	16	16	15	15	15	15	38	38	38	*43*
4	Muller	21	19	19	19	18	18	18	15	38	38	38	*43*
5	Bowman	36	29	29	30	25	25	27	31	39	39	39	*43*
7	Stapleton[1]	33	25	25	25	22	22	22	28	38	38	38	*43*
8	Holz[2]	29	26	26	26	23	23	24	28	*N/A*	*N/A*	*N/A*	*N/A*
10	Moses[1]	29	26	26	26	25	25	25	25	*N/A*	*N/A*	*N/A*	*N/A*
13	Jerrys Plains Centre	15	14	14	14	14	14	14	12	38	38	38	*43*
16	Algie	35	36	36	37	30	31	33	27	39	39	39	*43*
17	Algie	34	31	31	31	26	26	28	29	39	39	39	*43*
19	Birralee Feeds Pty Ltd	19	17	17	17	15	16	16	14	38	38	38	*43*
23	Cec M Hawkes Pty Ltd[1]	25	31	28	29	29	26	27	21	39	39	39	*N/A*
24	Clifton and Edwards	33	28	28	28	23	23	25	29	39	39	39	*43*
31	Cooper (Kilburnie)	20	18	18	18	17	17	17	14	39	39	39	*43*
32	Algie (Curlewis)	37	37	37	38	31	32	33	30	39	39	39	*43*
33	Edward & Haynes[2]	32	37	38	39	36	37	39	24	*N/A*	*N/A*	*N/A*	*N/A*
34	Ernst	33	30	30	31	25	26	28	28	39	39	39	*43*
36	Garland	19	17	17	17	16	16	16	14	38	38	38	*43*
38	Henderson[1]	34	40	40	40	43	43	43	23	39	39	39	*N/A*
43	Kannar[2]	33	39	40	41	40	41	42	24	*N/A*	*N/A*	*N/A*	*N/A*
45	Kelly[1]	33	37	38	38	36	36	37	25	39	39	39	*N/A*
47	Moxey	33	26	26	27	22	22	24	29	39	39	39	*43*
61	Shearer	36	29	29	30	24	25	27	30	39	39	39	*43*

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. These residences are owned by mining companies other than CNA.
3. Refer to *Table 4.3* for a definition of Options 1 to 3.
4. Maison Dieu residences are Location No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village Residences are Location No's 23, 33, 38, 43 and 45 and Jerrys Plains residences are Location No's 3, 4, 13, 19, 31 and 36. Isolated residences are Location No's 7, 8, 10.



Legend

Assessment Location

Project Application Area

Noise Contours

35 dB(A)
40 dB(A)
43 dB(A)
45 dB(A)

Figure 5.1

All Scenarios Combined
Leq 15 Minute Operation Noise Levels - Calm Weather, dB(A)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_AC_12	Suffix No:	R2
Date:	27.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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5.2 PREDICTED NOISE LEVELS - PREVAILING WEATHER CONDITIONS

Under various wind and temperature gradient conditions, noise levels may increase or decrease compared with calm weather conditions. This is due to refraction of sound propagating through the atmosphere, brought about by a change in sound speed with height. Received 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.

There is a premise that if the criterion is met under calm conditions, higher noise under strong winds (>3m/s) is generally acceptable. This is because the ambient noise at residences also increases during such weather conditions and mine noise is masked (for example, by wind induced vegetation noise). However, at wind speeds below 3 m/s and under temperature inversions, noise levels are assessable under the DECC's INP. These conditions are referred to as *INP weather conditions* as mentioned previously.

From the analysis of the meteorological conditions affecting the mine in *Section 2*, it was determined that ENM is typically conservative when used to predict noise under adverse weather conditions. Hence, ERM conducted a site specific validation of the ENM noise model to ascertain its accuracy under adverse weather conditions. A known noise source was generated with noise measurements conducted at various locations under varying weather conditions. These conditions were replicated in the ENM noise model and a comparison of the measured and modelled results was undertaken. The validation factors following post-field analysis were determined to be as follows:

- -3 dB(A) for equipment in the Cheshunt Pit Area (based on a validation study as documented in the HVO West Pit EIS, ERM 2003);
- -2.2 dB(A) for equipment in the Riverview Pit Area; and
- -1.6 dB(A) for equipment in the Hunter Valley Glider Club (HVGC) Area.

No validation factors were applied for the LCPP and the equipment associated with it or the South Lemington Pit 1.

The negative validation factors indicate that the ENM model over predicted noise levels under positive wind conditions. The validation factors were applied to modelled noise levels under positive wind conditions only. The full details of the ENM noise model validation procedure is detailed in *Appendix D.*

The predicted levels under INP weather conditions are provided in *Table 5.2 and Table 5.3* below. Noise contours for these scenarios are given in *Figures 5.2* to *5.6*.

Temperature inversions and INP based adverse wind conditions are only present during the night as discussed in *Section 2.4*.

Under temperature inversions, the likely acquisition criterion of 43 dB(A) is met at all the residences which are not currently under a zone of affection. *Table 5.2* shows Location No's 5, 16, 17, 24, 32, 47 and 61 (private residences which are not currently under any zone of affectation) are predicted to potentially exceed night limits.

The predictions in *Table 5.3* show that the night time operational limits are exceeded at several instances at various locations in Warkworth Village and Maison Dieu during adverse wind conditions. Location No's 5, 16, 24, 32, 34, 47 and 61 experience marginal exceedances over the likely acquisition criterion. At all these locations, predicted future HVO South mining noise levels are marginally below or marginally above existing noise levels, depending on the operating scenario. Location No's 3, 4, 13, 19, 31 and 36 comply with the limits under all scenarios.

As a result, further management measures were considered necessary to reduce noise levels as far as reasonably possible.

Table 5.2 Night $L_{eq,15minute}$ Noise Under Temperature Inversion Conditions, dB (A)

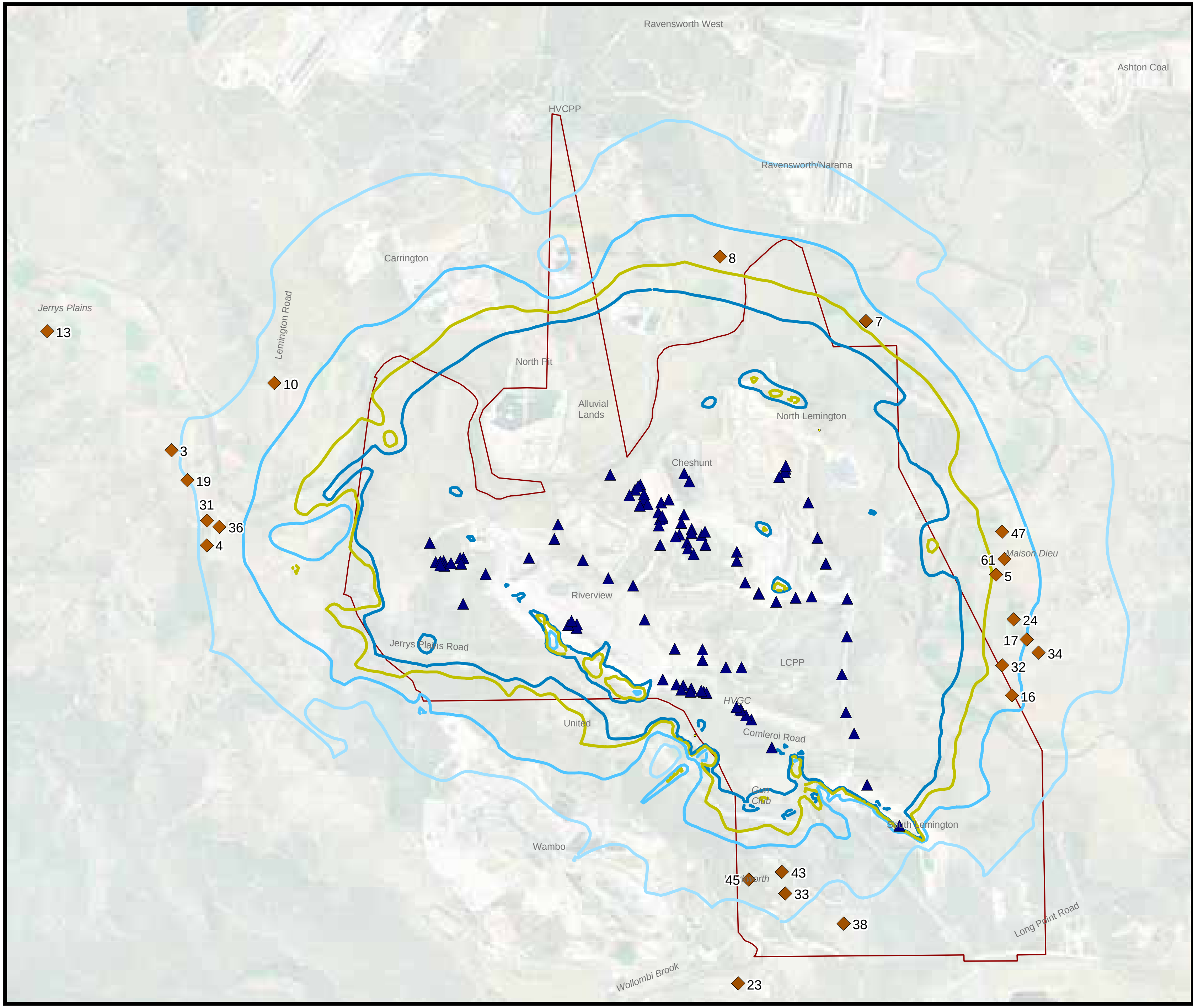
No.	Location	A	B2 Op1	B2 Op2	B2 Op3	C2 Op1	C2 Op2	C2 Op3	D	*Night Limits*	*Likely Acquisition Limits*
3	Elisnore	32	28	28	28	29	29	29	27	*38*	*43*
4	Muller	35	30	30	30	29	29	29	25	*38*	*43*
5	Bowman	41	38	38	39	35	35	37	38	*39*	*43*
7	Stapleton[1]	39	36	36	36	34	34	34	36	*38*	*N/A*
8	Holz[2]	38	37	37	37	36	36	36	36	*NA*	*N/A*
10	Moses[1]	36	33	33	33	34	34	34	34	*NA*	*N/A*
13	Jerrys Plains Centre	28	26	26	26	27	27	28	25	*38*	*43*
16	Algie	41	41	42	42	36	38	39	34	*39*	*43*
17	Algie	40	38	38	39	36	36	37	35	*39*	*43*
19	Birralee Feeds Pty Ltd	33	28	28	29	29	29	29	26	*38*	*43*
23	Cec M Hawkes Pty Ltd[1]	33	38	36	37	38	36	37	29	*39*	*N/A*
24	Clifton and Edwards	40	37	37	38	35	35	36	36	*39*	*43*
31	Cooper (Kilburnie)	34	30	30	30	29	29	29	25	*39*	*43*
32	Algie (Curlewis)	42	41	42	42	37	38	39	36	*39*	*43*
33	Edward & Haynes[2]	40	44	44	45	43	44	44	32	*N/A*	*N/A*
34	Ernst	39	38	39	39	36	36	37	34	*39*	*43*
36	Garland	35	31	31	31	29	29	29	25	*38*	*43*
38	Henderson[1]	38	45	44	44	46	46	46	31	*39*	*N/A*
43	Kannar[2]	42	47	47	47	44	45	46	33	*N/A*	*N/A*
45	Kelly[1]	41	43	43	44	41	41	42	32	*39*	*N/A*
47	Moxey	40	37	37	38	35	35	36	37	*39*	*43*
61	Shearer	41	38	38	39	35	35	37	37	*39*	*43*

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. These residences are owned by mining companies other than CNA.
3. Maison Dieu residences are Location No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village Residences are Location No's 23, 33, 38, 43 and 45 and Jerrys Plains residences are Location No's 3, 4, 13, 19, 31 and 36. Isolated residences are Location No's 7, 8, 10.

Table 5.3 Night $L_{eq\ ,15minute}$ Noise Under Adverse INP Wind Conditions, dB (A)

No.	Location	2006	A	B2 Op1	B2 Op2	B2 Op3	C2 Op1	C2 Op2	C2 Op3	D	*Night Limits*	*Likely Acquisition Limits*
3	Elisnore	32	35	35	35	36	35	35	35	31	*38*	*43*
4	Muller	33	38	37	37	37	36	36	36	29	*38*	*43*
5	Bowman	48	43	**44**	**44**	**45**	41	41	42	38	*39*	*43*
7	Stapleton[1]	47	42	**44**	**44**	**44**	43	43	43	41	*38*	*43*
8	Holz[2]	48	42	45	45	45	45	45	45	42	*N/A*	*N/A*
10	Moses[1]	36	39	39	39	39	40	40	40	36	*N/A*	*N/A*
13	Jerrys Plains Centre	28	29	31	31	31	31	31	31	26	*38*	*43*
16	Algie	44	41	**48**	**48**	**48**	42	**44**	**45**	31	*39*	*43*
17	Algie	45	41	42	43	43	39	40	41	34	*39*	*43*
19	Birralee Feeds Pty Ltd	33	36	36	36	36	36	36	36	31	*38*	*43*
23	Cec M Hawkes Pty Ltd[1]	39	26	44	39	40	44	40	40	22	*39*	*N/A*
24	Clifton and Edwards	46	41	43	**44**	**44**	40	41	41	36	*39*	*43*
31	Cooper (Kilburnie)	33	38	37	37	37	36	36	36	30	*39*	*43*
32	Algie (Curlewis)	46	43	**48**	**48**	**48**	42	**44**	**44**	33	*39*	*43*
33	Edward & Haynes[2]	43	33	48	48	49	48	48	49	22	*N/A*	*N/A*
34	Ernst	45	40	43	43	**44**	39	41	41	33	*39*	*43*
36	Garland	34	39	38	38	38	36	36	36	30	*38*	*43*
38	Henderson[1]	32	31	49	47	48	50	49	49	19	*39*	*N/A*
43	Kannar[2]	45	33	51	51	52	49	50	50	23	*N/A*	*N/A*
45	Kelly[1]	44	36	48	48	49	46	46	46	26	*39*	*N/A*
47	Moxey	49	42	43	43	**44**	41	41	42	39	*39*	*43*
61	Shearer	48	42	**44**	**44**	**45**	41	41	42	38	*39*	*43*

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. These residences are owned by mining companies other than CNA.
3. Maison Dieu residences are Location No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village Residences are Location No's 23, 33, 38, 43 and 45 and Jerrys Plains residences are Location No's 3, 4, 13, 19, 31 and 36. Isolated residences are Location No's 7, 8, 10.
4. Bold numbers indicate exceedance of likely acquisition limits where applicable for private residences not currently within a zone of affectation.
5. 2006 noise levels are the highest modelled existing noise levels as discussed in *Section 7.3.2*.



Legend

▲ Equipment Location

◆ Assessment Location

Project Application Area

Noise Contours

35 dB(A)
40 dB(A)
43 dB(A)
45 dB(A)

Figure 5.2

Scenario A
Leq 15 Minute Operation Noise Levels - INP Weather, dB(A)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_AC_07	Suffix No:	R3
Date:	28.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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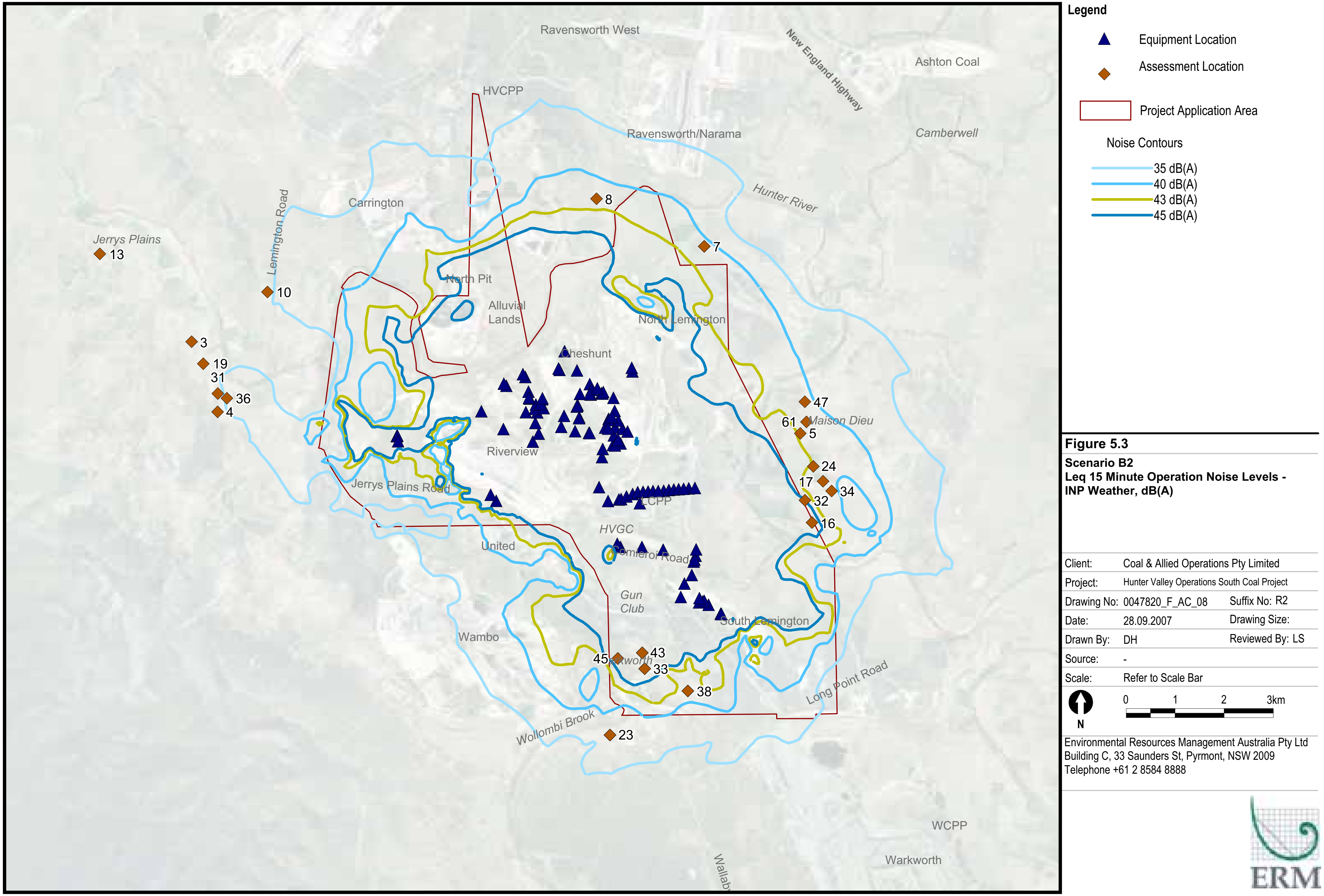

Figure 5.3

Scenario B2
Leq 15 Minute Operation Noise Levels - INP Weather, dB(A)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_AC_08	Suffix No:	R2
Date:	28.09.2007	Drawing Size:	
Drawn By:	DH	Reviewed By:	LS
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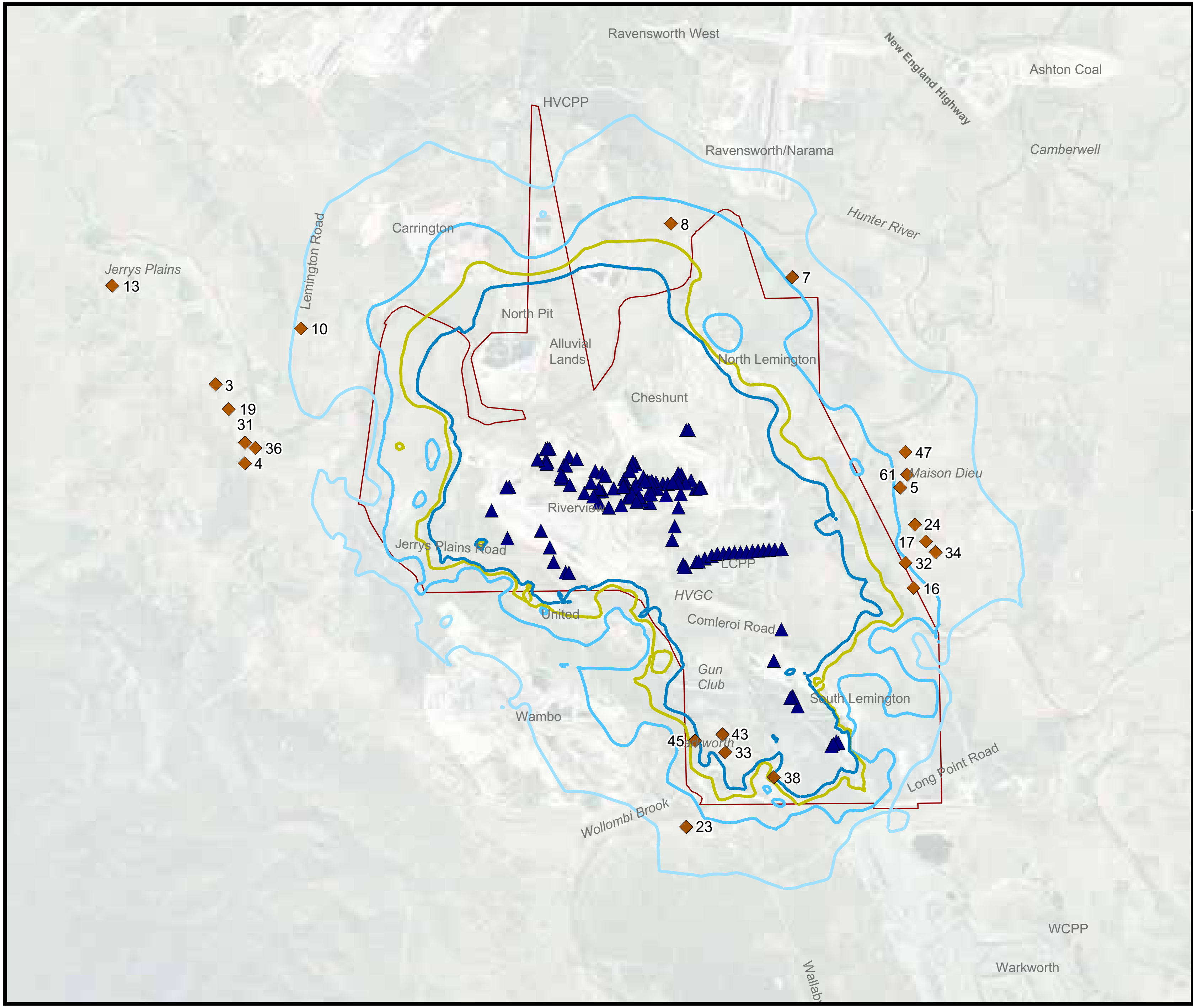

Legend

- Equipment Location
- Assessment Location
- Project Application Area

Noise Contours

- 35 dB(A)
- 40 dB(A)
- 43 dB(A)
- 45 dB(A)

Figure 5.4

Scenario C2
Leq 15 Minute Operation Noise Levels - INP Weather, dB(A)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_AC_09	Suffix No:	R2
Date:	28.06.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
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0 1 2 3km

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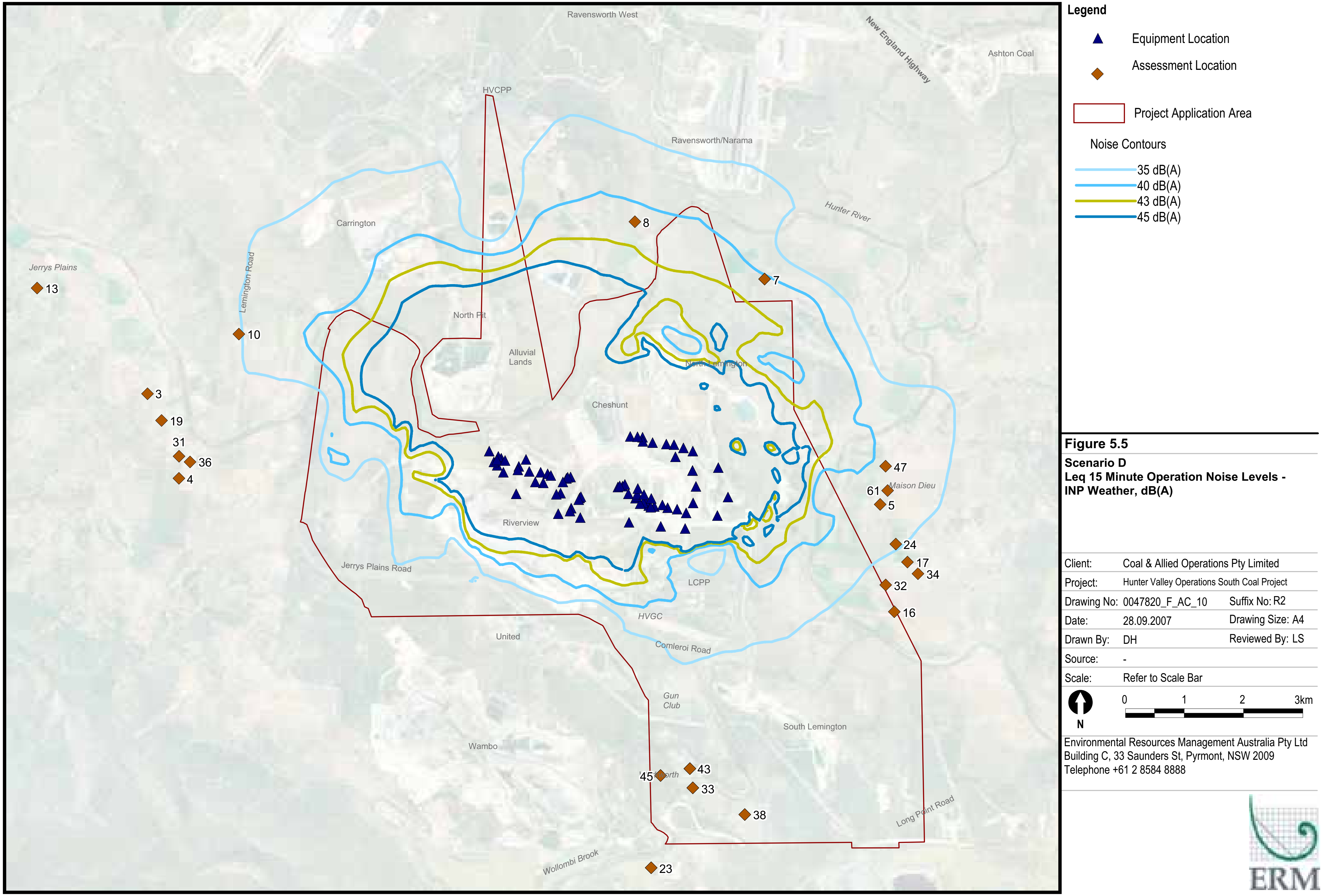

Figure 5.5

Scenario D
Leq 15 Minute Operation Noise Levels - INP Weather, dB(A)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_AC_10	Suffix No:	R2
Date:	28.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
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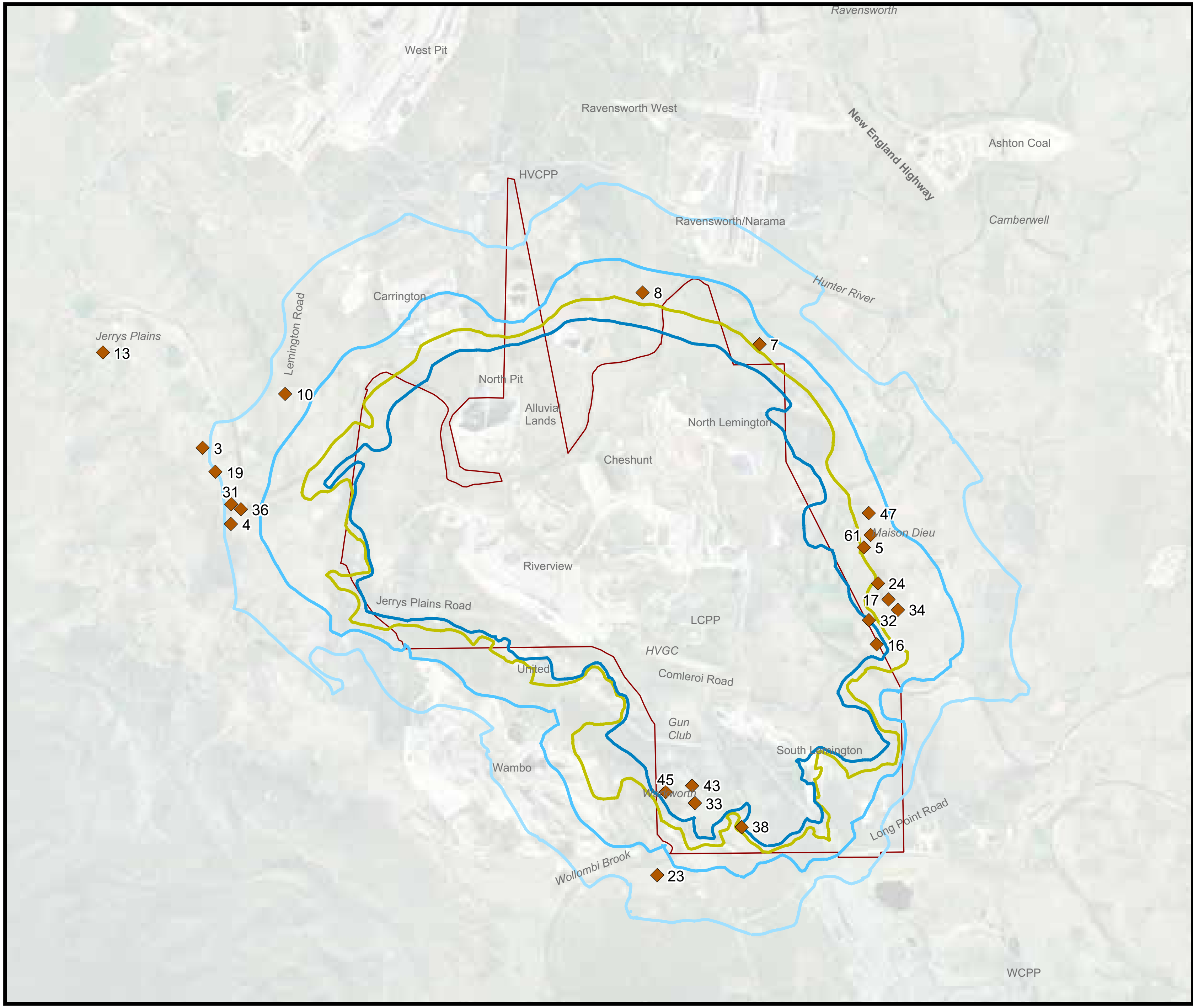

Legend

Assessment Location

Project Application Area

Noise Contours

- 35 dB(A)
- 40 dB(A)
- 43 dB(A)
- 45 dB(A)

Figure 5.6

All Scenarios Combined
Leq 15 Minute Operation Noise Levels - INP Weather, dB(A)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_AC_13	Suffix No:	R2
Date:	28.09.2007	Drawing Size:	A4
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

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5.3 *MANAGEMENT MEASURES*

Following analysis of the individual contribution of the noise sources at the various residences, the equipment at South Lemington Pit 1 and the truck haulage associated with it, were determined to be the main causes behind the night time criteria exceedances at the residences in Maison Dieu. The high noise levels at these locations are due to the presence of south westerly winds, which exceed the INP 30% threshold during the night.

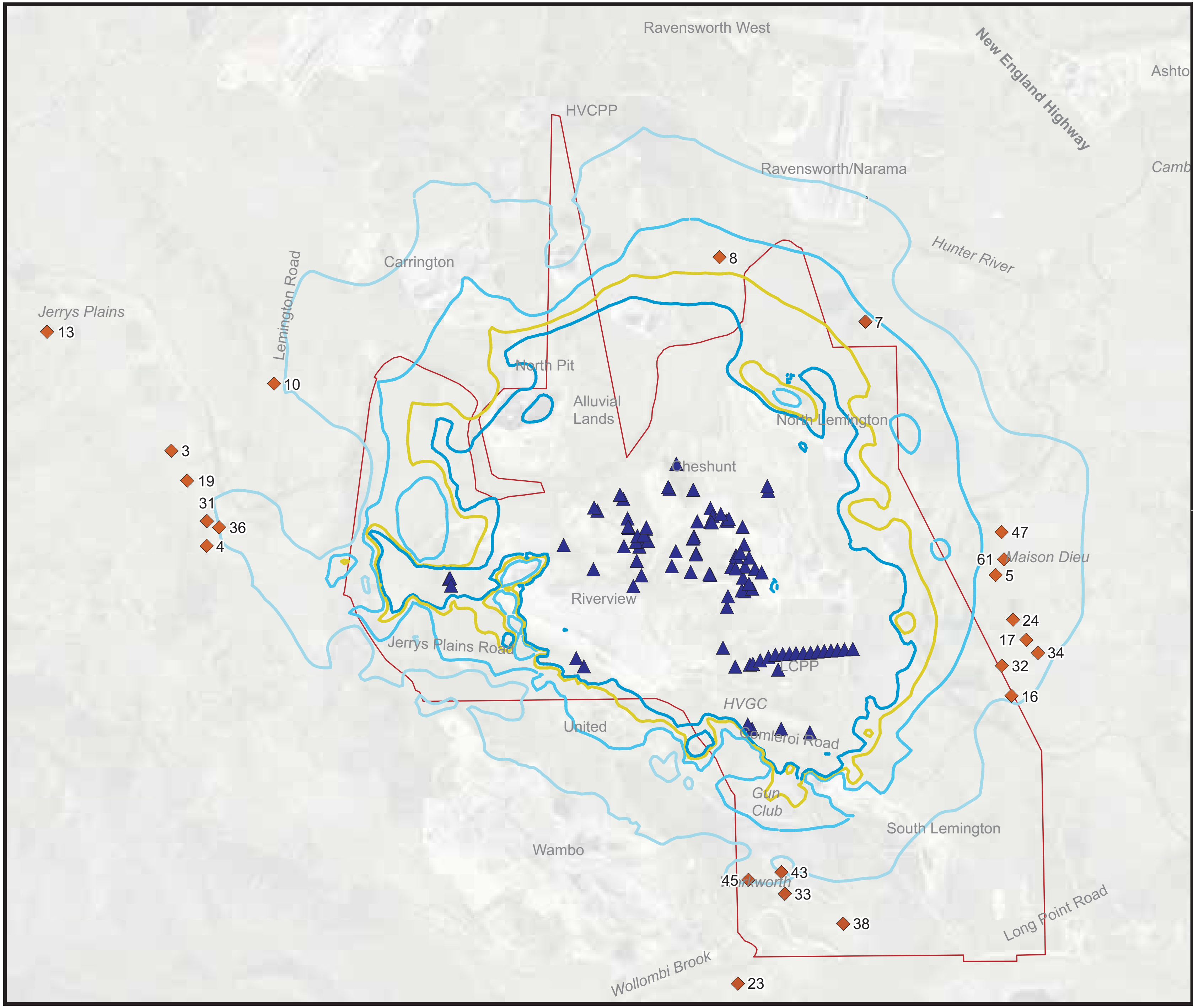
Scenario B2 and Scenario C2 have equipment operating in South Lemington Pit 1. For these scenarios, modelling indicates a potential exceedance for south westerlies at or above 2.1 metres per second (m/s). Equipment operation in South Lemington Pit 1 will be reviewed if it is determined that mine operations during nights with south westerly winds at or above 2.1 m/s may result in exceedance of noise criteria at Maison Dieu residences. At lower wind speeds, real time noise and weather monitoring will be used to guide modifications to operations as required. The results for this mitigation method are presented below in *Table 5.4*. *Figure 5.7*displays the noise contours with this mitigation measure in place.

The results show that noise levels are significantly reduced for the residences in Maison Dieu for Scenarios B2 and C2. The likely acquisition criterion of 43dB(A) is met at all the Maison Dieu residences during all weather conditions as a result of the mitigation measures.

Table 5.4 Mitigated Night $L_{eq,15minute}$ Noise Under Adverse Wind Conditions, dB (A)

No.	Locations	B2 Op1	B2 Op2	B2 Op3	C2 Op1	C2 Op2	C2 Op3	*Night Limits*	*Likely Acquisition Limits*
3	Elisnore	33	33	33	32	32	33	*38*	*43*
4	Muller	35	35	35	33	33	33	*38*	*43*
5	Bowman	39	40	41	38	38	40	*39*	*43*
7	Stapleton[1]	41	41	41	40	40	40	*38*	*N/A*
8	Holz[2]	42	42	42	42	42	42	*NA*	*N/A*
10	Moses[1]	36	36	36	37	37	37	*NA*	*N/A*
13	Jerrys Plains Centre	28	28	28	28	28	28	*38*	*43*
16	Algie	37	42	42	35	41	42	*39*	*43*
17	Algie	37	38	40	36	37	39	*39*	*43*
19	Birralee Feeds Pty Ltd	34	34	34	33	33	33	*38*	*43*
23	Cec M Hawkes Pty Ltd[1]	43	36	37	43	36	37	*39*	*N/A*
24	Clifton & Edwards	37	38	39	36	37	39	*39*	*43*
31	Cooper (Kilburnie)	35	35	35	33	33	33	*39*	*43*
32	Algie (Curlewis)	38	41	42	36	40	41	*39*	*43*
33	Edward and Haynes[2]	44	44	45	44	44	45	*N/A*	*N/A*
34	Ernst	37	39	40	35	38	39	*39*	*43*
36	Garland	35	35	36	33	33	34	*38*	*43*
38	Henderson[1]	48	45	46	48	45	46	*39*	*N/A*
43	Kannar[2]	42	45	46	41	44	46	*N/A*	*N/A*
45	Kelly[1]	42	42	43	41	41	43	*39*	*N/A*
47	Moxey	39	39	41	38	38	40	*39*	*43*
61	Shearer	39	39	41	38	38	40	*39*	*43*

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. These residences are owned by mining companies other than CNA.
3. Maison Dieu residences are Location No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village Residences are Location No's 23, 33, 38, 43 and 45 and Jerrys Plains residences are Location No's 3, 4, 13, 19, 31 and 36. Isolated residences are Location No's 7, 8, 10.



Legend

Equipment Location

Assessment Location

Project Application Area

Noise Contours

35 dB(A)

40 dB(A)

43 dB(A)

45 dB(A)

Figure 5.7

Mitigated B2
Leq 15 Minute Operation Noise Levels - INP Weather, dB(A)

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_AC_11 Suffix No: R2
Date:	27.09.2007 Drawing Size: A4
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

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5.4 *PERCENTAGE OCCURRENCE OF NOISE LEVELS*

The presence of mine noise levels at a given location varies and is dependent upon many factors including prevailing weather conditions. It is therefore prudent to gain an understanding of this variation rather than relying on a single predicted noise level for one set of weather conditions as presented earlier.

The ENM model calculates noise levels under various combinations of wind speed and direction and vertical temperature gradient. Hence, the proportion of time during which certain noise levels will be experienced can be calculated from the probabilities of various combinations of wind speed, wind direction and stability class.

The effects of a representative set of meteorological conditions on noise are presented for the mine operating Scenario B2 (Op 1), without South Lemington Pit 1 operating, for Location No's 16, 36 and 43. Location No's 16 and 36 are private residences and No. 43 is owned by a mining company other than CNA. These three residences provide a representation of others in the surrounding areas of Maison Dieu, Jerrys Plains Road and Warkworth Village respectively.

For each location, this involved calculating noise for each of 198 meteorological conditions based on a combination of wind speed, wind direction and temperature gradient, and combining these in proportion to the probability of their occurrence. These conditions are derived by adopting sixteen wind directions, six temperature gradients and two 10 m elevation wind speed ranges (ie 16 x 6 x 2 = 192). In addition, six calm weather conditions (defined by winds less than 0.5 m/s) and six stability classes were included in calculations. This was used to develop a noise probability distribution for each location.

The results of these calculations are presented in *Figure 5.8.*

As would be expected, the noise distribution has a larger range for residences further away from the operations (eg Location No. 36). This is due to the consideration of all prevailing weather effects, adverse or favourable, and the corresponding influence on noise propagation over large distances. Often a reasonable indicator of noise impact is associated with an industrial noise level present for at least 10% of the time. This is consistent with the intent of the INP. The 10% exceedance noise level is 48dB(A), 36dB(A), and 48dB(A) for Location No's 16, 36 and 43 respectively.

These compare to an INP based prediction (see *Table 5.4*) of 42dB(A), 35dB(A) and 45dB(A) for Location No's 16, 36 and 43 respectively. This demonstrates a reasonable level of correlation between the two methods, with the 10% approach being more conservative.

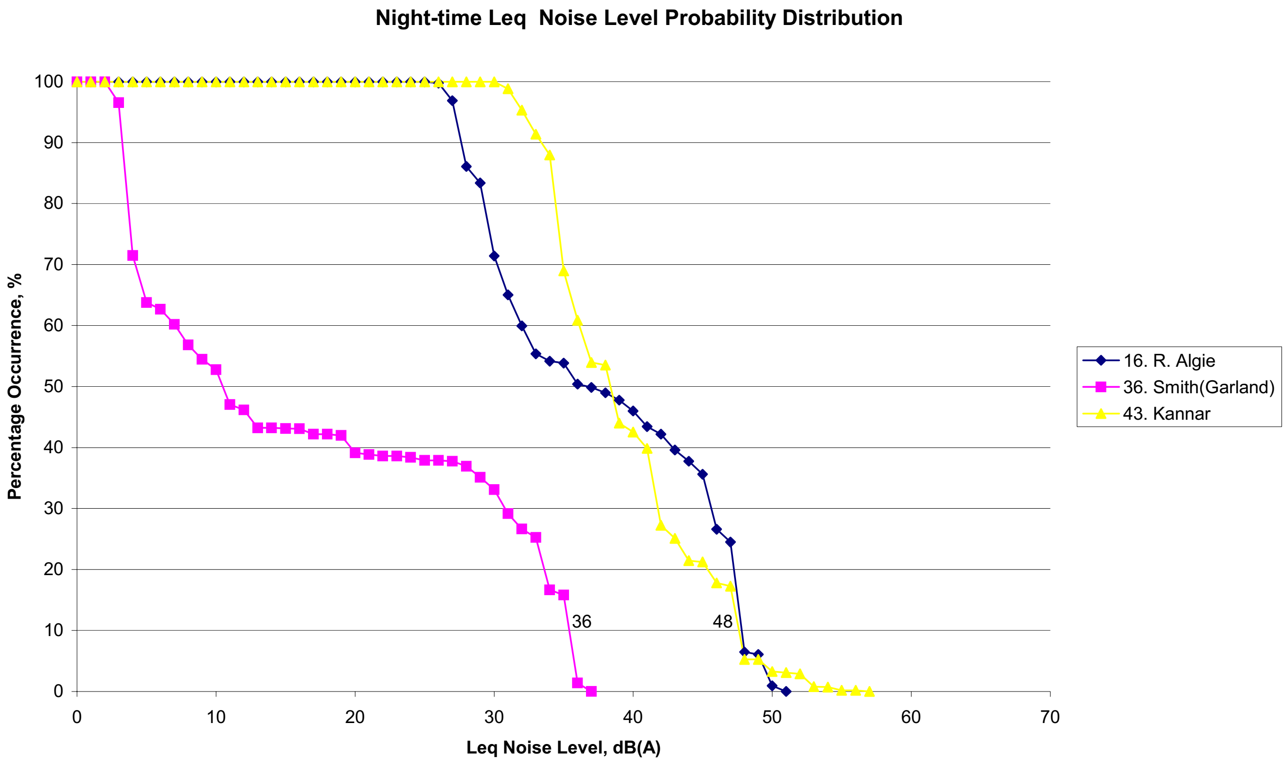

Figure 5.8 ***Night Time L_{eq} ,15 Minute Noise Level Probability Distribution***

The above calculations apply to stable meteorological conditions with constant wind speed and linear temperature gradients. Atmospheric turbulence results in fluctuations of the sounds received by the listener. Therefore, on occasions when there is a particular combination of non-linear wind and temperature gradients, noise from a particular source can focus on a point. Under these conditions, higher enhancements can be expected. The frequency and intensity of such events are not predictable, but would be relatively rare.

5.5 SLEEP DISTURBANCE

There is a potential for sleep of residents to be disturbed by transient noise such as shovel gates banging, bulldozer track plates, truck engine at fast revving and vehicle reversing alarms. *Table 5.5* presents noise levels for the noisiest of these sources measured by ERM for previous projects.

Table 5.5 ***Maximum Transient Noise***

Noise Source	Measured L_{max} Noise Level, dB(A)	Distance from Source (metres)
Shovel gate banging	60	400
Bulldozer with reversing alarm	69	80

A single truck movement may cause sleep disturbance, particularly if it is isolated from other mine-related noise. The maximum sound power level (L_{Wmax}) of haul trucks was measured at up to 125 dB(A).

Similarly, train movements on the proposed rail spur have been included in sleep disturbance calculations. A typical representative sound pressure level for a passing locomotive is 80dB(A)Lmax at 30 m (refer to *Table 5.*) or 118dB(A)Lmax sound power level. The proposed rail spur (either Option 1 or Option 2) is 1 km from the closest assessment location in Warkworth Village (Location 38) and 1.6 km from the closest assessment location in Maison Dieu (Location 32) at the nearest point.

From the modelled results, it was determined that for most cases, truck movements will result in higher maximum noise levels at residences.

Maximum noise levels were calculated under INP wind conditions for each location and the four operational stages.

Table 5.6 shows calculated maximum noise levels from the highest ranked source for a given location. This is based on the typical equipment locations used for mining operations and corresponds to the maximum sound power level for the particular item of plant (generally that for a truck or 125 dB(A)). The equipment judged to create a transient noise event was either a reject truck, waste truck, coal truck or a dozer. Calculations were for a single event, rather than the simultaneous operation of a number of plant items because the values given are instantaneous maxima and such events are not simultaneous. The criteria used to assess sleep disturbance are based on the DECC's background plus 15 dB for the L1,1min noise level (which in this case is conservatively approximated by the maximum noise level (Lmax)).

Table 5.6 Sleep Disturbance Impact – INP Weather (Mitigated)

No.	Location	External L_{max} Noise Level From On-Site Plant, dB(A)				$L_{1,1min}$ Criteria, dB(A)
		A	B2	C2	D	
3	Elisnore	38	31	34	35	45
4	Muller	42	34	37	31	45
5	Bowman	44	38	30	40	46
7	Stapleton	**49**	40	39	**47**	45
8	Holz[2]	45	44	39	42	45
10	Moses[1]	43	35	39	37	45
13	Jerrys Plains Centre	31	26	33	25	45
16	Algie	42	42	39	33	46
17	Algie	40	40	37	36	46
19	Birralee Feeds Pty Ltd	39	32	35	31	45
23	Cec M Hawkes Pty Ltd[1]	25	35	41	25	46
24	Clifton and Edwards	42	37	28	38	46
31	Cooper (Kilburnie)	41	33	36	31	49
32	Algie (Curlewis)	44	45	40	35	46
33	Edward & Haynes[2]	38	46	**48**	24	46
34	Ernst	40	41	37	33	46
36	Garland	42	34	37	32	45
38	Henderson[1]	34	38	**54**	22	46
43	Kannar[2]	35	**49**	**48**	25	46
45	Kelly[1]	39	46	39	29	46
47	Moxey	43	36	31	41	46
61	Shearer	43	37	31	39	46

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. These residences are owned by mining companies other than CNA.
3. Maison Dieu residences are Location No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village Residences are Location No's 23, 33, 38, 43 and 45 and Jerrys Plains residences are Location No's 3, 4, 13, 19, 31 and 36. Isolated residences are Location No's 7, 8, 10.

Table 5.6 demonstrates that calculated noise levels under prevailing weather conditions are within the stipulated criteria at most locations. There are criteria exceedances at Location No's 33, 38 and 43 which are residences owned or already under the zone of affectation of other mines. Location No. 7 experiences a marginal criteria exceedance of 2dB(A) for Scenario D and an exceedance of 4dB(A) for Scenario A. Location No. 7 is in a zone of affectation of another mine. Furthermore, maximum internal levels are likely to be below 50-55 dB(A) which recent literature studies (reference Environmental Criteria for Road Traffic Noise (DECC 1999)) state are generally perceived to be the minimum noise level to cause an awakening reaction of a resident.

5.6 *CUMULATIVE NOISE ASSESSMENT*

Adjoining industrial activity also influences the noise climate at locations potentially exposed to the proposal. Other industrial operations of significance are HVO North, Wambo (including rail spur), Mt Thorley Warkworth, Ravensworth-Narama and Ashton Coal Mine.

Noise contribution from these surrounding mines was sourced from the following documents:

- an EIS produced by ERM Australia Pty Limited in October 2003 for HVO West Pit Extension and Minor Modifications;
- an EIS produced by Resource Strategies Pty Limited in June 2003 for the Wambo Development Project;
- an EIS produced by ERM Australia Pty Limited in August 2002 for the Extension of Warkworth Coal Mine;
- an EIS produced by ERM Mitchell McCotter in August 1997 for the Extension of Mining Operations at Ravensworth-Narama;
- an EIS produced by HLA-Envirosciences Pty Limited in November 2001 for the Ashton Coal Project; and
- The aforementioned documents provided predicted L_{eq} noise levels for adverse weather.

Since not all of the locations used for this proposal were assessed in studies for other mines, some locations were assigned noise levels based on a representative location in the same vicinity.

Generally, cumulative noise from these operations was added to the results for worst case INP weather from the proposal. However, a special case is Warkworth Village where this would be unrealistic as, for example, a westerly wind that may enhance noise from Wambo will not enhance noise from the proposal. Hence, the locations in Warkworth Village were assessed separately.

5.6.1 Cumulative Noise Impact

Table 5.7 summarises the cumulative noise effects of surrounding mines and related infrastructure. The percentage values in the parentheses indicate the proposal's contribution (in noise terms) at that location. The results are for prevailing weather conditions as described earlier and are therefore conservative. The critical night period was used as the period of assessment for cumulative noise impact.

It should be noted that based on the information provided in other EISs, Wambo and Ravensworth-Narama mines will cease operations in 2016 and 2007 respectively. However, the Ravensworth-Narama mine was presumed to operate until 2012 for assessment purposes. Warkworth Coal Mine is expected to operate throughout the length of the subject proposal. The predicted noise from these operations was therefore cumulatively assessed accordingly.

Table 5.7 Cumulative Night-time L_{eq} Noise Levels at Assessment Locations

No	Location	Cumulative Noise Level (Proposal contribution), dB(A)							
		A	B2 Op1	B2 Op2	B2 Op3	C2 Op1	C2 Op2	C2 Op3	D
3	Elisnore	37 (32%)	37 (20%)	37 (21%)	37 (21%)	36 (20%)	37 (18%)	37 (19%)	35 (19%)
4	Muller	39 (41%)	39 (20%)	39 (20%)	39 (20%)	39 (13%)	39 (14%)	39 (15%)	33 (22%)
5	Bowman	**41 (78%)**	38 (63%)	**41 (74%)**	**42 (71%)**	38 (50%)	39 (58%)	40 (66%)	37 (69%)
7	Stapleton[1]	41 (69%)	39 (79%)	39 (80%)	39 (85%)	38 (79%)	38 (74%)	39 (64%)	39 (74%)
8	Holz[2]	44 (32%)	42 (50%)	42 (54%)	42 (56%)	42 (50%)	42 (49%)	42 (50%)	42 (47%)
10	Moses[1]	40 (40%)	39 (25%)	39 (25%)	39 (26%)	39 (32%)	39 (32%)	39 (33%)	40 (22%)
13	Jerrys Plains Centre	33 (21%)	35 (10%)	35 (10%)	35 (11%)	35 (10%)	35 (11%)	35 (12%)	38 (3%)
16	Algie	40 (69%)	38 (40%)	**45 (93%)**	**45 (96%)**	38 (25%)	**42 (79%)**	**43 (68%)**	36 (17%)
17	Algie	40 (56%)	38 (40%)	40 (66%)	**41 (63%)**	38 (32%)	39 (50%)	40 (53%)	36 (33%)
19	Birralee Feeds Pty Ltd	36 (52%)	35 (40%)	35 (39%)	35 (41%)	34 (40%)	34 (39%)	34 (41%)	28 (100%)
24	Clifton and Edwards	39 (74%)	37 (50%)	**41 (75%)**	**41 (83%)**	36 (50%)	38 (68%)	39 (67%)	35 (65%)
31	Cooper	39 (40%)	39 (20%)	39 (20%)	39 (20%)	39 (13%)	39 (13%)	39 (14%)	33 (26%)
32	Algie (Curlewis)	**41 (72%)**	38 (50%)	**45 (88%)**	**45 (92%)**	38 (32%)	**42 (67%)**	**42 (77%)**	36 (28%)
34	Ernst	40 (48%)	38 (40%)	41 (64%)	41 (70%)	38 (25%)	39 (58%)	40 (54%)	36 (26%)
36	Garland	40 (39%)	39 (20%)	39 (23%)	39 (24%)	39 (13%)	39 (15%)	39 (15%)	33 (24%)
47	Moxey	**41 (59%)**	39 (50%)	40 (66%)	**41 (66%)**	39 (40%)	39 (49%)	40 (56%)	39 (54%)
61	Shearer	**41 (68%)**	39 (50%)	**41 (68%)**	**42 (66%)**	39 (40%)	39 (55%)	40 (63%)	38 (55%)

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. This residence is owned by a mining company other than CNA.
3. Maison Dieu residences are Location No's 5, 16, 17, 24, 32, 34, 47 and 61, Warkworth Village Residences are Location No's 23, 33, 38, 43 and 45 and Jerrys Plains residences are Location No's 3, 4, 13, 19, 31 and 36. Isolated residences are Location No's 7, 8, 10.
4. Bold numbers indicate exceedance of the DECC night time amenity goal of 40 dB(A) at private residences.

Applying a night time cumulative noise criterion equivalent to the DECC's night time amenity goal of 40 dB(A) Leq,9hour (applicable for a rural residence according to the INP), shows that all private residences not currently within a zone of affectation will be within 5 dB(A) above the DECC's amenity goal. The private residences which are currently in a zone of affectation are well above the amenity goal. As discussed earlier, the predictions above are based on a worst case Leq,15minute noise level from each operation. The data in *Table 5.7* includes; a conservative 3 dB correction for the predicted worst case Leq,15minute and Leq,9hour noise level. This correction is due to the inherent downtime of plant over the 9 hour night-time period as compared with a worst case 15-minute noise emission level.

Private residences predicted to experience cumulative noise above the DECC criterion are Location No's 5, 16, 17, 24, 32, 47 and 61.

Residences in Warkworth Village are discussed in the following section.

5.6.2 Cumulative Noise Impact at Warkworth Village

For the residences at Warkworth Village, the two main noise contributors are the proposal and Wambo Mine. All assessed locations are either within a zone of affectation or owned by other mines. The adverse winds affecting the proposal and the adverse winds affecting Wambo Mine will not be the same for these locations and hence three separate scenarios are assessed where the wind situations affecting both the proposal and Wambo Mine are similar. *Table 5.8* below shows all three wind scenarios.

Table 5.8 Wind Scenarios for Residences at Warkworth Village

Wind Scenario	Proposal	Wambo Mine
1	0 m/s	0 m/s
2	2.1 m/s at 225 degrees	2m/s at 270 degrees with a temperature inversion of 3 degrees C/m
3	2.7 m/s at 135 degrees	3m/s at 135 degrees

Table 5.9 provides the results for these three modelling scenarios. From the results, it can be seen that the proposal will be the sole contributor of noise to these residences only for Scenario D when the Wambo Mine is expected to have ceased operation.

Wind scenario 1 shows that in the absence of wind, Wambo Mine is the main contributor of noise at Location No's 23, 33 and 45.

For wind scenario 2, the proposal's contribution is diminished at Warkworth Village as expected due to westerly winds. Wambo remains the main noise contributor in all scenarios prior to operating Scenario D.

For wind scenario 3, the proposal is predicted to be a significant noise contributor at Location No. 38 only. It is worth noting again that the residences which are in Warkworth Village are currently within the Wambo Mine affectation zone as documented in Wambo's consent or owned by Wambo.

Table 5.9 Cumulative Night-time L_{eq} Noise Levels at Warkworth Village, dB(A)

	Location				
	23[1]	33[2]	38[1]	43[2]	45[1]
Scenario	**Cec M Hawkes Pty Ltd**	**Haynes**	**Henderson**	**Kannar**	**Kelly**
			Wind Scenario 1 (Calm)		
A	46 (0%)	49 (1%)	37 (11%)	46 (2%)	50 (2%)
B2 Op1	47 (23%)	50 (30%)	47 (79%)	50 (56%)	51 (26%)
B2 Op2	46 (10%)	50 (30%)	45 (78%)	50 (63%)	51 (27%)
B2 Op3	46 (11%)	51 (27%)	45 (92%)	50 (69%)	51 (29%)
C2 Op1	47 (25%)	50 (32%)	48 (85%)	49 (51%)	51 (15%)
C2 Op2	46 (12%)	50 (33%)	46 (96%)	49 (60%)	51 (15%)
C2 Op3	47 (11%)	51 (30%)	47 (85%)	50 (54%)	51 (17%)
D	19 (100%)	19 (100%)	16 (100%)	20 (100%)	23 (100%)
			Wind Scenario 2 (Westerly)		
A	53 (0%)	54 (0%)	48 (1%)	50 (0%)	54 (0%)
B2 Op1	53 (0%)	54 (0%)	47 (4%)	50 (1%)	53 (0%)
B2 Op2	53 (0%)	54 (1%)	47 (4%)	50 (2%)	53 (1%)
B2 Op3	53 (0%)	54 (1%)	47 (4%)	50 (4%)	53 (1%)
C2 Op1	53 (0%)	54 (0%)	47 (7%)	50 (2%)	53 (0%)
C2 Op2	53 (0%)	54 (1%)	47 (7%)	50 (3%)	53 (1%)
C2 Op3	53 (0%)	54 (1%)	47 (7%)	50 (4%)	53 (1%)
D	10 (100%)	13 (100%)	13 (100%)	14 (100%)	14 (100%)
			Wind Scenario 3 (South Easterly)		
A	42 (0%)	50 (0%)	35 (7%)	50 (0%)	54 (0%)
B2 Op1	42 (2%)	50 (1%)	38 (56%)	50 (2%)	54 (0%)
B2 Op2	42 (1%)	50 (1%)	38 (57%)	50 (3%)	54 (0%)
B2 Op3	42 (1%)	50 (2%)	38 (59%)	50 (4%)	54 (1%)
C2 Op1	42 (11%)	50 (10%)	41 (74%)	51 (16%)	54 (3%)
C2 Op2	42 (3%)	50 (11%)	41 (69%)	51 (18%)	54 (3%)
C2 Op3	42 (5%)	51 (11%)	41 (72%)	51 (20%)	54 (4%)
D	10 (100%)	12 (100%)	11 (100%)	13 (100%)	14 (100%)

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. These residences are owned by mining companies other than CNA.
3. The proposal's contribution to total received noise levels is shown in brackets as a percentage %.
4. The results for the proposal scenario include the mitigation described earlier.

5.7 OTHER NOISE EMISSIONS

5.7.1 Construction Activities

Construction activities for the proposal will include:

- works associated with the intermittent transfer of heavy equipment across the Hunter River;
- construction of the Belt Line Conveyor;
- construction of a new rail spur from the Wambo Spur to be located adjacent to the LCPP; and
- the LCPP is in the planning stage at the time of this report and will also be upgraded or replaced.

The works above are well removed from private residences and there will be no significant construction activities that are likely to add to received noise levels (from mining operations) at residences.

5.7.2 Road Traffic Noise

An additional 50 workers are proposed to be employed at HVO over the life of the proposal. An additional 100 workers will be required during the construction phase to upgrade the LCPP and associated coal transport infrastructure.

The traffic assessment presented in the Environmental Assessment indicates an increase of between 0.5 and 2.3% in daily traffic volumes at Jerrys Plains Road and Lemington Road. In noise terms this equates to a negligible increase in noise. There will be no significant input related to road traffic noise generated by the proposal.

5.7.3 Main Rail Line Noise

The proposal will not result in any significant net increase in rail traffic on the main railway line over and above that which is currently approved. The increase sought in throughput for the LCPP will not exceed current coal loader consent conditions. The change in rail operations from the LCPP will require up to three additional train loads per day on average. Whilst this will mean a further six pass-by events per day, the maximum (Lmax) noise level will be similar to existing events. Further, given existing rail volumes, the additional six pass-bys will not increase average day and night (Leq,15hr and Leq,9hr) noise levels by any perceptible quantity (ie <2dB).

The following data is provided as relevant information.

Measured noise levels for various train sets are published by the former Rail Access Corporation (RAC) and these are used here for demonstrating likely noise levels at assessment locations that are 30 m away. *Table 5.10* indicates that freight type trains (including locomotives, coal, ore and other freight) generally produce a noise level of 80dB(A) as a median value (with a 6dB(A) standard deviation) at 30 m. This is below the ARTC's current licence limit of 87dB(A) stipulated in their Environment Protection Licence described earlier.

Table 5.10 Freight Train Noise Levels

Location	Lmax, dB(A)			30m ARTC's EPL Criteria
	Range	Median	Standard Deviation	
30m	63-93	80	6	87dB(A)

Source: Rail Access Corporation (RAC) Database; Based on 144 freight measurements at 30m.

5.8 *NOISE AND DUST INTERACTIONS*

It should be noted that dust impacts are a result of all wind conditions, which demonstrates a prominent north west to south east axis in the area. However, noise impacts are assessed for winds analysed according to the INP. This results in assessable winds from easterly through to south westerly.

The Maison Dieu community happens to be susceptible to both impacts.

The noise and air quality impact assessments predict that assessment locations in the Maison Dieu area would experience some exceedances of the DECC assessment criteria due to emissions from HVO South alone. For noise, this occurs during mining in South Lemington Pit 1 at night time and if relatively light winds from the south west prevail. For air quality, the impact occurs for all assessed mining scenarios when measured on a 24-hour basis with an exceedance of the 50 $\mu g/m^3$ goal predicted.

These will need to be managed via real time monitoring and noise and air quality management systems. For noise this may mean cessation of night mining in South Lemington Pit 1 during south westerly winds as determined by monitoring.

For air quality this would involve continuous monitoring of PM_{10} concentrations and calculation of the rolling 24-hour PM_{10} concentration. Rolling 24-hour PM_{10} concentrations that approached 50 ug/m^3 would trigger a review of mining operations and meteorological conditions to determine the contributing activities. If these are identified as mining operations then the activities responsible for the elevated concentrations would need to be suspended or redeployed, or otherwise modified.

5.9 *RELOCATION / RECONFIGURATION OF THE HUNTER VALLEY GLIDER CLUB*

The HVGC is to be relocated / reconfigured as part of the proposal. The potential noise impact associated with the proposed relocation is presented in the following section, based on a maximum of 30 daily flights.

5.9.1 *Description*

The HVGC is currently located approximately 1 km south of the LCPP. The HVGC's airstrip and clubhouse are to be shifted approximately 400 m to the east and one strip width to the north to accommodate mining activities.

The gliders are used recreationally and as a training tool for Air Force cadets. The gliders are by themselves quiet and are not powered with any mechanical devices. During take-off, these gliders are tethered to powered aircraft known as 'Tugs'. The Tugs currently in use are the Piper PA25 and the Pawnee 235. Aircraft noise associated with the HVGC involves the use of these Tugs to lift the gliders to the required altitude for the gliders to remain airborne. Upon reaching the desired altitude, the Tug releases the glider attached to it and returns to the HVGC. Hence, the flight path of the Tugs is in close proximity of the HVGC.

The gliders do not have lights installed on them hence flights are limited to daylight and are constrained by inclement weather. There is no aircraft noise associated with the HVGC during the night and hence sleep disturbance issues are not relevant.

An average of 50 launches take place every week and during the peak summer period, 25 to 30 launches may be expected each day, most of these during weekends.

5.9.2 *Criteria*

Noise criteria applicable to aircraft noise associated with the HVGC are obtained from the Australian Standard AS2021 – 2000 Appendix D "*Method for Determining Building Site Acceptability for Light General Aviation Aerodromes Without ANEF Charts*". The criteria are stated in *Table 5.11* below.

Table 5.11 Recommended Aircraft Noise Levels from AS2021

Building Site	Aircraft noise level expected at building site, dB(A) L_{max}					
	20 or less flights per day			Greater than 20 flights per day		
	Acceptable	**Conditional**	**Unacceptable**	**Acceptable**	**Conditional**	**Unacceptable**
Houses, home units, flat, caravan parks	<80	80 to 90	>90	<75	75 to 85	>85
Hotels, motels, hostel	<85	85 to 95	>95	<80	80 to 90	>90
Schools, University	<80	80 to 90	>90	<75	75 to 85	>85
Hospitals, nursing homes	<80	80 t0 90	>90	<75	75 to 85	>85
Public building	<85	85 to 95	>95	<80	80 to 90	>90
Commercial building	<90	90 to 100	>100	<80	80 to 90	>90
Light industrial	<95	95 to 105	>105	<90	90 to 100	>100
Heavy Industrial	No limit	No limit	No Limit	No Limit	No Limit	No Limit

1. The number of aircraft operations is the estimated average number of flights per day over the site. Each night time flight between the hours of 1900 and 0700 is to count as four operations.

From *Table 5.11*, a L_{max} level of up to 75 dB(A) is acceptable for houses during the worst case scenario of there being 30 launches during the summer period. It should be noted that on average, less than 20 launches take place and the L_{max} level of 80 dB(A) would be applicable. The more stringent criteria of 75 dB(A) is used for assessment purposes here.

5.9.3 *Results*

ERM conducted a site visit to the HVGC on 17 June, 2006 to obtain data and evaluate the potential noise impact associated with the relocation of the HVGC. Noise measurements were conducted with two SVAN 912 Sound Level Meters configured to measure A-weighted L_{max} levels under a 'slow' time-weighting (as is required by AS2021). Measurements were conducted under the flight path of the Tug aircraft to evaluate the noise impact of the aircraft fly over. The results are presented in *Table 5.12*.

Table 5.12 ***Noise Measurements under Flight Path of Tug Aircraft on 17 June, 2006***

Time	Location			Noise Level, $L_{ASmax\ dB(A)}$
	GPS_x	GPS_y	Description	
13.09	0315170	6396843	End of eastern end of runway; Aircraft 150 m away.	71.1
13.12	0315170	6396843	End of eastern end of runway; Aircraft 20 m away.	74.5
13:15	0315170	6396843	End of eastern end of runway; Aircraft directly above.	61.6
13.28	0315194	6396831	30 m east of eastern end of runway; Aircraft directly above.	75.5
13.28	0315356	6396803	150 m east of eastern end of runway; Aircraft 50 m away.	76.0
13.32	0315194	6396831	30 m east of eastern end of runway; Aircraft directly above .	59.7
13.33	0315356	6396803	150 m east of eastern end of runway.	55.7
13.50	0315318	6395741	100 m east of eastern end of runway; Aircraft 50 m away.	68.9
13.51	0315309	6396750	100 m east of eastern end of runway; Aircraft 150 m away.	71.1
13.53	0315309	6396750	100 m east of eastern end of runway; Aircraft 300 m away.	63.4

1. GPS co-ordinates used the MGA56 datum.

The measured levels mainly comply with the criterion of 75 dB(A) and marginally exceed this criterion at two instances. It should be noted that the closest residences are beyond the flight path of the Tug aircraft and noise levels at these residences are unlikely to exceed the levels measured above.

In addition to evaluating noise levels under the flight path, measurements were undertaken at the HVGC strip to evaluate take off and landing noise associated with the Tug aircraft. The location of these measurements was at 50 m from the centre of the runway which is the main take-off and landing point and hence they represent the maximum noise levels experienced at the HVGC. The results are presented in *Table 5.13*.

Table 5.13 ***Noise Measurements at Hunter Valley Gliding Club Airstrip on 17th June, 2006***

Time	Event	Noise Level, $L_{ASmax\ dB(A)}$
12.54	Take-off	84.9
13:03	Landing(Fly-by during landing)	54.5
13:06	Take-off	84.3
13:09	Landing(Fly-by during landing)	50.3
13:12	Take-off	82.6
13:13	Fly-by south-east of eastern end of runway	58.6
13:14	Fly-by south of hangar	65.6

1. All the above measurements were conducted at GPS co-ordinates (0313715, 6397240) in the MGA56 datum.

6 BLASTING NOISE AND VIBRATION

The proposal includes three mining areas where blasting will occur. These are the Cheshunt, Riverview and South Lemington Pits.

HVO South is located in a highly sensitive environment with both private and commercial near neighbours. The closest and therefore potentially most affected residence to the proposed blast locations is Location No. 7 (Stapleton), which is approximately 1.8 km away from current and proposed blasts. United Colliery located directly south of Riverview Pit is the closest commercial development.

The blast design is actively managed by the operation, and hence corresponding airblast overpressure and ground vibration is minimised. HVO South's existing blast management procedures will be used to ensure appropriate charge masses are used for blasting. Such MIC masses are presented in *Table 6.1*. These were derived from 95% formulae in Blastronics Pty Limited publication for monitoring data collected at similar mines in the area.

Table 6.1 Recommended Blast Charge Mass

Blast to Location Distance, m	MIC_{8ms} to Satisfy ANZECC 95% Overpressure Limit of 115 dB(Lin), kg	MIC_{8ms} to Satisfy ANZECC 95% Ground Vibration Limit of 5 mm/s (ppv), kg
1,500	163	745
2,000	386	1,324
2,500	753	2,069
3,000	1,302	2,980
4,000	3,088	5,299
5,000	6,031	8,279
6,000	10,422	11,922

1. These results are derived from equations contained in the Drill and Blast Study, Mount Pleasant prepared by Blastronics Pty Limited for CNA in September 1994.
2. In general, blast overpressure considerations limit MIC.

The highest MIC that is recommended to be used at HVO South is 386 kg when the proximity of the residences is less than 2 km.

The St Phillip's Church in Warkworth is located approximately 1.8 km from South Lemington Pit 1, and 2 km to 4 km from Riverview Pit as mining progresses. The MIC masses for blasts within the proximity of the St Phillip's Church will be managed to minimise impacts on the building.

Blasting will occur between the hours of 7.00 am to 6.00 pm. This will provide the mine with flexibility to blast during meteorological conditions that will result in the least impact on its neighbours. Typically, blasting operations will be conducted more than once a day. All blasts will be monitored for overpressure noise and ground vibration at several locations.

It is recommended that when a temperature inversion is known to exist, blasting should be avoided if practical. This does not apply where the effects of blasting are not perceived at noise sensitive locations. In addition to the above criteria, general best practice procedures can be used to effectively minimise noise impacts (see *Section 7*).

7 MANAGEMENT MEASURES

The management of noise and blast overpressure and vibration generated by HVO activities is undertaken with reference to the corresponding management plan that details the key objectives and control measures.

The management plans outline key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle.

The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

7.1.1 Noise

The key objectives for noise management are to:

- manage the operations in a way that minimises noise impacts to the environment, neighbours and structures, and limits interference to mining production;
- review monitoring results against model predictions and modify activities to ensure compliance with the relevant criteria; and
- keep the local community and regulators informed of activities where required and to respond quickly and effectively to issues and complaints.

The recommended management measures have been considered in the context of the existing HVO operations and the CNA EMS. As a result a number of control measures for noise will be implemented across HVO South to minimise the potential impacts resulting from the proposal. The project's statement of commitments will adopt the derived noise limits or results of noise modelling (mitigated) as detailed in this report.

Mitigation Measures

The following controls will occur under standard conditions (24 hour mining operations; construction operations during daylight hours:

- plant, machinery and haul roads will be maintained in good condition according to manufacturer's specification and all repairs conducted promptly to ensure that equipment remains in a sound operating condition;
- sound power level testing of equipment will be undertaken annually in accordance with the CNA EMS Noise Procedure;
- activities that generate complaints will be monitored and modified if monitoring results confirm that DECC noise criteria are being exceeded;

- environmental inductions will ensure that relevant employees are aware of potential impacts on sensitive locations from equipment and its operation;

- noise emission levels will be considered in awarding relevant contracts and purchasing new equipment;

- attended and unattended monitoring of noise at sites as detailed in the Noise Monitoring Programme with quarterly attended monitoring undertaken by a qualified acoustic consultant to supplement site noise data;

- monitoring using both directional and non-directional monitors with frequency filtering capabilities to determine the noise source;

- maintenance of monitoring systems consistent with regulatory requirements, best practice analytical techniques and published standards;

- installation, operation and calibration of monitors in accordance with relevant Australia Standards;

- maintenance of all monitoring records in CNA's environmental monitoring database; and

- noise monitoring results for sites as listed in the Noise Monitoring Programme to be included in the AEMR.

If it is determined that mine operations during adverse meteorological conditions may result in exceedance of noise criteria at sensitive locations, the following options will be considered:

- review of the elevation of mining and dumping and, where possible, relocate equipment to lower elevations, until more suitable conditions return;

- amended working hours;

- temporary cessation of work within an area or from a particularly noisy piece of equipment; and

- construction of a temporary or long-term noise mitigation bund to shield the mining operation.

In the event of community concern additional noise monitoring may also be undertaken at sensitive sites.

Commitments Specific to the Proposal

In addition to the mitigation measures presented above, equipment operation within South Lemington Pit 1 and associated truck movements will cease during night time operations if monitoring identifies that unacceptable noise impacts will result from south westerly winds (occurring at or above 2.1 m/s). At lower wind speeds, real time noise and/or weather monitoring will be used to guide modifications to operations as required.

7.1.2 Blasting

The key objectives for blast and vibration management are to:

- manage the operations in a way that minimises blast and vibration impacts to environment, neighbours and structures, and limits interference to mining production;

- review blast design and monitoring results to ensure limits to ensure compliance with the relevant criteria; and

- keep the local community and regulators informed of activities where required and to respond quickly and effectively to issues and complaints.

The recommended management measures have been considered in the context of the existing HVO operations and the CNA EMS. As a result a number of control measures for blast and vibration will be implemented across HVO South to minimise the potential impacts resulting from the proposal.

Mitigation Measures:

- notification procedure for nearby residents unless otherwise agreed;

- assessment of real-time weather conditions prior to blasting and no blasting when unfavourable weather conditions area present;

- blasting to occur generally within the hours of 7am to 6pm Monday to Saturday, and no blasting on Sundays or public holidays unless otherwise agreed with DECC;

- ensuring good blast design and evacuating the area within 300 to 500 m of a blast to ensure safety from fly rock;

- Road Closure Management Plan for public roads;

- completion of a Ground Disturbance Permit prior to blasting activities to avoid damage to subsurface utilities;

- a programme of regular monitoring, including sensitive buildings where identified;

- investigation of any blasts if monitoring results confirm that DECC criteria are being exceeded;

- maintenance of monitoring systems consistent with regulatory requirements, best practice analytical techniques and published standards;

- installation, operation and calibration of monitors in accordance with relevant Australian Standards;

- maintenance of all monitoring results in CNA's environmental monitoring database; and

- monitoring results for sites as listed in the Blast Monitoring Programme to be included in the AEMR.

Commitments Specific to the Proposal:

In addition to the mitigation measures presented above, blasts will be designed to minimise impacts on neighbouring mine ventilation structures and minimise the potential for fracture development along pit walls to assist with pit wall stability:

- blast vibration will be managed through design and modelling;
- bench heights will be managed to not significantly exceed 15 m;
- no throw blasts will take place adjacent to final walls;
- high density explosives will be toe loaded;
- blast monitoring and post blast analysis will be undertaken where required;
- presplit blasting will be implemented on final walls where this indicates improved wall conditions; and
- visual monitoring will be undertaken.

8 *CONCLUSIONS*

This study considers the potential noise impacts of the proposal, which incorporates all of HVO South as described in *Section 1.1*. The acoustic assessment includes modelling of all major mining equipment at representative operational locations. The study had the following features:

- existing mine noise verification was undertaken by comparing attended quarterly measured data and ENM calculations;
- extensive site validation of the ENM software at Cheshunt, Riverview and South Lemington Pits;
- years of site-specific hourly meteorological data analysed to describe prevailing winds in accordance with the DECC's INP;
- source sound power levels for all equipment measured under operational conditions at mines;
- the noise modelling addressed the DECC's INP with regard to adverse weather conditions; and
- predicted mine noise is based on predicted worst case operating scenarios and hence results in an 'outer-envelope' impact area.

The noise modelling has shown that under calm weather conditions all private residential properties not currently located within a zone of affectation experience noise levels below the operational noise limits. The noise management measure of selective equipment operation in South Lemington Pit 1 during south westerly winds at night will ensure all residences are below the likely acquisition criteria.

For private residences not in a zone of affectation, during INP weather conditions, exceedances of the operational limits are predicted at Maison Dieu Location No's 5, 16, 17, 24, 32, 34, 47 and 61. Exceedances are also predicted to occur at Location No. 36, located towards Jerrys Plains. With stipulated mitigation strategies applied, the likely acquisition limit is met at all locations not currently within a zone of affectation. At most locations, predicted future HVO South mining noise levels are marginally below or marginally above existing noise levels, depending on the operating scenario.

CNA's environmental plans and procedures, which include ongoing noise monitoring, will be used to assess the performance of the mining operations against the predicted noise levels.

Blast design will incorporate control on the MIC as described in this study and implementation of CNA's environmental plans and procedures will ensure that acceptable limits are maintained. This will include monitoring of all HVO blasts.

The cumulative industrial noise assessment demonstrates that the proposal is a significant contributor at Maison Dieu residences during westerly winds as expected, although is not the sole industrial source at these locations. For Warkworth Village the proposal becomes significant at one of five of the nominated residences under adverse easterly winds. However, noise levels are only marginally above INP cumulative amenity targets under such winds. Further, these residences are either owned or in affectation zones of other mines.

The relocation of the HVGC is expected to result in a negligible change in noise for residences.

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CNA (2005) *Corporate EMS Procedures.*

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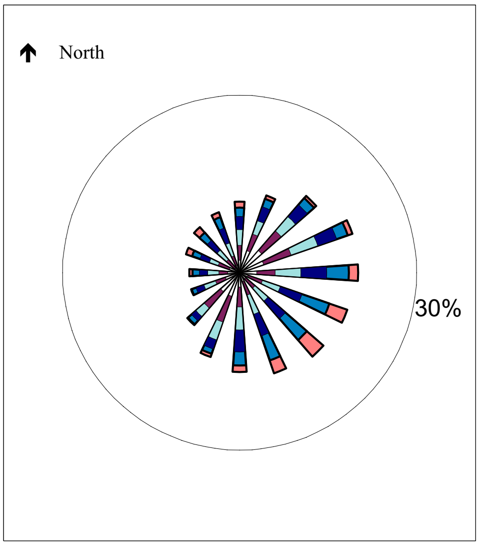
RTA Technology *Environmental Noise Model (ENM), Windows Version 3.06*.

Appendix A

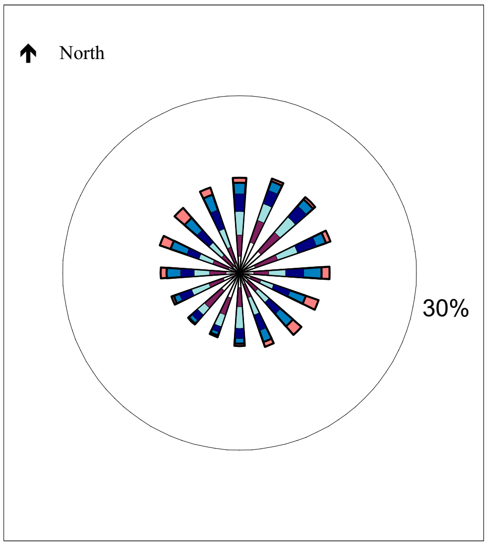
Vector Wind Roses Annual Hourly Wind Analysis

Day

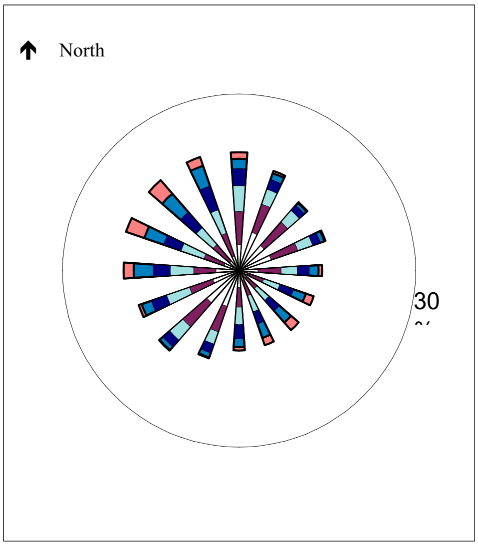
Summer



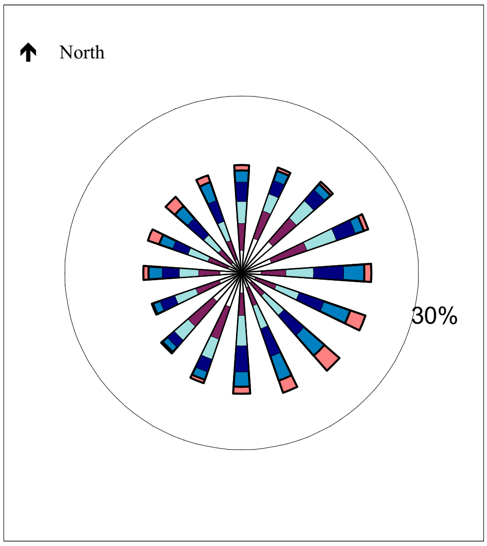
Spring



Winter



Autumn

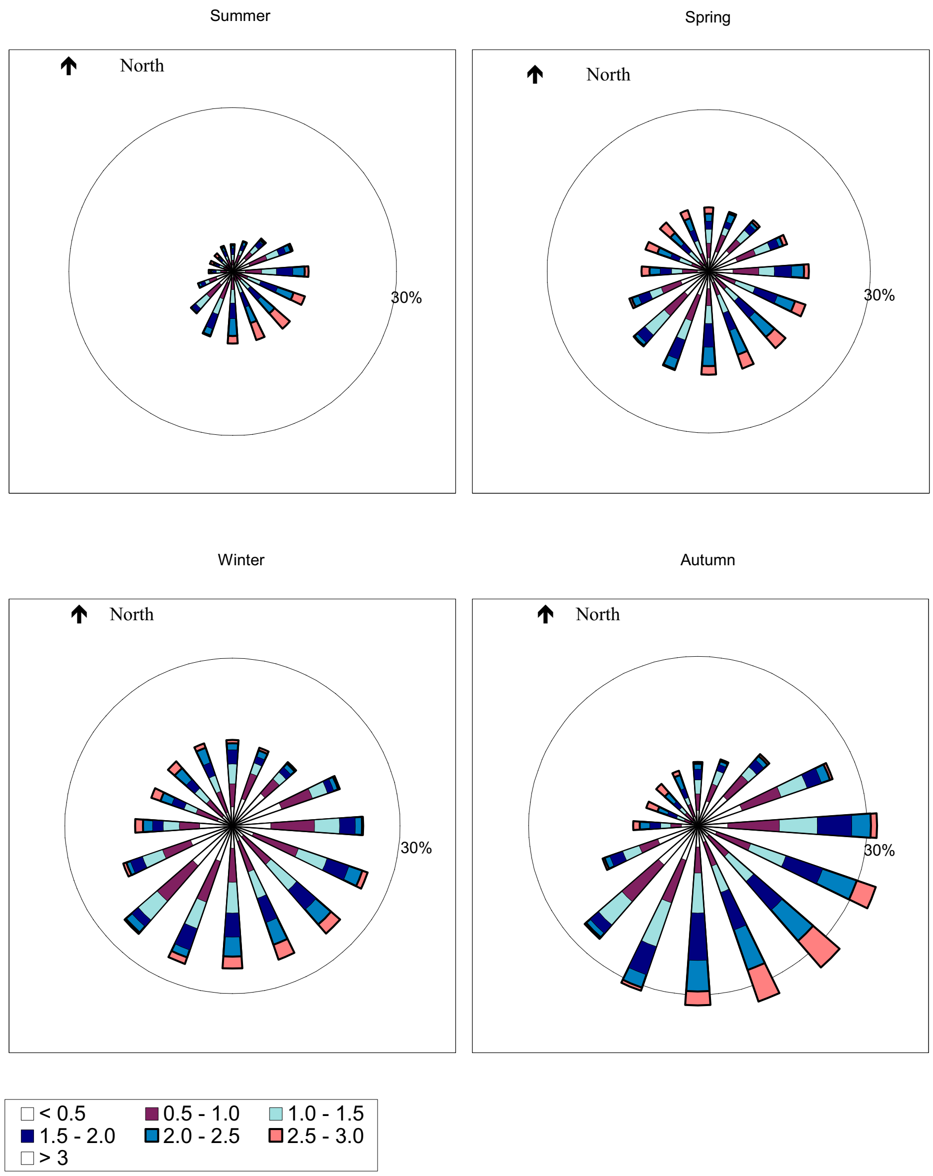


□ < 0.5 ■ 0.5 - 1.0 ■ 1.0 - 1.5
■ 1.5 - 2.0 ■ 2.0 - 2.5 ■ 2.5 - 3.0
□ > 3

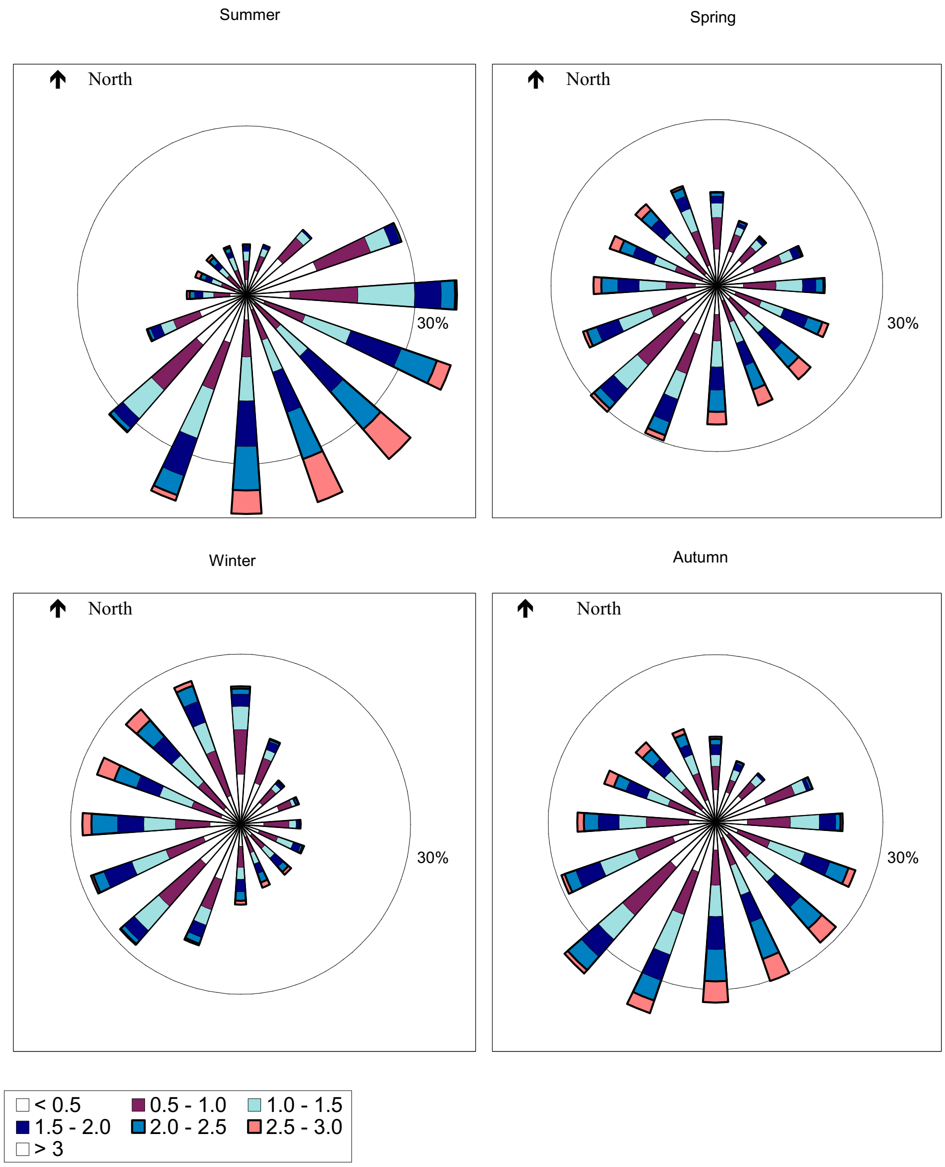
Data Source: Hunter Valley Operations South
Data Range: Hourly, 01-07-96 to 03-07-06(excluding years 98,01 and 04)

The segments of each arm represent the six valid wind speed classes, with increasing windspeed from the centre outwards. The length of each arm represents the vector components (for each direction) of wind speeds 3m/s or below as a proportion of the total time for the period .
The circle represents the 30% occurrence threshold.

Evening


Summer
North
30%
Spring
North
30%
Winter
North
30%
Autumn
North
30%
< 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
> 3

Night


Summer
North
30%
Spring
North
30%
Winter
North
30%
Autumn
North
30%
< 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
> 3

Appendix B

Sound Power Spectral Data

Table B.1 Representative $L_{eq, 15\ minute}$ Sound Power Spectral Data, dB

Item	31.5[1]	63.0	125.0	250.0	500.0	1000.0	2000.0	4000.0	8000.0	16000.0	Linear	A-weight	Type
Dragline	117	117	116	115	111	109	105	103	101	5	123	114	L_{eq}
Coal Truck	110	121	116	111	109	111	111	110	95	93	124	117	L_{eq}
Dozer	115	111	110	112	106	106	102	97	88	5	119	110	L_{eq}
Drill	106	110	123	114	119	111	109	103	98	90	125	119	L_{eq}
Front End Loader	98	99	108	109	106	107	102	96	92	80	114	110	L_{eq}
Grader	107	108	115	111	109	108	106	99	99	92	119	113	L_{eq}
Scraper	114	113	114	106	107	105	104	96	87	5	119	110	L_{eq}
Rubber Tyred Dozer	108	107	115	115	112	112	107	101	97	5	121	116	L_{eq}
Reject Truck	112	111	113	113	111	110	108	101	95	5	120	115	L_{eq}
Water Cart	113	112	113	115	112	111	109	102	96	5	121	116	L_{eq}
Waste Truck - 240T	112	111	113	113	111	110	108	101	95	5	120	115	L_{eq}
Shovel	110	111	112	114	118	112	108	103	96	86	122	118	L_{eq}
LCCP	135	120	117	109	108	105	103	103	101	5	135	112	L_{eq}
Conveyor per 100m	90	88	85	87	90	91	84	81	71	66	97	94	L_{eq}
Rail Loader and Locomotive	116	119	115	110	103	103	103	100	98	96	116	110	L_{eq}

1. Frequency in Hz

Appendix C

Mine Plans and Equipment Locations

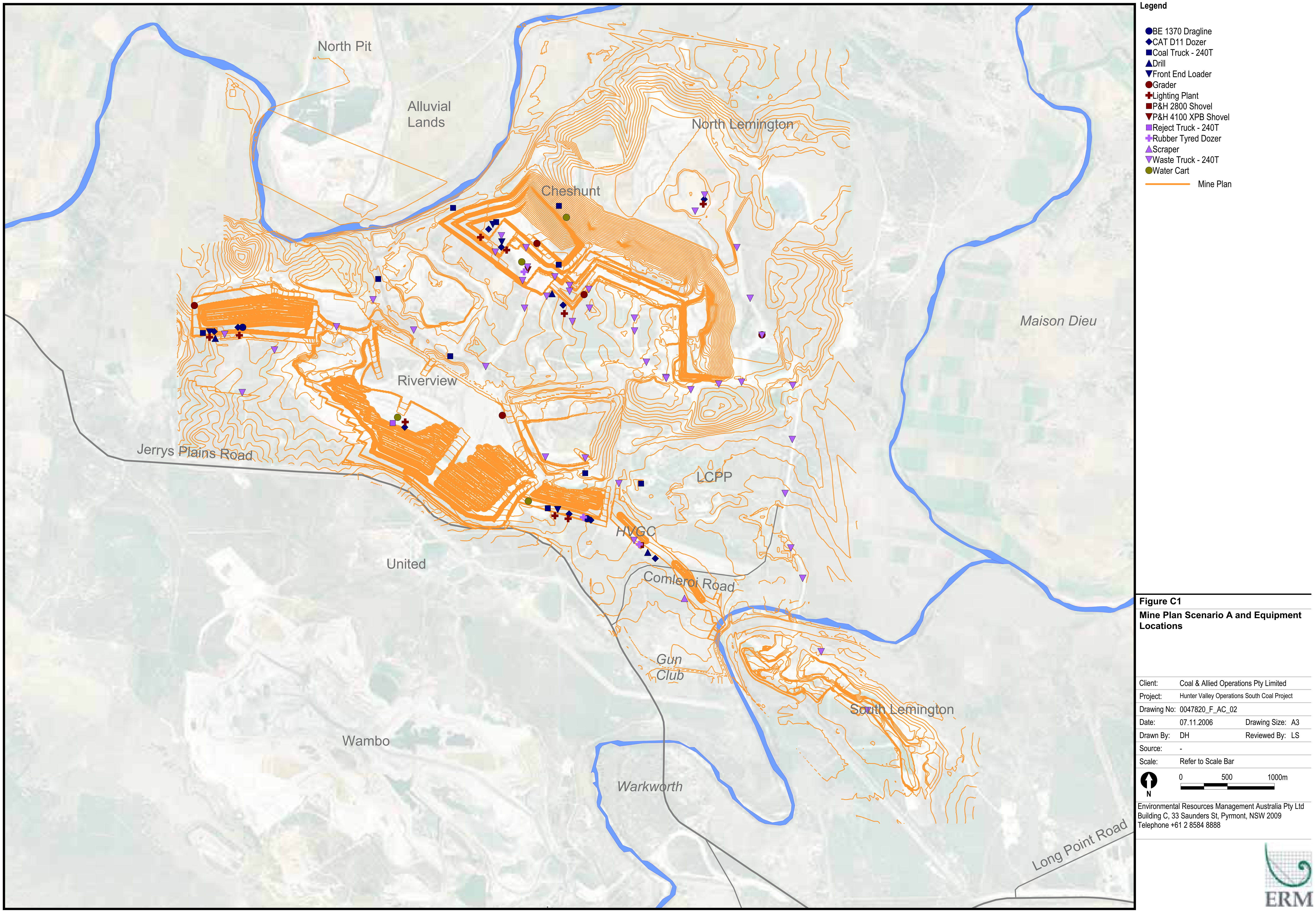


Figure C1

Mine Plan Scenario A and Equipment Locations

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_AC_02
Date:	07.11.2006 — Drawing Size: A3
Drawn By:	DH — Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

N — 0 500 1000m

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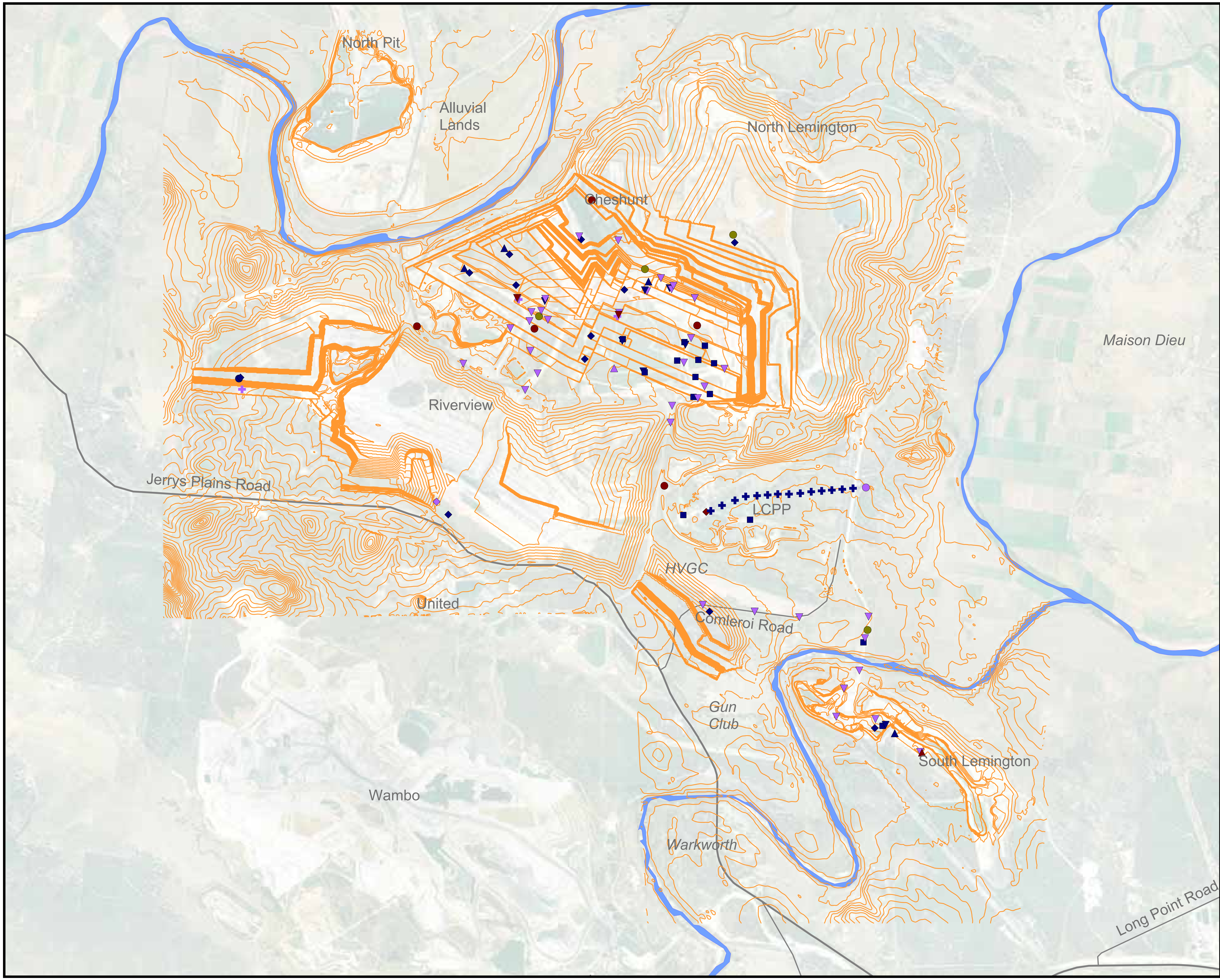
ERM



Legend

- BE 1370 Dragline
- CAT D11 Dozer
- Coal Truck - 240T
- Conveyor
- Drill
- Front End Loader
- Grader
- LCPP
- Lighting Plant
- P&H 2800 Shovel
- P&H 4100 Shovel
- P&H 4100 XPB Shovel
- Rail Loader and Locomotive
- Reject Truck
- Reject Truck - 240T
- Rubber Tyred Dozer
- Scraper
- Waste Truck - 240T
- Water Cart
- Mine Plan

Figure C2

Mine Plan Scenario B2 and Equipment Locations

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_AC_03		
Date:	07.11.2006	Drawing Size:	A3
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

N

0 500 1000m

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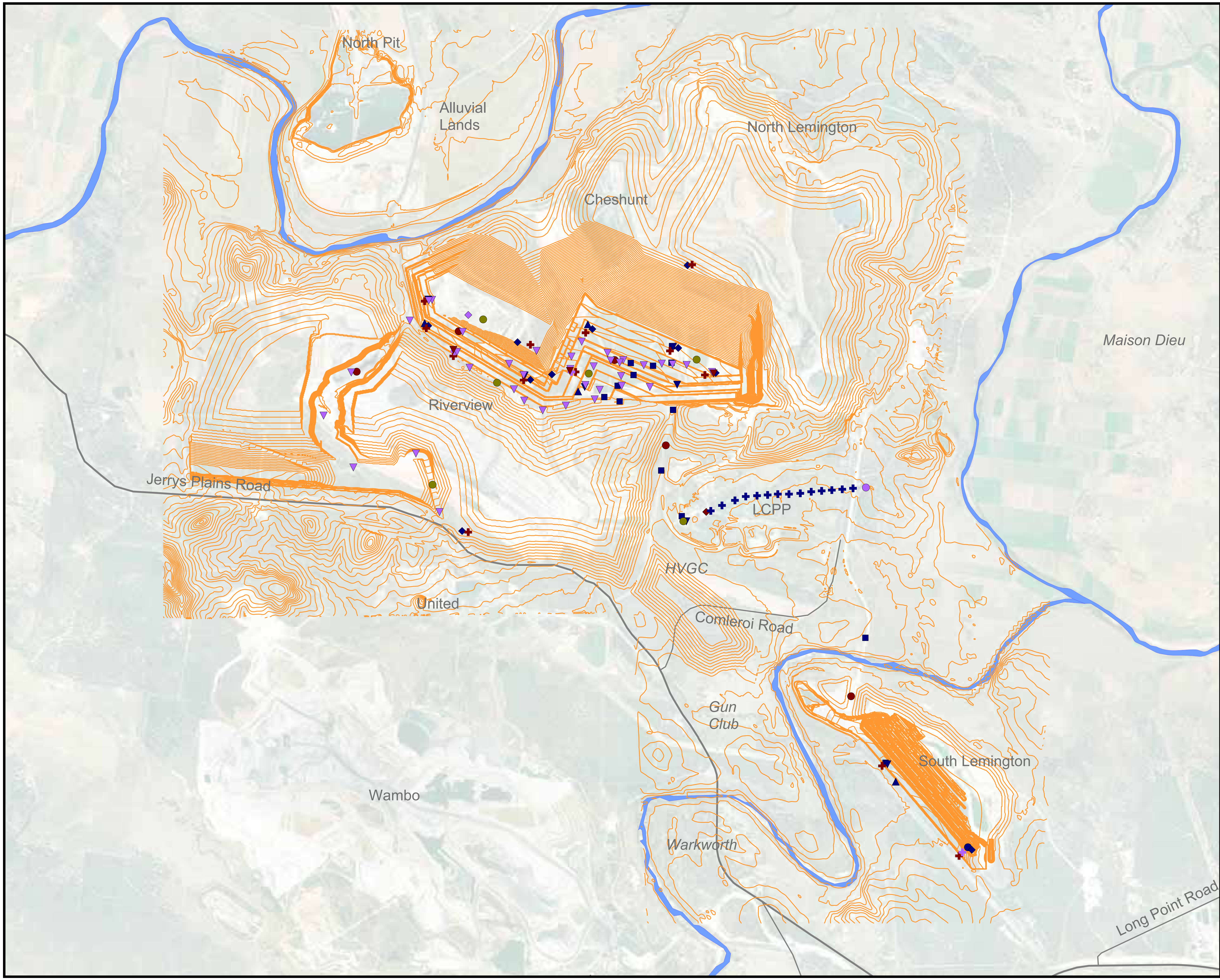
ERM



Legend

- BE 1370 Dragline
- CAT D11 Dozer
- Coal Truck - 240T
- Conveyor
- Drill
- Front End Loader
- Grader
- LCPP
- Lighting Plant
- P&H 4100 XPB Shovel
- Rail Loader and Locomotive
- Reject Truck
- Rubber Tyred Dozer
- Waste Truck - 240T
- Water Cart
- Mine Plan

Figure C3

Mine Plan Scenario C2 and Equipment Locations

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_AC_04
Date:	13.11.2006 Drawing Size: A3
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

N 0 500 1000m

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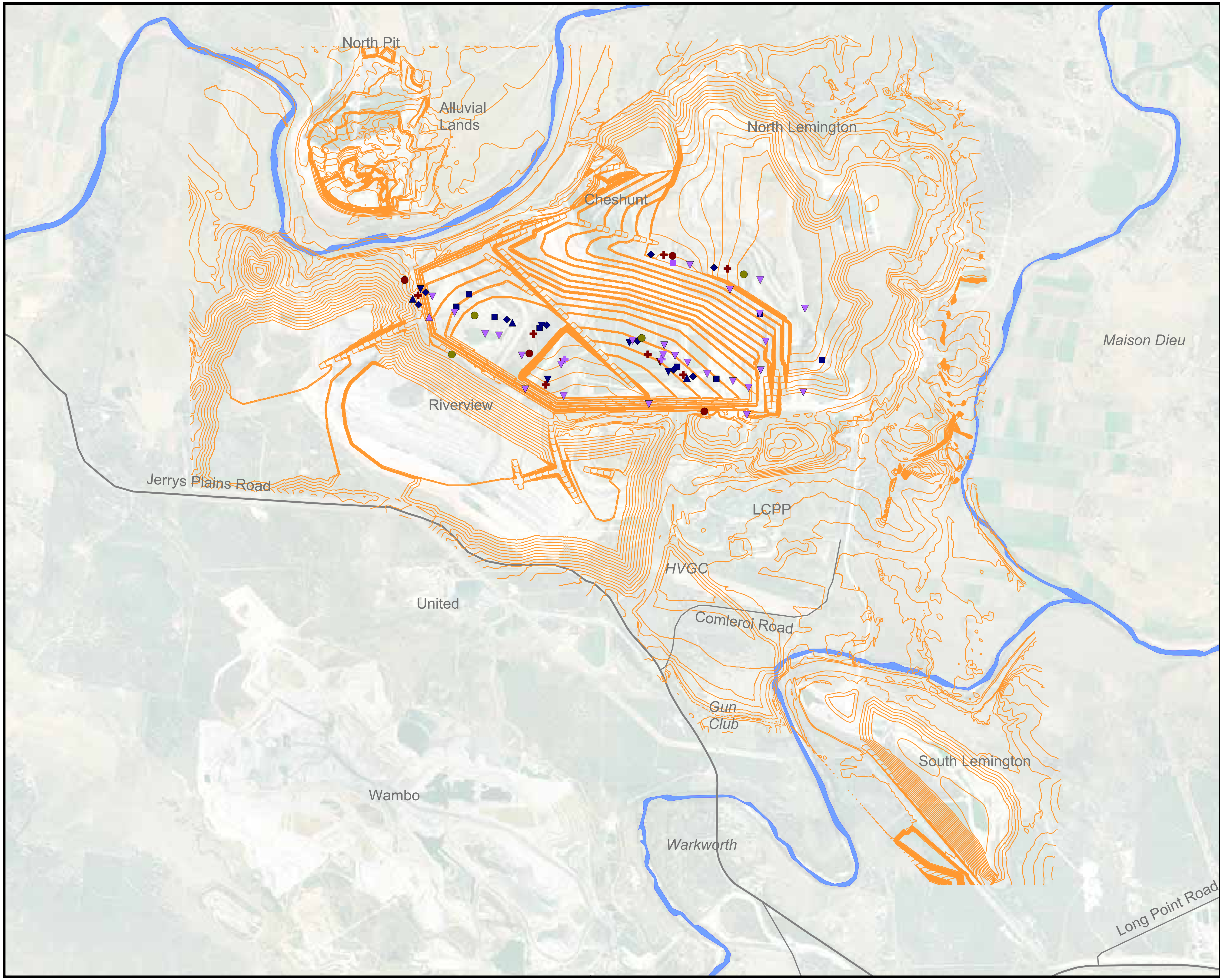
ERM



Legend

- CAT D11 Dozer
- Coal Truck - 240T
- Drill
- Front End Loader
- Grader
- Lighting Plant
- P&H 4100 XPB Shovel
- Reject Truck - 240T
- Rubber Tyred Dozer
- Scraper
- Waste Truck - 240T
- Water Cart
- Mine Plan

Figure C4

Mine Plan Scenario D and Equipment Locations

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0047820_F_AC_05		
Date:	07.11.2006	Drawing Size:	A3
Drawn By:	DH	Reviewed By:	LS
Source:	-		
Scale:	Refer to Scale Bar		

N

0 500 1000m

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ERM

Appendix D

ENM Noise Model Validation Procedure

D.1 ENM NOISE MODEL

ENM (Environmental Noise Model) is the noise modelling software that was used to predict noise levels for HVO South. Whilst the DECC approve of the ENM software and recognise it as appropriate for predictions, they also recommend that on-site validation be carried out where possible. This provides the DECC and the proponent with added confidence in the predicted noise levels. One such validation was undertaken with respect to existing noise levels as detailed in *Section 4* of this report. This relates to the 'snap-shot' method of modelling noise and indicates reasonable correlation. The following section relates to validation of the modelling software and in particular its accuracy during positive winds.

ENM utilises weather parameters and intervening topography between the source and the receiver as part of its calculation procedure. While ENM is considered to be accurate for calm weather conditions, it has been known to over predict noise levels during adverse wind conditions. Adverse source-to-receiver winds tend to create a substantial noise impact at receivers. Hence, it was necessary to investigate this phenomenon. Following are comprehensive procedures that were used to validate the ENM noise model and hence ascertain the accuracy of the modelled results under adverse source-to-receiver wind conditions.

D.2 OVERVIEW OF VALIDATION PROCEDURE

A known noise source was separately set up at three of the potential mining areas at HVO South including west and south-east of the existing Riverview Pits, and South Lemington Pit 1. While the noise source is active, hand-held Sound Level Analyser measurements were conducted to measure the noise levels generated over various distances under varying weather conditions. The weather conditions were measured simultaneously to the noise measurements by a meteorological station on-site. These meteorological parameters were then input into the ENM noise model together with the known source's sound power level to predict noise levels at the measurement locations. The modelled results were then compared with the measured results to determine a correction factor under adverse source-to-receiver winds. This correction factor was then applied to modelled results associated with the site under such winds. The data obtained from tests at South Lemington Pit 1 resulted in no adjustment to ENM. This is because the ENM predicted noise and the measured dB(A) noise were within less than 1dB of each other on average. Hence, no further discussion is provided.

D.3 NOISE SOURCE

The noise source consisted of four RCF 400A 15"Active Speakers mounted on speaker-stands 2 m above the ground. The speakers were arranged back to back facing outwards and were connected to a Yamaha CDX550 CD Player. Both the speakers and the CD player were powered by a portable 5 kVA petrol generator. A surge arrestor was also in place to avoid fluctuations in the electrical output.

The CD player played a CD containing pure tones comprising the following frequencies:

- 100 Hz;
- 200 Hz;
- 400 Hz;
- 630 Hz;
- 800 Hz; and
- 1000 Hz.

The purpose of generating noise levels at these tones is to enable the measurements at the receiver locations to be devoid of extraneous noise sources. Ambient noise in the area of the measurements was generally minimal at these frequencies and hence, the main contributor of noise at these frequencies was the speakers. However, influence of background or ambient noise was subtracted on some occasions, dependent upon the strength of the received noise.

The speakers were adjusted to almost maximum volume and with the noise source active and stable, sound pressure level measurements were taken 20 m from each speaker using 2 SVAN 912 Sound Level Analysers. The measurements consisted of narrow band noise measurements from 1Hz to 1600Hz and 1/3 octave band noise measurements. Both meters were utilised for this purpose and records were kept of the orientation of the speakers with respect to north. The GPS co-ordinates of the speaker positions were also recorded.

D.4 METEOROLOGICAL DATA

The meteorological data was provided by CNA from the HVO Cheshunt Meteorological Station. The meteorological parameters collected were one-minute samples of wind speed, wind direction, temperature, relative humidity and hourly samples of sigma-theta (standard deviation of wind direction) information which were used for determining temperature inversions. They were collected at a height of 10 m above the ground.

The meteorological station was located less than 2 km from the location of the speakers and the data collected was representative of the meteorological conditions at the noise source.

D.5 RECEIVER LOCATIONS

Noise measurements were conducted with 2 SVAN 912 Sound Level Analysers. Both meters had their times synchronised with the meteorological station and the watch of the acoustician conducting the measurement. The sound level meters were programmed to record narrow band noise levels from 1Hz to 1600Hz. This range covers the pure tones generated by the speakers at 100Hz, 200Hz, 400Hz, 630Hz, 800Hz and 1000Hz.

Typically, over a distance of 1 km with a light source-to-receiver wind (~1m/s), the noise from the lower frequencies namely, 100 Hz and 200 Hz were measurable while noise at the higher frequencies was attenuated chiefly by air absorption.

The receiver locations were selected based on several factors, namely:

- source-to-receiver winds as this is the chief phenomenon that is being investigated. Audibility of the noise source over large distances (>1 km) gave an indication of the wind direction (winds blowing in the opposite direction ie receiver-to-source winds will reduce audibility of the noise source over such distances).

- the presence of undulating ground between the source and the receiver location; and

- absence of extraneous noise sources which would mask the source noise contribution (eg passing vehicles).

D.6 *MEASUREMENTS*

The attached measurements were conducted over 2 weeks from 13th June 2006 to 17th June 2006 at the Glider Club Pit Area and from 19th June 2006 to 23rd June 2006 at the Riverview Pit Area. Measurements were conducted between 9pm and 6am when winds are expected to be generally milder. A total of 20 different receiver locations were used for measurements over this period. The receiver locations are identified in *Figure D.1*.

Approximately 570 measurements were obtained throughout the two weeks to provide a large enough sample size for analysis.

Figure D.1 Site Validation - Source and Measurement Locations

D.7 ANALYSIS OF RESULTS

The measurements were processed to filter out the noise levels measured at 100, 200, 400 , 630, 800 and 1000 Hz. Noise at each frequency was analysed to ensure that the level measured was due to the subject noise source. Measurements affected by extraneous noise sources were discarded.

Measurements were also correlated with the one-minute meteorological data from the meteorological station.

Using the meteorological conditions that correspond to each minute measurement, the ENM model was set up based on the GPS co-ordinates of the source and corresponding receivers.

The ENM model output of noise levels at each frequency band of interest (100, 200, 400, 630, 800, 1000 Hz) was filtered and was then juxtaposed with the measurement at the same meteorological condition. The result was a large variation between measured and modelled when linear minute by minute data was compared. However, consistent with the INP, batches of generally 15 minute or longer energy average and overall dB(A) data was obtained. This provided a better correlation between ENM modelling results and measured data on an overall dB(A) basis.

An example of the energy produced by the speakers at 20 m is demonstrated below.

Date	**22/06/06**							
Time	22:00							
GPS Co-ordinates of centre of speakers	309233	6399119						
Distance from speaker to measurement position	20m							
			Noise Levels dB					
SVAN SLM Serial #	Measurement Position	Narrow band File No.	100 Hz	200 Hz	400 Hz	630 Hz	800 Hz	1000 Hz
2082	1	L2	101	94	81	65	69	63
	2	L3	92	83	78	66	77	73
	3	L6	98	88	81	72	73	74
	4	L7	92	87	79	70	70	69
2226	1	L2	102	93	80	65	71	70
	2	L3	94	79	80	66	75	76
	3	L6	99	83	83	71	70	71
	4	L7	93	85	78	70	65	63

The wind conditions for which data was analysed is demonstrated in the charts below. This shows that the majority of the positive winds where generally below 3m/s.

Whilst the data trends for each frequency indicate increasing noise level with increasing positive wind speed, the gradient and correlation of these trends is low. This demonstrates that conditions (atmospheric or physical) between the source and the receiver are complex and therefore cannot simply be represented by a single set of weather parameters. This was true for minute-by-minute comparisons, however, longer averaging time resulted in better correlations as will be discussed later.

D.7.1 Riverview Pit (West) Results

Figure D.2 displays the 1-minute sample results of noise levels as measured and predicted, as well as measured wind speeds used for modelling. The wind speed data is generally below 3m/s and hence provides data assessable according to the INP. As would be expected, the ENM predictions correlate closely with wind speed, although the highest predicted noise level will not necessarily be associated with the highest recorded wind speed as it depends on the vector wind component as experienced by the receiver in a given position relative to the source.

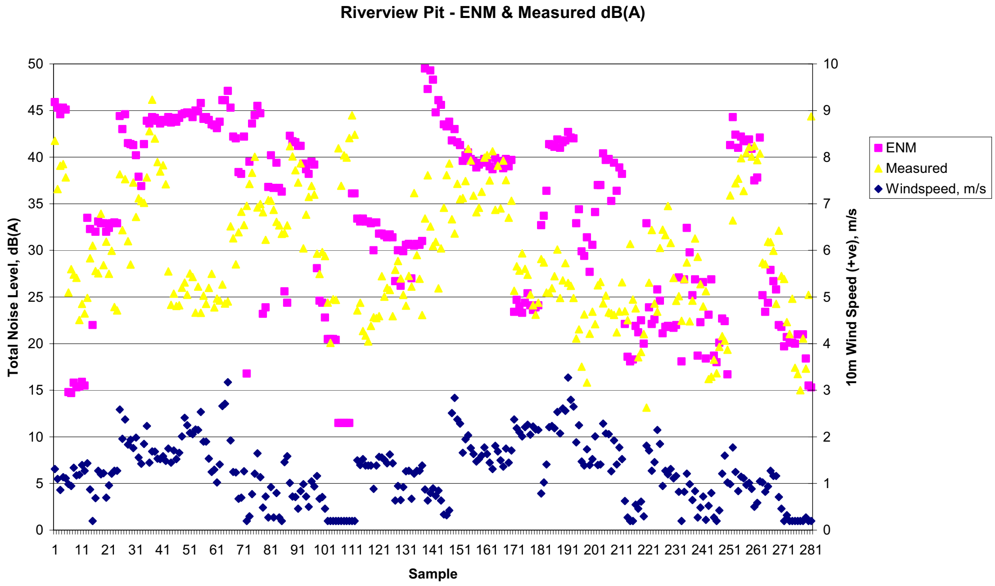


Figure D.2 Riverview Pit (West) – ENM and Measured Noise Levels for Positive Winds (1-min Data)

The Figure B.3 chart shows some correlation between ENM and Measured values with a trend in the expected direction between the two. Of importance is measured levels above 30 dB(A), or a level at or above the background noise and hence audible. For measured levels above 30dB(A) the ENM model mostly over predicts noise. Whilst there is a large spread in the data, a larger portion of this data is demonstrated to be over-predicted by ENM. The overall implication is therefore an overestimation of noise by ENM during positive winds.

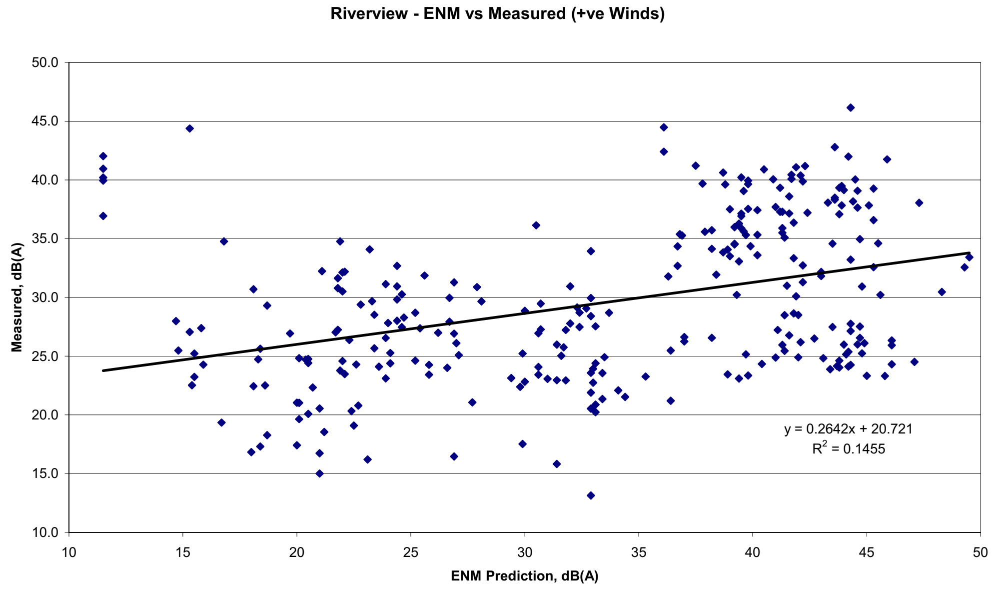


Figure D.3 *Riverview Pit (West) – ENM Vs Measured Noise Levels for Positive Winds (1-min Data)*

D.7.2 Riverview Pit (South East or Glider Club Area) Results

Figure B.4 displays the 1-minute sample results of noise levels as measured and predicted, as well as measured wind speeds used for modelling. The majority of wind speed data is below 3m/s and hence provides data assessable according to the INP. As would be expected, the ENM predictions correlate closely with wind speed, although the highest predicted noise level will not necessarily be associated with the highest recorded wind speed as this depends on the vector wind component as experienced by the receiver in a given position relative to the source.

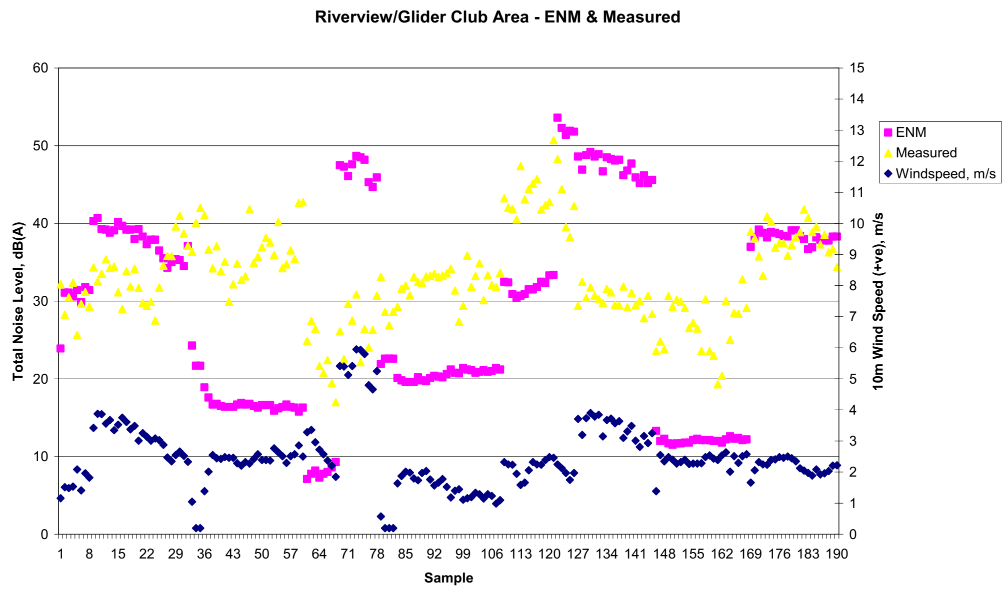


Figure D.4 *Riverview/Glider Club - ENM and Measured Noise Levels for Positive Winds (1-min Data)*

The Figure B.5 chart shows some correlation between ENM and Measured values with an increasing trend between the two. Of importance is measured levels above 30 dB(A), or a level at or above the background noise and hence audible. For measured levels above 30dB(A) the ENM model mostly over predicts noise. Whilst there is a large spread in the data, a larger portion of this data is demonstrated to be over predicted by ENM. The overall implication is therefore an overestimation of noise by ENM during positive winds.

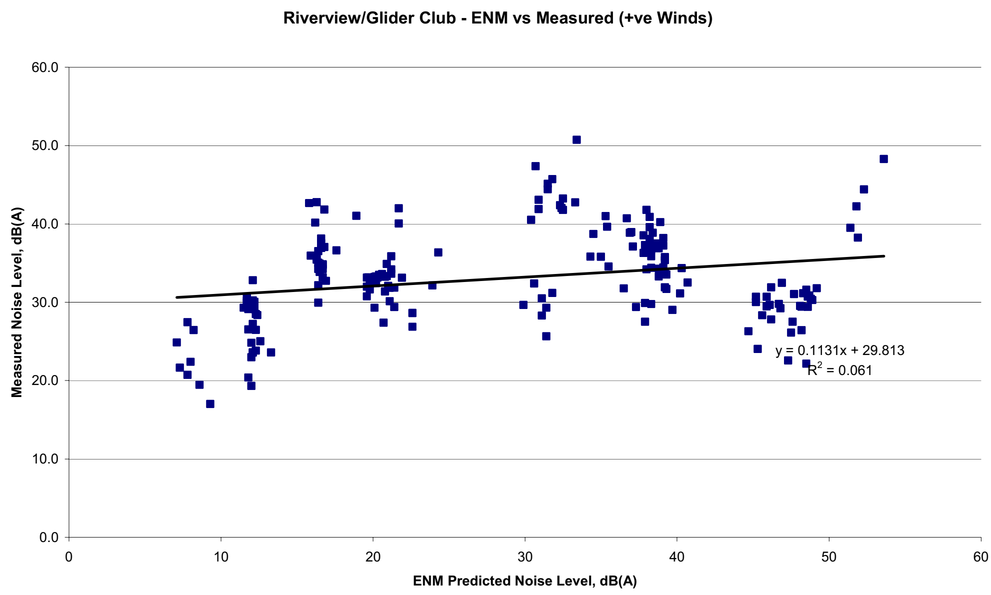


Figure D.5 *Riverview/Glider Club – ENM Vs Measured Noise Levels for Positive Winds (1-min Data)*

D.8 ENM MODEL VALIDATION FACTOR

The measured and modelled data was analysed for periods of generally 15 to 20 minutes for a given location. This provided data points for comparison as shown in Tables B.1 and B.2 below. The data shows some good correlation between ENM and Measured values or within ±5dB as documented by the software developer.

Of note is that two-thirds of the data are over-predictions by ENM. The overall implication is therefore an overestimation of noise by ENM during winds.

An analysis of the entire data points results in a modest over estimation by ENM of 1.6dB and 2.2 dB, on average, for the two areas respectively. This was therefore applied to modelling results for the proposed operations for equipment in these two areas only.

Table D.1 Riverview (West) Validation Factor Calculation

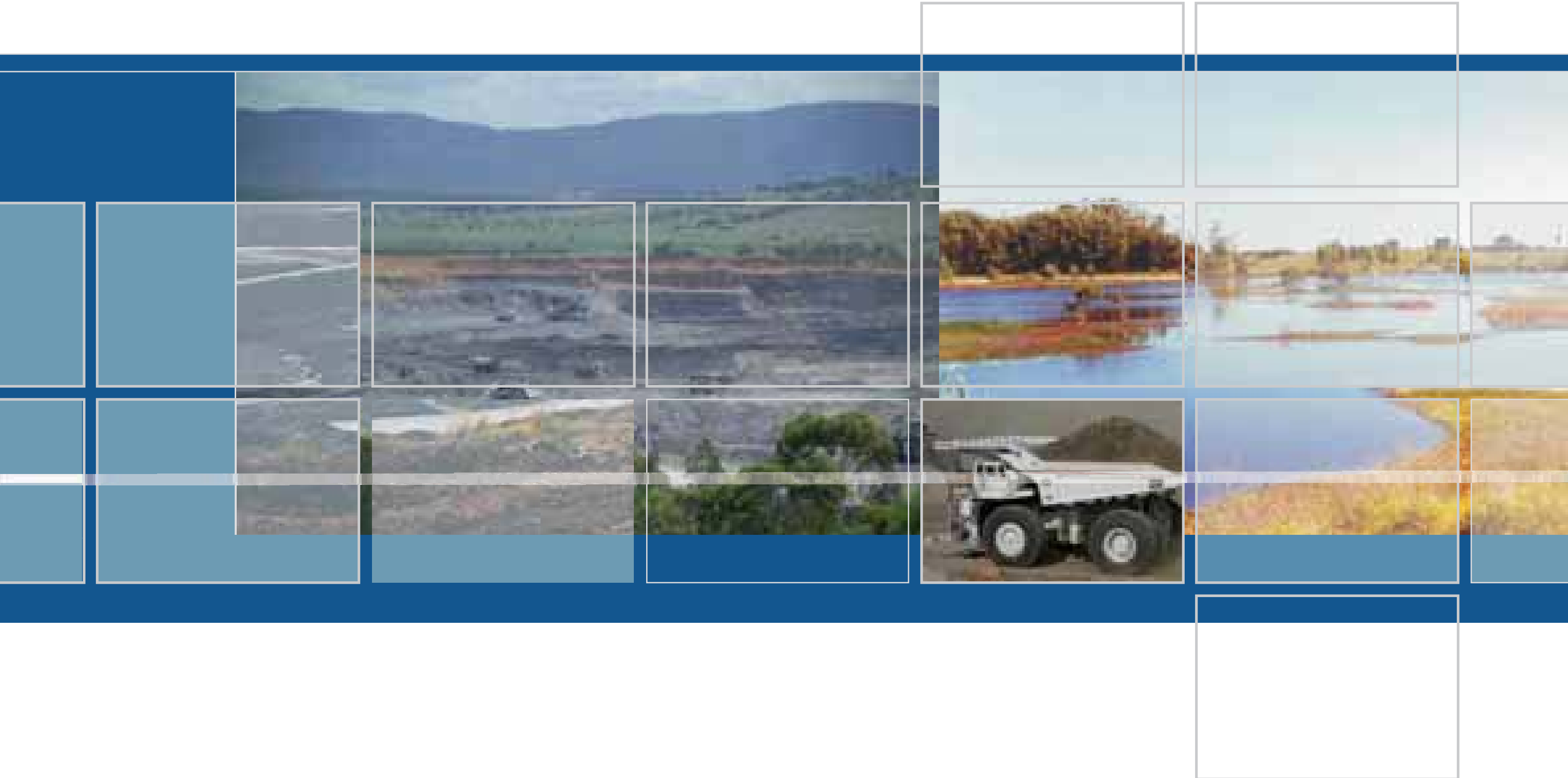
	Total Noise Level, dBA		ENM Minus Measured, dB(A)	
15-20minute Sample	**ENM**	**Measured**	**Over-Prediction**	**Under- Prediction**
1	45.3	39.3	6.0	
2	15.4	25.9		-10.5
3	32.1	29.9	2.1	
4	32.7	28.2	4.5	
5	42.1	35.6	6.5	
6	43.9	40.7	3.2	
7	44.4	25.9	18.5	
8	44.7	24.8	19.9	
9	45.0	25.3	19.7	
10	41.4	32.7	8.7	
11	44.0	37.5	6.5	
12	23.6	32.9		-9.3
13	38.0	34.0	4.0	
14	25.0	32.3		-7.3
15	41.6	39.5	2.1	
16	39.0	35.1	3.9	
17	25.4	29.2		-3.7
18	20.5	23.9		-3.4
19	11.5	40.3		-28.8
20	36.1	43.6		-7.5
21	32.9	22.4	10.4	
22	31.0	26.3	4.8	
23	30.0	29.3	0.6	
24	46.7	35.1	11.7	
25	40.8	36.9	3.8	
26	39.4	38.4	1.0	
27	39.3	46.5		-7.2
28	24.3	28.0		-3.7
29	23.9	24.3		-0.4
30	49.8	27.8	22.0	
31	52.1	37.1	15.0	
32	31.8	21.2	10.6	
33	38.5	34.8	3.7	
34	25.1	24.3	0.8	
35	22.9	30.3		-7.4
36	28.3	25.6	2.7	
37	23.9	27.4		-3.5
38	22.1	19.1	3.0	
39	42.3	37.2	5.2	
40	40.7	40.5	0.2	
41	34.2	29.0	5.2	
42	20.1	22.1		-2.0
43	19.3	36.7		-17.3
		Total Samples	**29**	**14**
		Average Difference		**2.2**

The Average Difference value is that for the combined over and under ENM predictions, and is the adopted Validation Factor for this area.

Table D.2 Riverview/Glider Club Area Validation Factor Calculation

	Total Noise Level, dBA		ENM Minus Measured, dB(A)	
15-20minute Sample	**ENM**	**Measured**	**Over-Prediction**	**Under- Prediction**
1	30.0	31.1		-1.1
2	31.2	29.4	1.8	
3	47.2	38.8	8.4	
4	46.9	37.1	9.8	
5	48.4	38.1	10.3	
6	47.8	33.6	14.2	
7	39.8	37.0	2.8	
8	42.7	37.3	5.4	
9	47.3	42.6	4.7	
10	39.7	33.5	6.2	
11	38.5	31.9	6.6	
12	35.9	37.2		-1.3
13	20.2	38.6		-18.4
14	16.6	36.0		-19.4
15	16.3	38.9		-22.6
16	8.1	23.7		-15.6
17	57.1	36.3	20.8	
18	57.9	32.6	25.3	
19	44.6	27.6	17	
20	20.7	32.0		-11.3
21	21.0	32.8		-11.8
22	32.0	44.9		-13
23	52.3	44.1	8.2	
24	45.8	37.0	8.8	
25	40.6	37.2	3.4	
26	48.1	43.2	4.9	
27	48.5	30.8	17.7	
28	46.5	29.9	16.5	
29	12.0	28.1		-16
30	16.2	27.9		-11.7
31	38.5	37.9	0.6	
32	38.0	38.7		-0.7
		Total Samples	**20**	**12**
		Average Difference		**1.6**

The Average Difference value is that for the combined over and under ENM predictions, and is the adopted Validation Factor for this area.



Annex I

HVO South Coal Project, Air Quality Assessment Report,
Holmes Air Sciences, 2008

Final

AIR QUALITY ASSESSMENT: HUNTER VALLEY OPERATIONS SOUTH COAL PROJECT

January 2008

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GLOSSARY

Air-NEPMs	National Environment Protection Measures for Ambient Air Quality
bcm	bank cubic metre
CPP	coal preparation plant
CH_4	methane
CL	coal loading
CNA	Coal & Allied Operations Pty Limited
CO_2	carbon dioxide
DECC	Department of Environment and Climate Change
EIS	Environmental Impact Statement
EMS	Environmental Management System
Equivalent aerodynamic diameter	the diameter of a spherical particle with a density of one gram per cubic centimetre that behave in the air in the same way as the particle in question
ERM	Environmental Resource Management
ESD	ecologically sustainable development
FEL	front end loader
HCPP	Howick Coal Preparation Plant
HVAS	High Volume Air Sampler
HVO	Hunter Valley Operations
HVO South	Hunter Valley Operations south of the Hunter River
HVCPP	Hunter Valley Coal Preparation Plant
IPCC	Intergovernmental Panel on Climate Change
ISCMOD	Industrial Source Complex Model (Modified Version)
LCPP	Lemington Coal Preparation Plant
PM_{10}	Particulate matter with equivalent aerodynamic diameter of 10 μm
$PM_{2.5}$	Particulate matter with equivalent aerodynamic diameter of 2.5 μm
Mtpa	Million tonnes per annum
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
N_20	Nitrous Oxide
NSW DECC	New South Wales Department of Environment and Climate Change
OB	overburden
ROM	run of mine
TSP	Total suspended particulate (matter)
WE	wind erosion
US EPA	United States Environmental Protection Authority
$\mu g/m^3$	microgram/cubic metre
μm	micron (millionth of a metre)
VKT	vehicle kilometres travelled

EXECUTIVE SUMMARY

Coal & Allied Operations Pty Limited (CNA) propose to undertake an environmental assessment and prepare a Project Application under Part 3A of the *Environmental Planning and Assessment Act 1979.* The purpose of the environmental assessment and Application is to allow for the replacement of the existing consents, infrastructure upgrades, modifications and extension to mining at Hunter Valley Operations south of the Hunter River (HVO South) and ultimately to obtain a single Project Approval for the operations.

This study assesses the air quality impacts of the continuation of mining by considering a number of proposed operating scenarios. These scenarios are intended to illustrate the scale of air quality impacts expected to occur.

The assessment has been conducted using a modified version of the Industrial Source Complex Model (ISCMOD), with local meteorological data and estimates of the emissions associated with mining. Model predictions include emissions from a range of nearby mines and an allowance for background emissions of particulate matter from non-mining sources.

Existing air quality has been reviewed using data collected by CNA's network of dust monitors, which include dust deposition gauges, Total Suspended Particulate (TSP) and PM_{10} monitors. These data have been used to assess the performance of the ISCMOD model in relation to predictions of TSP and PM_{10} concentrations. This has been has been done by using the model to predict the rate of dust deposition and TSP and PM_{10} concentrations at the locations where monitoring is undertaken. The results show that the model tends to overestimate annual average PM_{10} concentration by approximately 6% and to underestimate annual average TSP concentrations. A regression equation has been used to adjust the annual TSP concentrations upwards to make sure that the predicted levels better match the measured values and the assessment has been based on the adjusted predictions.

The assessment indicates that residences in the Maison Dieu area to the east of the proposed mining area are predicted to experience 24-hour PM_{10} concentrations above the NSW Department of Environment and Climate Change's (DECC) 50 $\mu g/m^3$ concentration on occasions and these potential impacts will need to be mitigated by a real time dust management plan. Annual average PM_{10}, TSP concentrations, and annual average deposition levels are predicted to comply with the DECC's assessment criteria in the Maison Dieu area.

Some locations to the southeast of the mine are predicted to experience cumulative impacts above the DECC's assessment criteria, but the contribution that HVO South makes to these is relatively minor. It is important to note that residences within Warkworth Village are either within a zone of affectation, subject to a private land holder's agreement with mines other than HVO or owned by mining companies other then CNA.

1 INTRODUCTION

This report has been prepared by Holmes Air Sciences on behalf of Environmental Resources Management Australia (ERM). Its purpose is to assess the air quality effects of the proposed continuation and extension of mining and associated operations in CNA's operations south of the Hunter River (HVO South)

2 IDENTIFICATION OF ISSUES

The project will result in the liberation of particulate matter in the form of fugitive emissions arising from handling of soil, overburden, interburden and coal, from the combustion of diesel fuel in mining equipment and from the use of explosives. In addition, there will be emissions of gases including carbon monoxide, nitrogen oxides and sulphur dioxide from diesel powered equipment and from blasting. In practice, the sources of gaseous emissions on opencut mines are too small and too widely dispersed for there to be a significant risk that the assessment criteria for these pollutants will be exceeded. Thus, the focus of this assessment is on the potential for emissions of particulate matter to give rise to concentrations or deposition rates above the air quality assessment criteria set by the DECC (see *Section 5*). The effects of gaseous emissions are not assessed in detail.

There is no history of spontaneous combustion at HVO. The potential for a spontaneous combustion event resulting from the proposal is negligible given the nature of the coal seams being mined. However, if an event did take place, management procedures outlined in CNA EMS Spontaneous Combustion Procedure would be implemented.

3 LOCAL SETTING AND BACKGROUND

The project area is located within a mining and agricultural region and is surrounded by:

- Bayswater Power Station, Liddell Power Station and the Liddell Mine, Cumnock No. 1 Colliery, Ravensworth Coal Mine, Mt Owen, Ravensworth East and grazing land to the north;
- Irrigated and grazing agricultural land to the east;
- United, Wambo and Mount Thorley and Warkworth mines and Warkworth Village to the south; and
- Grazing land and the village of Jerrys Plains to the west.

These mines and the main infrastructure that service the area are shown in *Figures 1 and 2*. The terrain in the project area is shown in *Figure 3*.

The mining and processing activities at HVO are managed by CNA as one operation and are geographically divided by the Hunter River, with general nomenclature for the two areas being HVO North and HVO South. The two areas operate independently, but there is some interaction between the two. The focus of this assessment is on the operations south of the river, but emissions from mining north of the river and from other mines not operated by CNA are also included.

HVO has developed because of expansion and acquisition and is now comprised of six areas;

1. West Pit;
2. Carrington Pit;
3. The Alluvial Lands and North Pit;
4. Cheshunt Pit;
5. Riverview Pit; and
6. South Lemington (Pits 1 and 2).

West Pit, Carrington, The Alluvial Lands and North Pit are part of HVO North, and Cheshunt, Riverview and South Lemington Pits are part of HVO South.

4 APPROACH TO ASSESSMENT AND DEFINITION OF THE PROPOSAL

4.1 Overview

The mining that is the subject of this assessment will be confined to the opencut pits referred to as Cheshunt, Riverview and South Lemington (Pits 1 and 2) (see *Figure 1*). Coal could be processed in the Hunter Valley Coal Preparation Plant (HVCPP) or the Lemington Coal Preparation Plant (LCPP), which may be recommissioned and upgraded (to 16 Mtpa capacity).

The proposal envisages that the mine will retain a considerable degree of flexibility in the way that it can be operated and some flexibility in the sequence of mine development. This is being done so that CNA can respond to changing market conditions. It will also enable the mines to share infrastructure to improve efficiency.

Each opencut pit will be developed in accordance with mine plans, which have been developed taking account of geological and engineering constraints. However, the relative rate at which each pit will be mined, the equipment to be used in mining and the CPP used to process the coal from a given pit will not be fixed. This creates challenges for the assessment process and the approach taken has been to review the overall objectives of the mine's development up to a nominal period taken to be 2029. Within this period, a number of worst case scenarios have been selected for assessment. All scenarios involve mining in the same areas and recovering the same coal. The main differences are in the rate at which mining takes place. To identify the worst case scenarios the periods where the mining rate is greatest were reviewed. These were then assessed to identify those areas that involved mining closest to dust sensitive locations bearing in mind that the prevailing winds would carry dust mainly to the southeast or northwest of the mining areas. This meant that scenarios were selected which would be expected to give rise to maximum effects in the Maison Dieu area and the Warkworth Village area. In practice, residences to the northwest were too far away to be significantly affected by emissions from the areas covered by this assessment.

In practice, this approach is similar to the normal assessment process where a particular mine development plan is assessed at a set of strategically selected years, chosen to represent the impact of the mine over its life. The assessment results are used to define the area likely to be affected by emissions from the mine over its life. The main difference is that the timing of impacts is not known. This could be important for neighbouring mines where cumulative impacts depend on the relative positions of different mining areas at any particular time. To overcome this, it is necessary to introduce some additional conservativeness in the assessment. Emissions from neighbouring mines were taken from information published in Environmental Impact Statements (EISs) where it was assumed that emissions from neighbouring mines would be those that applied for the years closest to the years being modelled for HVO South.

The general locations of the future sources of dust over the assessment period are shown in *Figure 2*, which also shows the locations of the dust sensitive areas. The prevailing winds are discussed in *Section 6.2.1*, but for the moment, it is only necessary to note that over the year winds blow predominantly from the northwest or southeast. Northwesterly winds are most common in winter and southeasterlies in summer. This means that most dust will be transported to the southeast or northwest of the sources of dust.

The project will also involve the relocation of the Hunter Valley Gliding Club, whose airfield would be reconfigured as a result of extending the eastern part of the Riverview Pit. The relocation will involve relatively minor earthworks compared with the mining operations and no special air quality assessment is required for these works.

The mine development plans require flexibility in the selection of equipment used in the mining operations. It may be necessary to employ up to two draglines and two large shovels or one dragline and three large shovels.

To see how significant this choice may be it is useful to consider the following. The emission factor (quantity of dust generated per unit operation) for a dragline moving overburden can be calculated using Equation 1 (see *Appendix A*). The emission factor is 0.032 kg/bcm. Thus, the handling of 1 Mbcm of overburden would result in the liberation of 32,000 kg of TSP[1].

If this same operation were to be undertaken using a shovel to load a fleet of 240 t trucks to haul the material over a 3 km (return) distance and the density of overburden was 2.4 t/bcm then the total TSP liberated would be:

- loading and unloading 2.4 Mt of overburden (1 Mbcm) would liberate 9,600 kg [2 x 2.4 x 10^6 t x 0.002 kg/t]; and

- transporting of overburden 30,000 kg [2.4 Mt / 240 t/load x 3 km/trip x 1 kg/VKT].

The total TSP emission would be 39,600 kg.

It can be seen that the difference in dust generation between dragline use and truck and shovel fleet use is small. It will be apparent that the comparison presented above depends strongly on the distance assumed for hauling to the emplacement area. If very long haul distances are required then the dragline will generate less dust, but the dragline by itself is not capable of transferring overburden much further than 200 m. Therefore, it would usually not be feasible to use a dragline if long haulage of overburden is required and so the assumption that the haul distance is only 3 km return is reasonable. Also, for the HVO South project, it should be noted that the 240 t trucks may be replaced by larger, ultra-class trucks, and so there would be less VKT travelled than in the example. Modelling was undertaken assuming 240 t trucks. This represents a worst-case assumption.

Finally, it should be noted that at any particular time, a dragline will be a well defined source of dust. By contrast, a truck and shovel fleet operation will be a more diffuse source, with most of the dust being generated along a 3 km or (2 x 1.5 km) haul route. This will result in a more diffuse emissions source and lower maximum short-term concentrations at any particular location.

In general, truck and shovel operations are more flexible because it is usually possible to vary the emplacement area as meteorological conditions change. Thus, the air quality at a particular residence can be protected without shutting down the operation. By contrast, a dragline operation cannot be re-located at short notice so is not as easy to manage in unfavourable weather. However if the dragline has sufficient capacity to allow its operation to be suspended during unfavourable weather, then it is possible to manage air quality using shutdowns when adverse winds occur or when measured dust concentrations occur.

For the purpose of this study, it has been assumed that the dragline and truck and shovel options are indistinguishable in the air quality impacts that they create. To take account of the matters discussed above it is understood that if a dragline were to be employed then it would be necessary to have procedures that would allow dragline operations to be suspended if emissions were to cause impacts in an area that was sensitive to dust.

The mine plan also envisages some high-wall mining. This is not explicitly included in the modelling assessment because this method of mining produces less dust than conventional opencut mining and consequently the assumption that all mining is conventional opencut mining is conservative.

Table 1 and *Figure 2* identifies the residences that are potentially impacted by dust and for which detailed assessments have been undertaken. There are three groups. The first group is located in the Maison Dieu area, the second is in the Warkworth Village area and the third group is to the west along the Jerrys Plains Road. In addition, there are four isolated rural Locations 7, 8, 10 and 13 (see *Figure 2*).

[1] TSP refers to all particulate matter measured by a high volume air sampler. The lower size cut-off is smaller than 0.3 μm. The upper size cut-off is not precisely defined and varies with wind speed and the angle that the wind makes with the sampling unit. Typically the upper size range is considered to be 30 to 50 μm.

Table 1. Surrounding Assessment Locations used for Modelling Purposes			
Location		MGA56 Coordinates	
No.	Name	Easting	Northing
Locations at Maison Dieu (East)			
5	Bowman	317887	6399172
16	Algie	318128	6397347
17	Algie	318352	6398192
24	Clifton and Edwards	318153	6398497
32	Algie (Curlewis)	317982	6397802
34	Ernst	318530	6397994
47	Moxey	317979	6399821
61	Shearer	318014	6399408
Locations at Warkworth (South)			
23	Hawkes (Springwood)	313989	6392994
33	Edward and Haynes	314699	6394353
38	Henderson	315584	6393898
43	Kannar	314648	6394680
45	Kelly	314149	6394563
Locations west along Jerrys Plains Road (West)			
3	Elisnore	305416	6401053
4	Muller	305950	6399615
13	Jerrys Plains Centre	303535	6402851
19	Birralee Feeds Pty Ltd	305655	6400600
31	Cooper (Kilburnie)	305953	6399990
36	Garland	306139	6399895
Isolated Locations			
7	Stapleton (Cheshunt) – North East	315919	6403004
8	Holz (Oaklands) - North	313711	6403979
10	Moses (Wandewoi) – North West	306970	6402069
1. Location No. is consistent with the HVO West Pit consent (DA 450-10-2003).			

Three scenarios (see *Figure 5*) have been selected to illustrate the worst case impacts in each of these areas. In addition, 2006 has also been modelled so that predicted concentrations can be compared with measured values. This provides a reference point that enables the performance of the model to be assessed. The scenarios are described below:

4.2 Existing situation

Production conditions as they have been in 2006 have been modelled. This involves mining in the Cheshunt and Riverview Pits with Run of Mine (ROM) coal being hauled to the HVCPP. The following summarises the production levels:

Cheshunt
ROM coal production 3,155,109 t
Overburden production truck and shovel (prime) 18,641,411 bcm
Overburden production truck and shovel (rehandle) 351,763 bcm

Riverview
ROM coal production 2,767,507 t
Overburden production truck and shovel (prime) 7,918,300bcm
Overburden production truck and shovel (rehandle) 0 bcm
Overburden production via dragline (prime) 10,431,041 bcm
Overburden production via dragline (rehandle) 5,916,191 bcm
Overburden via throw blasting 454,759 bcm

4.3 Mine Plan A approximately 2010

In Mine Plan A, mining will occur in the Cheshunt and Riverview Pits, the following summarises the production levels:

Cheshunt
ROM coal production 4,900,000 t
Overburden production truck and shovel (prime) 22,000,000 bcm
Overburden production truck and shovel (rehandle) 173,026 bcm

Riverview (Western and Eastern towards South Lemington Pit 2)
ROM coal production 5,700,000 t
Overburden production truck and shovel (prime) 7,593,301 bcm
Overburden production truck and shovel (rehandle) 38,242 bcm
Overburden production via dragline (prime) 22,000,000 bcm
Overburden production via dragline (rehandle) 7,700,000 bcm
Overburden via throw blasting 1,500,000 bcm

4.4 Mine Plan B1 approximately 2014

In Mine Plan B1, mining will occur in the Cheshunt, Riverview and South Lemington Pit 1, the following summarises the production levels:

Cheshunt
ROM coal production 10,625,000 t
Overburden production truck and shovel (prime) 42,500,000 bcm
Overburden production truck and shovel (rehandle) 800,000 bcm

Riverview
ROM coal production 4,250,000 t
Overburden production truck and shovel (prime) 0 bcm
Overburden production truck and shovel (rehandle) 74,242 bcm
Overburden production via dragline (prime) 22,000,000 bcm
Overburden production via dragline (rehandle) 7,700,000 bcm
Overburden via throw blasting 1,500,000 bcm

South Lemington Pit 1
ROM coal production 50,000 t
Overburden production truck and shovel (prime) 170,000 bcm
Overburden production truck and shovel (rehandle) 10,000 bcm

4.5 Mine Plan C1 approximately 2019

In Mine Plan C1, mining will occur in the Cheshunt Pit, the following summarises the production levels:

Cheshunt
ROM coal production 10,625,000 t
Overburden production truck and shovel (prime) 42,500,000 bcm
Overburden production truck and shovel (rehandle) 797,062 bcm

South Lemington Pits 1 and 2 and Riverview
Mining at South Lemington Pits 1 and 2 and Riverview will be completed by 2019 although some overburden emplacement would be taking place in Riverview.

5 AIR QUALITY ASSESSMENT CRITERIA

In its guidelines, the DECC (DECC, 2005) specifies air quality assessment criteria relevant for mining. Three categories of particulate matter need to be considered. These are TSP[2], PM_{10} [3] and deposited dust (insoluble solids)[4].

The assessment criteria for these are summarised in *Table 2*. Where relevant, these criteria are have been made consistent with the National Environment Protection Measures (NEPM) for Ambient Air Quality (referred to as the Ambient Air-NEPMs (see NEPC, 1998)). However, the DECC's criteria include averaging periods, which are not included in the Air-NEPMs and references to other measures of air quality, namely dust deposition and TSP, which are also not part of the Air-NEPMs.

Table 2: DECC Air Quality Assessment Criteria

Pollutant	**Averaging period**	**Concentration**	
NSW DECC Impact assessment criteria for pollutants (for use in modelling)			
PM_{10}	24 hour Annual	50* µg/m^3 30 µg/m^3	
NSW DECC amenity based criteria for dust concentrations - TSP			
TSP	Annual	90 µg/m^3	
NSW DECC amenity based criteria for dust fallout – Deposited Dust			
		Maximum increase in deposited dust level	**Maximum total deposited dust level**
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

Note: for mining projects, which are committed to the application of best practice controls, the 50 µg/m^3 is often applied as an incremental goal applicable to assessing the effects of emissions from the project alone. This goal would normally be provided in the conditions of consent.

The National Environmental Protection Council (NEPC) has published an advisory NEPM for $PM_{2.5}$ (NEPC, 2002). The numerical values for $PM_{2.5}$ NEPM are:

- 8 µg/m3 – annual average; and
- 25 µg/m3 – maximum 1-day average.

At this stage, the proposed advisory $PM_{2.5}$ standard is not part of the NSW DECC assessment criteria and for this reason is not considered further in the assessment.

The suite of ambient air quality criteria used in the assessment is comprehensive and would be expected to protect against all harmful effects of emissions from the proposal including health and nuisance effects.

[2] TSP refers to all particles suspended in the air. In practice, the upper size range is typically 30 to 50 µm.

[3] PM_{10} refers to all particles with equivalent aerodynamic diameters of less than 10 µm, that is, all particles that behave aerodynamically in the same way as spherical particles with unit density.

[4] Deposited dust is measured using a funnel of known cross-section area, which captures dust that falls out of the atmosphere or is washed out, by rain. The captured material is fed to a bottle, the contents of which are collected and analysed in a laboratory at nominal monthly intervals.

6 REVIEW OF EXISTING ENVIRONMENT

This section provides a description of the meteorological and air quality monitoring programmes operated by CNA in the study area and provides a review of the data. The main objective of the review is to establish existing air quality conditions and to identify the best source of meteorological data to be used in the assessment. In a green-fields development, or a wholly new development, the monitoring data would provide an indication of baseline conditions onto which emissions from the proposal would be added.

The current proposal is essentially a continuation of existing operations and so the assessment is more complicated. It is not possible to add the effects of the proposal onto the existing background. This is because the existing operations, which will be continued as part of the proposed operations, are already contributing to the current background. However, the review of air quality monitoring data is useful in showing the extent to which the existing operations are affecting air quality and indicating the accuracy of the modelling methodology.

6.1 Description of monitoring programmes

6.1.1 Meteorological monitoring

Meteorological data are collected at six locations, two of which are relevant for this study. The locations of the two stations and the parameters recorded are summarised in *Table* . The station locations are also shown on *Figure 4*.

Table 3. Summary of meteorological monitoring sites

Station name	MGA Coordinate (mE)	MGA Coordinate (mN)	Parameters recorded
Cheshunt	314776	6398518	Wind speed Wind direction Sigma-theta (since January 2006) Temperature
Corporate Centre Hunter Valley Operations	310206	6406171	Wind speed Wind direction Sigma-theta (up to December 2002) Temperature

In addition to the CNA meteorological data, it is useful to refer to long-term climatic data. The Bureau of Meteorology's monitoring station at Jerrys Plains has been used for this purpose. The Jerrys Plains station has been in operation since 1884 and collects data on rainfall, temperature and humidity among other parameters.

6.1.2 Air quality monitoring

The CNA air quality network has evolved over time. The monitoring sites, including some of which are no longer operational, but which are still of interest for this study, are shown on *Figure 4*. They include 24 dust deposition gauges measuring the monthly average rate of dust deposition, 13 High Volume Air Samplers (HVAS), seven of which measure (or measured) 24-hour average TSP concentrations, and six of which measure 24-hour average concentrations of PM_{10}. Currently there are 12 HVASs measuring either TSP or PM_{10} every sixth day.

6.2 Review of meteorological data

6.2.1 Wind speed and wind direction

A modified version of the United States Environmental Protection Agency's (US EPA) computer-based dispersion model ISCST3[5] (ISCMOD see later) has been used in this study to assess the dispersion of particulate matter. Meteorological data are required as input to the model.

Data are available from a number of sites including two meteorological stations operated by CNA at the locations shown in *Figure 4*. Data from the Corporate Centre HVO station covering the twelve-month period 1 January 2002 to 31 December 2002 have been used for the current study. A total of 8,736 hours of data were available for this period. This corresponds to 99.7% of the data potentially available in a year. As discussed below, the distribution of winds for this year of data was consistent with long-term patterns observed in the central parts of the Hunter Valley. The reason for using the 2002 data is that it included information on sigma-theta[6] (the standard deviation of horizontal wind direction), which can be used to derive the prevailing atmospheric stability class, which is an important parameter in determining the rate at which a plume will disperse. Sigma-theta data are not currently collected at this site.

The Cheshunt Meteorological station is also suitably located from the point of view of dispersion modelling for the area. However, the Cheshunt meteorological station has only recently been equipped to monitor sigma-theta and a full year of data is not yet available.

Given the importance of wind speed and wind direction in determining the transport and diffusion of dust emissions it is interesting to compare the pattern of winds at the two sites. It is also interesting to be able to explore the degree of variation in wind direction and speed from one year to the next. *Figure 6* shows annual wind roses prepared from the HVO data for the years 2002 to July 2006 and for the Cheshunt meteorological station for the period January 2006 to July 2006. The figures also show the annual average wind speed over the periods. It can be seen that the Cheshunt site experiences a higher wind speed than does the HVO site. This is most likely because the Cheshunt site is on elevated ground that places the wind speed sensor significantly higher than the surrounding terrain compared with the HVO site. The wind roses at the HVO site show a very similar pattern over the six years of data. (Note the 2006 data do not span a full year and are therefore different from the others). Finally, the winds at the Cheshunt site have a more north-south orientation than do the winds at HVO South.

Figure 7 shows seasonal and annual wind roses for the 2002 HVO site, which is the data set applied with the model.

Both data sets show a pattern of seasonal winds that is typical of central regions of the Hunter Valley. On an annual basis, winds are generally aligned along a northwest-southeast axis. In summer, winds are generally from the southeast and in winter from the northwest.

Appendix B summarises the wind speed, wind direction and stability class statistics of the HVO meteorological data set. The mean annual wind speed is 3.01 m/s.

6.2.2 Temperature and humidity

Temperature and humidity data representative of the local area are presented in *Table* . These data were obtained from the Bureau of Meteorology's weather station located at the Jerrys Plains Post Office. The weather station has collected data since 1884 and thus provides a useful historical record over the longer term.

[5] Industrial Source Complex Model – Short-term Version 3

[6] Sigma-theta is the standard deviation of horizontal wind direction. It is used to determine the stability of the atmosphere and hence the rate at which a plume will disperse.

Table shows that January is the warmest month, with a mean monthly maximum temperature of 31.8 °C. July is the coolest month experiencing a mean monthly minimum temperature of 3.7 °C. The annual average maximum and minimum temperatures experienced at Jerrys Plains are 25.2°C and 10.5°C respectively.

The annual average relative humidity reading collected at 9 am from the Jerrys Plains site is 69%, and at 3 pm the annual average is 47%. The month with the highest humidity on average is June with a 9 am average of 79%, and the lowest is November with a 3 pm average of 41%.

6.2.3 Rainfall and evaporation

Rainfall data are presented in *Table* . The mean annual rainfall at Jerrys Plains is 638.8 mm over an average of 86 rain days. January is the wettest month with a mean monthly rainfall of 78.2 mm over 7.9 rain days, while August is the month with lowest average rainfall, with a monthly mean of 36.6 mm over 7 rain days.

Evaporation data are available from the "Climatic Atlas of Australia" (Bureau of Meteorology, 1988). Evaporation rates for Singleton for January, April, July and October are approximately 225, 125, 75, and 175 mm respectively. Thus, evaporation is well above the expected rainfall amount for all the months of the year.

Table 4. Temperature, humidity and rainfall data for Jerrys Plains Post Office (Station number 061086; Commenced: 1884, Last record: 2004; Latitude (deg S): - 32.4972; Longitude (deg E): 150.9093)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9 am Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	23.3	22.7	21.3	17.9	13.5	10.5	9.2	11.3	15.2	18.9	21.1	23.1	17.3
Wet-bulb	19.2	19.3	17.9	14.9	11.5	8.9	7.6	8.9	11.7	14.4	16.2	18.1	14
Humidity	67	72	71	71	77	79	78	72	65	60	59	60	69
3 pm Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	29.6	28.9	27.1	24.2	20	17.1	16.3	18.2	21.1	23.9	26.8	29	23.5
Wet-bulb	21	21.1	19.6	17.1	14.5	12.2	11.1	12	13.9	16.1	17.8	19.6	16.3
Humidity	46	50	50	47	51	53	50	45	43	43	41	42	47
Daily Maximum Temperature (°C)													
Mean	31.8	30.9	29	25.3	21.2	17.9	17.3	19.4	22.8	26.2	29.3	31.4	25.2
Daily Minimum Temperature (°C)													
Mean	17.1	17.1	15	10.8	7.4	5.2	3.7	4.4	6.9	10.2	13.1	15.7	10.5
Rainfall (mm)													
Mean	78.2	71.7	58.2	44.7	41.3	45.3	44.3	36.6	41.3	51.9	58.2	67.3	638.8
Median	65.5	46	45.7	32.5	29.9	28.8	36.3	30.5	33.8	47.6	48.9	55	644.1
Raindays (Number)													
Mean	7.9	7.3	7.3	6.3	6.6	7.3	7	7	6.6	7.5	7.6	7.5	86

Source: Bureau of Meteorology web site (2005)

6.2.4 Mixing height and stability class

Information on hourly mixing height and stability class are required as input to the dispersion model. Intensive sonde[7] studies of the upper atmosphere around the Liddell Power Station have been undertaken on behalf of the Electricity Commission of NSW (now Pacific Power) by Malfroy (1989**)** and Malfroy (1992). However, no long-term direct measurements on mixing height are available for the area and theoretically derived values have been used. The theoretical values in the day have been estimated by assuming that the maximum mixing height reached during the day was 1500 m, 1200 m, 1000 m and 1200 m for summer, autumn, winter and spring respectively. At night, theoretical values derived from the wind speed and stability data have been used. These give mixing height values, which are consistent with the values reported by Malfroy.

Stability class[8] is used by dispersion models to determine the rate at which the plume grows by the process of turbulent mixing. Each stability class is associated with a dispersion curve, which is used by the model to calculate the plume dimension and dust concentration at points downwind of the source. In the model used here, the Pasquill-Gifford dispersion curves have been used.

The frequency of occurrence of particular stability classes in the 2002 HVO meteorological station data set, which was used in the dispersion model, is shown in *Table 5***.**

Table 5. Frequency of occurrence of stability classes for HVO Meteorological Station data 2002

Stability	Frequency of occurrence
A	12.6%
B	8.1%
C	12.7%
D	40.9%
E	13.3%
F	12.3%

Note: the stability classes presented vary slightly from those reported in the noise study as F and G classes are combined for air quality studies.

6.3 Review of air quality monitoring data

This section provides a review of the TSP, PM_{10} and dust (insoluble solids) deposition data.

6.3.1 TSP and PM_{10}

Twenty-four hour average concentrations of TSP or PM_{10} or both, have been measured every sixth day over various periods at the ten sites shown in *Figure 4*. The sites and the data available at each site are summarised below:

- HV-TSP1 (Cornfield TSP) from 4 April 1998 to 26 December 2001
- HV4 TSP from 9 January 2004 to 25 September 2006
- HV-TSP2 (Cheshunt TSP) from 4 April 1998 to 4 January 2006
- HV-TSP2 (Stapleton TSP, previously Cheshunt TSP) from 10 January 2006 to 25 September 2006
- Kilburnie South TSP from 20 February 2005 to present and PM_{10} from 28 December 2004 to 25 September 2006

[7] A sonde in this context is a package of instruments that are carried aloft by balloon and transmit information about temperature, humidity and pressure back to the ground.

[8] In dispersion modelling, stability class is used to categorise the rate at which a plume will disperse. The Pasquill-Gifford stability class scheme used in this study defines six stability classes A through to F. Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions, plumes will spread rapidly. Class F relates to stable conditions. These occur at night, early morning or late afternoon, when the sky is clear, winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

- Lemington HV2 TSP from 20 February 2005 to 25 September 2006
- HV-TSP3 (Moxey TSP) and PM_{10} from 8 January 2003 to 25 September 2006
- HV-TSP1 W (Wandewoi TSP) from 23 July 2001 to present and PM_{10} from 28 December 2004 to 25 September 2006
- LEM-HV1 (previous Warkworth School TSP) and PM_{10} from 27 December 2002 to 25 September 2006
- Jerrys Plains School PM_{10} from 2 February 2005 to 25 September 2006
- Oaklands PM_{10} from 10 December 2004 to 25 September 2006.

The results of the TSP monitoring are summarised in *Table* and *Figure 8***.** The locations of the monitoring sites are shown in *Figure 4*.

Table 6. Summary of TSP monitoring results (24-hour average concentrations) - $\mu g/m^3$

Year		Cornfield (HV-TSP1)	Cheshunt (HV-TSP2)	HV TSP4	Kilburnie South	LEM HV2	Moxeys (HV-TSP3)	Wandewoi (HV-TSP1 W)	Warkworth School (LEM-HV1)
1998	Avg.	29.4	107.8						
	Max.	86.0	230						
	Min.	2.4	13.9						
1999	Avg.	38.5	110.7						
	Max.	84.2	361.6						
	Min.	6.8	25.1						
2000	Avg.	38.8	88.4						
	Max.	85.3	189.9						
	Min.	3.9	21.1						
2001	Avg.	32.2	82.8					36.2	
	Max.	91.8	217.8					91.8	
	Min.	5.2	17.3					7.6	
2002	Avg.		149.2					55.2	
	Max.		390.2					148.9	
	Min.		26.2					5.7	
2003	Avg.		155.9			57.7	129.0	45.1	68.1
	Max.		478.8			221	2781.7	173	236
	Min.		21.9			18	19.4	6.4	19
2004	Avg.		96.7	56.5		49.5	51.5	39.3	58.3
	Max.		386.0	117.1		126.5	107.1	83.1	141
	Min.		13.3	12.1		7.8	14.7	3.7	17.1
2005	Avg.		80.5	50.5	33.2	48.3	52.2	42.4	60.1
	Max.		243	201	125	205	235	157	155
	Min.		10.1	11.3	3.5	7.4	7.3	3.2	13.4

Notes: Avg. is the annual average, Max. is the maximum 24-hour average recorded during the year, Min. is the minimum 24-hour average recorded in the year. No annual summary data is provided for the incomplete year of 2006 but data for 2006 are shown on *Figure 8*.

The PM_{10} results are summarised in *Table* and *Figure 9*.

Table 7. Summary of PM_{10} monitoring results (24-hour average concentrations) - $\mu g/m^3$

Year		Jerrys Plains School	Kilburnie South	Moxeys	Oaklands	Wandewoi	Previous Warkworth School (LEM-PM10)
2003	Avg.			26.5			25.6
	Max.			161.9			132.0
	Min.			2.1			3.0
2004	Avg.			18.1			27.1
	Max.			38.4			78.7
	Min.			4.3			6.7
2005	Avg.	14.2	15.9	20.2	23.7	16.5	29.0
	Max.	49.6	86.5	90.6	64.6	45.7	95.2
	Min.	1.0	1.9	1.4	3.2	1.6	2.3

Notes: Avg. is the annual average, Max. is the maximum 24-hour average recorded during the year, Min. is the minimum 24-hour average recorded in the year. No annual summary is provided for the incomplete year of 2006 but data for 2006 are shown on *Figure 9*.

When interpreting the monitoring data, it should be noted that they include the effects of existing mining operations, including operations which when continued, will be part of the operations assessed in this report. As a result, the data cannot be used directly to determine the background levels that would apply in the absence of the proposed mining. Adding predicted concentrations due to the proposed operations to monitored levels would double count the effects of some of the existing and future emissions.

Figure 2 shows the location of the main dust generating areas over the life of the project and the locations of the dust sensitive areas that will potentially be affected by emissions from the proposed mining. The current results for the three clusters of assessment locations and four isolated rural locations are detailed below. As discussed above the observations include the effects of all existing sources of particulate matter.

Annual average concentrations have been derived from 2005 data, the most recent full year of monitoring.

Maison Dieu area

TSP concentrations in the Maison Dieu area are best represented by the measurements made by the HVASs located at HV2, Knodlers Lane and HV-TSP3 (Moxey) (see *Figure 4*). In 2005 (the most recent full year of monitoring) annual average TSP concentrations at these three sites have been in the range of 48.3 to 52.2 $\mu g/m^3$, and thus TSP concentrations are within the DECC's assessment criterion of 90 $\mu g/m^3$. Similar concentrations were measured in 2004, but in 2003, the Moxeys monitor recorded a 24-hour average TSP concentration of 2,782 $\mu g/m^3$ on 14 April 2003 and 1,003 $\mu g/m^3$ on 8 May 2003. These very high concentrations affect the annual averages for these sites. The reasons for the high concentrations measured on these two days are not known, but the cause is likely to have been a local source. None of the other monitors recorded such high concentrations. If these two measurements are excluded, the annual average TSP concentration becomes 66.7 $\mu g/m^3$, which is again below the DECC's annual average 90 $\mu g/m^3$ assessment criterion.

PM_{10} concentrations in the Maison Dieu area are best represented by the measurements made by the HVAS at HV-TSP3 (Moxey). In 2005, annual average PM_{10} concentration was 20.2 $\mu g/m^3$ and the maximum 24-hour average PM_{10} concentration was 90.6 $\mu g/m^3$. Thus, the annual average PM_{10} concentration was within the DECC's annual average assessment criterion of 30 $\mu g/m^3$, but the 24-hour assessment criterion of 50 $\mu g/m^3$ was exceeded. Similar concentrations were measured in 2004, but in 2003, the HV-TSP3 (Moxey) monitor recorded an annual average PM_{10} concentration of 26.5 $\mu g/m^3$ and a maximum 24-hour average PM_{10} concentration of 161.9 $\mu g/m^3$. As with the TSP concentrations measured at the same site, a day with an extremely high concentration has affected the annual average. It is relevant to try and understand the causes of these events and to see how they correlate with the TSP monitoring results. Unfortunately, no PM_{10} measurement was available for 14 April 2003 when the 24-hour average TSP concentration of 2,782 $\mu g/m^3$ was measured, but the 161.9 $\mu g/m^3$ (PM_{10}) occurred on the same day that a TSP concentration of 1,003 $\mu g/m^3$ was measured (8 May 2003). None of the other monitoring sites in the network recorded unusually high concentrations and it is likely that the source of dust was local to the monitoring site.

It is interesting to note that the 24-hour PM_{10} assessment criterion was exceeded twice in 2005 (based on sampling every sixth day) and not at all in the previous year. Note the NEPM standard for PM_{10} allows for five exceedances per year of the 50 $\mu g/m^3$ concentration level (based on continuous monitoring).

Thus, it may be concluded that currently TSP and PM_{10} concentrations in the Maison Dieu area generally comply with the DECC's assessment criteria, but some exceedances of the 24-hour PM_{10} criterion are measured in some years.

Warkworth Village

TSP concentrations in the Warkworth Village area are best represented by the measurements made by the LEM-HV1 HVAS located at the previous Warkworth School and referred to a "Warkworth School" on *Figure 4*. In 2005, the annual average TSP concentration at this site was 60.1 $\mu g/m^3$, and thus was within the DECC's assessment criterion of 90 $\mu g/m^3$. Similar concentrations were measured in 2003 and 2004.

PM_{10} concentrations are also measured at this site. In 2005, the annual average PM_{10} concentration was 29.0 $\mu g/m^3$ and the maximum 24-hour average PM_{10} concentration was 95.2 $\mu g/m^3$. Thus, the annual average PM_{10} concentration was within the DECC's annual average assessment criterion of 30 $\mu g/m^3$, but the 24-hour assessment criterion of 50 $\mu g/m^3$ was exceeded. The annual average and maximum 24-hour average PM_{10} concentrations in 2004 were 27.1 and 78.7 $\mu g/m^3$ respectively. In 2003 the corresponding figures were 25.6 and 132.0 $\mu g/m^3$.

It may be concluded that currently annual average TSP and PM_{10} concentrations in the Warkworth Village area comply with the DECC's assessment criteria, but some exceedances of the 24-hour PM_{10} criterion are measured in some years. It should also be noted that a 1.1 $\mu g/m^3$ increase in the annual average PM_{10} concentrations in the Warkworth Village area would cause the DECC's annual average PM_{10} assessment criterion of 30 $\mu g/m^3$ to be exceeded. That is, there is very little capacity for this part of the airshed to accept additional new emissions of PM_{10}.

Western Group of Assessment Locations

Air quality at the western group of locations along Jerrys Plains Road is best represented by data from the measurements made at the HV-TSP1 HVAS (Wandewoi). In 2005, the annual average TSP concentration at this site was 42.5 $\mu g/m^3$, and thus was within the DECC's assessment criterion of 90 $\mu g/m^3$. Similar concentrations were measured in 2004, 2003 and 2002, when the annual average TSP concentrations were 39.3, 45.1 and 36.2 $\mu g/m^3$ respectively.

PM_{10} concentrations are also measured at the same site. In 2005 annual average PM_{10} concentration was 16.5 $\mu g/m^3$ and the maximum 24-hour average PM_{10} concentration was 45.7 $\mu g/m^3$. Thus, the annual average PM_{10} concentration was within the DECC's annual average assessment criterion of 30 $\mu g/m^3$, and within the 24-hour assessment criterion of 50 $\mu g/m^3$.

It may be concluded that currently annual average TSP and PM_{10} concentrations in the western area comply with the DECC's assessment criteria. Some exceedances of the 24-hour PM_{10} criterion would be expected from time to time especially when bushfire smoke is present, but no exceedances were measured in 2005.

Others

Wandewoi is also one of the isolated rural residences and thus air quality at this site is well described by the discussion in the previous paragraphs and air quality at Jerrys Plains would be reasonably well represented by data from the TSP and PM_{10} monitoring data at Wandewoi.

Measurements of TSP concentrations are made at Location 7 (see Stapleton monitor referred to in Figure 4) and these are likely to be reasonably representative of the data for Location 8 (Holz), located approximately 2 km to the northwest of Location 7.

Monitoring at the Stapleton site commenced on 10 January 2006 after relocation of the HV-TSP2 monitor from Cheshunt, following purchase of the property by CNA. To date only 14 measurements are available from the Stapleton site. The average TSP concentration to date is 45.6 $\mu g/m^3$. Previous monitoring undertaken as part of the Ravensworth/Narama monitoring network indicates higher annual average concentrations (60.6 $\mu g/m^3$ in 2003 and 71.7 $\mu g/m^3$ in 2004). Thus, it is possible that the annual average will be higher once the monitoring programme has continued for a full year.

Note: data from the Cheshunt monitor should be considered unrepresentative of a normal residential location. The monitor was located immediately to the west of the Cheshunt opencut pit and would not normally represent conditions in a residential area. The location was used as a monitoring site because a residence was in fact at this location during an extended period of negotiations.

6.3.2 Deposition

The locations of relevant dust deposition gauges operated by CNA are shown in *Figure 4*. *Table* shows the annual average deposition levels at each gauge since 1998, or whenever the gauge in question was installed. Many of the gauges (see *Figure 4*) are located within the Mining Lease close to areas where active mining is taking place. The data from these gauges can be used to show the rate at which dust deposition levels decrease with distance from actively mined areas, but is not relevant for determining the background level.

Monitoring data from gauges DL14, DL21, DL22, DL23 and Knodlers Lane provide data that is representative of conditions experienced by locations in the Maison Dieu area.

DL43 may be used to provide data representative of conditions in Warkworth Village.

Gauges labelled 'Moses Crossing' and 'Jerrys Plains' would provide data representative of air quality experienced in the group of residences to the west. These gauges have been operating for less than 12 months, which is long enough to provide estimates of the annual average dust deposition levels. Gauges D101, D102, D103, D104, D110 and D112 have been used to represent conditions at the residences to the west, even though these gauges are generally closer to mining areas than they are to the residences.

D112, DL2, DL4 and D34 provide data that represents conditions at the isolated rural locations.

Table indicates that since 2003, DL14, DL21, DL22 and Knodlers Lane have recorded annual average deposition levels of insoluble solids in the range of 1.2 to 2.6 g/m^2/month. DL23 has recorded annual average deposition levels of insoluble solids in the range of 1.7 to 5.0 g/m^2/month. The data indicate that deposition levels at all monitors except for DL23 have recorded deposition levels within the DECC's annual average assessment criterion of 4 g/m^2/month.

Examination of the monthly data to determine why DL23 (located in southern Maison Dieu) recorded an annual average deposition level of 5 g/m^2/month in 2005 reveals that there were two anomalously high measurements. The first occurred in May and the second occurred in November 2005. Monthly deposition levels of 9.1 and 27.9 g/m^2/month were recorded in these two months respectively. Many other gauges on the eastern side of the existing disturbed areas associated with the existing opencut areas recorded elevated deposition levels in November, but some also recorded low levels. All gauges on the western side recorded lower levels. The prevailing winds in November were from the south-southeast, southeast and east southeast accounting for approximately 60% of winds. By contrast, less than 20% of winds were from the west-northwest and northwest. This would suggest that the mining was not the principal source of dust, but it is possible that the high levels recorded on the eastern side were the result of one short-lived episode, but a detailed examination of the hourly meteorological data failed to identify and period that would have explained the observations. This highlights the difficulty in using monthly average data to identify sources of dust.

The event in May is also not easy to interpret. Gauge DL23 recorded a deposition level of 9.1 g/m^2/month the nearby gauge, DL22, only recorded 1.8 g/m^2/month.

When considered over a long period, the majority of the annual average dust deposition levels in the Maison Dieu area (11 of the 15 annual recorded deposition levels at the five gauges in the past three years) have been below or equal to 2 g/m^2/month. Since the recordings incorporate the effect of emissions from existing operations, which will be similar to the future operations, it seems reasonable to set the annual average incremental limit for dust deposition at 2 g/m^2/month.

Table shows that since 2003, annual average deposition levels at DL43 (representing Warkworth Village) have been in the range 2 to 3.9 g/m^2/month and are within the DECC's annual average assessment criterion of 4 g/m^2/month. Again, bearing in mind that the proposed operation includes activities that are currently taking place, it would be reasonable to adopt 2 g/m^2/month as the annual average deposition increment. This could be accepted from the proposal without giving rise to adverse air quality effects.

Table shows that in 2005 Gauges D101, D102, D103, D104, D110 and D112 (representing residences to the west including Locations 10 and 13) have recorded annual average deposition levels (insoluble solids) in the range of 1.0 to 3.0 g/m^2/month. Similar levels have been recorded at these gauges since 1998. Again, bearing in mind that the proposed operation includes activities that are currently taking place, it would be reasonable to adopt 2 g/m^2/month as the annual average deposition increment. This could be accepted from the proposal without giving rise to adverse air quality effects.

Finally, D112, DL2, DL4 and D34 provide data that represent conditions at the isolated rural residences. In 2005, these gauges recorded annual average deposition levels (insoluble solids) in the range 1.0 to 3.6 g/m^2/month. Using the same argument as for the other residential areas, it is reasonable to assume that the area could accept a predicted increase in annual average dust deposition of 2 g/m^2/month.

In summary, on the basis that dust deposition levels currently experienced in the surrounding residential areas includes dust from many of the activities that are proposed to be part of the continued mining, it has been taken as reasonable that these areas could accept an annual deposition level of 2 g/m^2/month (insoluble solids). This does not mean that deposition levels would increase by 2 g/m^2/month above current levels. It will be important to ensure that no residence is predicted to experience a total annual average dust deposition level (insoluble solids) above 4 g/m^2/month.

Table 8. Summary of annual average dust (insoluble solids) deposition data - g/m²/month

Gauge	Location	1998	1999	2000	2001	2002	2003	2004	2005
D1				4.6	2.7	2.8	2.8	2.6	2.5
D2				2.2	3.4	2.9	3.4		
D2a				0.0	0.0	0.0	2.3	4.5	6.4
D3				8.6	3.0	3.4	4.3	4.2	5.3
D5				6.5	4.1	2.0	4.5	4.2	4.7
D7		4.2	3.8	5.3	4.5				
D7A				5.3	1.6	2.3	3.5	1.7	3.2
D8				4.9	2.9	2.4	3.4	1.8	4.9
D9		1.9	2.0	2.3	2.0	2.8	2.7	3.5	7.2
D15				5.3	2.2	3.7	4.0	2.2	3.5
D16				4.1	5.3	7.5	3.6	7.8	3.7
D19		2.7	3.5	3.8	2.7	5.2	0.0	3.3	2.7
D30		2.7	2.9	3.2	2.4				
D31		2.9	2.6	3.3					
D32		2.2	2.0	2.1	1.9	3.0	2.2	3.9	4.9
D33		2.8	2.0	23.7	6.2	3.2	2.5	1.9	3.1
D34		2.2	2.1	2.9	2.3	3.0	0.0	2.3	2.3
D38		1.7	2.5	2.0	1.8				
D39		2.0	2.1	3.7	2.5				
D43		1.4	1.3	1.4					
D101		1.4	1.3	1.4	1.4	1.5	1.6	1.2	2.2
D102		0.9	0.8	1.4	0.8	1.1	1.5	1.7	1.5
D103		1.0	1.1	1.7	0.7	1.4	2.9	2.8	3.0
D104		1.0	2.3	2.5	1.1	1.9	1.9	2.4	2.8
D105		3.7	4.7	2.6	2.7	3.6	2.6	2.1	3.0
D107		6.3	4.6	3.4	4.6	10.1	4.0	7.8	6.2
D109		4.2	3.7	4.4	2.1				
D110		1.1	1.4	2.2	1.1	1.8	1.9	1.7	1.8
D112		1.4	0.7	1.0	1.1	1.8	1.3	1.1	1.0
D113		2.4	3.6	2.7					
D114		3.2	3.3	4.7	2.7	3.1	4.1	3.6	3.6
D115		8.9	2.2	4.0					
D116		4.5	4.6	4.5	3.5	5.3	4.1	3.8	3.7
D117							2.0	1.3	2.0
DCL					4.3	4.6	3.8	3.8	4.5
DL1							1.9	3.4	3.6
DL2							1.5	1.5	3.5
DL4							2.2	2.3	3.0
DL10							1.9	1.7	2.0
DL14							1.6	1.7	2.0
DL17							2.9	2.6	2.9
DL21							1.7	2.4	1.6
DL22							1.7	1.6	2.6
DL23							2.0	1.7	5.0
DL30							2.7	6.5	7.0
DL43							2.0	2.2	3.9
DL44							2.9	2.1	3.0
DL45							1.5	2.0	3.2
Knodlers Lane	Maison Dieu						1.4	1.2	2.6

7 EMISSIONS

To predict dust concentration and deposition levels the model requires information on the rate at which dust is released from different geographic areas in the modelling domain. Examination of *Figure 1* shows that there a number of opencut mines each of which will contribute dust to the atmosphere. The rate of emission will depend largely on the intensity of mining and area of exposed land that can contribute to wind erosion. There will also be sources of particulate matter that are not associated with mining. These will include emissions from distant locations within and outside the Hunter Valley including agriculture, domestic sources, power stations, motor vehicles, rail locomotives, sea-salt, bushfire smoke and other natural sources.

It is not practical to model all of these explicitly. The approach adopted here has been to define three classes of source:

1. the remote sources that would be expected to contribute a more or less uniform background to the ambient concentration in the modelling; these sources would include emissions from remote areas that have become well mixed by virtue of large travel distances;
2. easily identified sources such as nearby mines that are sufficiently far away so that the detailed layout of sources within the mine does not need to be represented in the modelling. However, these need to be included explicitly in the model because the effect that they make over the modelling domain varies significantly; and
3. sources associated with the proposal most of which will need to be included explicitly in the model because there will be strong concentration gradients associated with the emissions. These sources will change in position and intensity over the life of the mine.

Category 1 sources have been included initially by adding to the predicted annual average TSP, PM_{10} and dust deposition levels 10 $\mu g/m^3$, 5 $\mu g/m^3$ and 0.5 g/m^2/month. These figures have been based on the concentration and deposition levels that apply in clean areas of the state where air quality is not affected by any easily identifiable source of particulate matter emissions. A comparison of predicted TSP concentrations with measured concentrations for 2006 suggests that the background TSP level in the HVO South area should be 27 $\mu g/m^3$ and this figure has been used in place of the 10 $\mu g/m^3$ used initially. This value is obviously too high to be representative of clean areas in NSW but may account for the background contributed by remote sources and un-modelled sources such residential access roads, local stock movements etc (see later).

Category 2 sources include the mines shown on *Figure 1* excluding those associated with HVO South, namely:

1. Mt Thorley;
2. Warkworth;
3. Wambo;
4. United;
5. Cumnock;
6. Ravensworth/Narama;
7. Ashton;
8. Ravensworth East;
9. Mt Owen;
10. The Alluvials/North Pit;
11. Carrington; and
12. West Pit.

Mines 10 to 12 are part of CNA's operations north of the Hunter River.

Category 3 sources have been represented in the model using detailed emissions calculations and a detailed representation of the locations where dust emissions will occur for each of the years that have been modelled.

The category 3 sources include emissions from:

1. Riverview;
2. Riverview South West Extension;
3. Cheshunt; and
4. South Lemington (Pits 1 and 2, including Riverview South East).

Emissions from Category 2 mines have been estimated using either published emissions from Environmental Impact Statements or from estimates of dust emissions based on the ROM coal production for the year closest to the years modelled (Croft & Associates, 1982; Epps & Associates 1989; ERM, 1999; Holmes Air Sciences, 2002; Holmes Air Sciences, 2004).

In the cumulative modelling work, each neighbouring mine has been treated as a number (between one and three) of volume sources. These have been located at the apparent points of major emission as estimated from the known locations of the pits and/or major dust sources on the mine or facility.

Sources have been considered in three classes:

1. wind erosion sources where emissions vary with the hourly average wind speed according to the cube of the wind speed;
2. loading and dumping operations where emissions vary as wind speed raised to the power of 1.3; and
3. all other sources where emissions are assumed to be independent of wind speed.

For mines, the proportion of emissions in each of these categories has been assumed to be the same as applies at the Project, namely:

1. 0.133 for wind erosion sources.
2. 0.135 for emissions that depend on wind speed (such as loading and dumping); and
3. 0.732 for emissions independent of wind speed;

These factors are based on an analysis of mine dust inventories undertaken as part of the Mt Arthur North, Environmental Impact Statement (EIS) (URS, 2000).

Table 9. Summary of estimated annual TSP emissions (µg/m^3) for Category 2 dust sources included in modelling

	2006	2010	2014	2019
Mt Thorley				
Total	8,942,600	0	0	0
Wind insensitive	6,545,983	0	0	0
Wind sensitive	1,207,251	0	0	0
Wind erosion	1,189,366	0	0	0
Warkworth				
Total	5,385,361	7,950,030	9,255,169	8,169,435
Wind insensitive	3,942,084	5,819,422	6,774,784	5,980,026
Wind sensitive	727,024	1,073,254	1,249,448	1,102,874
Wind erosion	716,253	1,057,354	1,230,937	1,086,535
Wambo				
Total	3,969,329	5,122,771	5,139,243	0
Wind insensitive	2,905,549	3,749,868	3,761,926	0
Wind sensitive	535,859	691,574	693,798	0
Wind erosion	527,921	681,329	683,519	0
United				
Total	1,026,264	1,026,264	1,026,264	1,026,264
Wind insensitive	751,225	751,225	751,225	751,225

Table 9. Summary of estimated annual TSP emissions (µg/m^3) for Category 2 dust sources included in modelling

	2006	2010	2014	2019
Wind sensitive	138,546	138,546	138,546	138,546
Wind erosion	136,493	136,493	136,493	136,493
Cumnock				
Total	2,406,642	2,406,642	2,406,642	0
Wind insensitive	1,761,662	1,761,662	1,761,662	0
Wind sensitive	324,897	324,897	324,897	0
Wind erosion	320,083	320,083	320,083	0
Ravensworth/Narama				
Total	2,028,000	1,248,000	1,248,000	1,248,000
Wind insensitive	1,484,496	913,536	913,536	913,536
Wind sensitive	273,780	168,480	168,480	168,480
Wind erosion	269,724	165,984	165,984	165,984
Ashton				
Total	1,782,385	0	0	0
Wind insensitive	1,304,706	0	0	0
Wind sensitive	240,622	0	0	0
Wind erosion	237,057	0	0	0
Ravensworth East				
Total	5,540,773	5,540,773	5,540,773	5,540,773
Wind insensitive	4,055,846	4,055,846	4,055,846	4,055,846
Wind sensitive	748,004	748,004	748,004	748,004
Wind erosion	736,923	736,923	736,923	736,923
Mt Owen				
Total	4,211,368	4,211,369	4,114,779	4,678,016
Wind insensitive	3,082,721	3,082,722	3,012,018	3,424,308
Wind sensitive	568,535	568,535	555,495	631,532
Wind erosion	560,112	560,112	547,266	622,176
The Alluvials/North Pit				
Total	0	0	0	0
Wind insensitive	0	0	0	0
Wind sensitive	0	0	0	0
Wind erosion	0	0	0	0
Carrington				
Total	3,794,183	996,522	996,522	0
Wind insensitive	2,777,342	729,454	729,454	0
Wind sensitive	512,215	134,530	134,530	0
Wind erosion	504,626	132,537	132,537	0
West Pit				
Total	4,000,642	4,033,431	4,731,295	0
Wind insensitive	2,928,470	2,952,471	3,463,308	0
Wind sensitive	540,087	544,513	638,725	0
Wind erosion	532,085	536,446	629,262	0

Those mining areas that are the subject of this assessment, namely, Riverview, Riverview South East Extension, Cheshunt and South Lemington Pits 1 and 2, have been subjected to a more detailed analysis to identify dust emissions associated with all significant dust emission sources associated with their operation. The estimated inventory has been based on information provided by CNA mine planners. This information has included data on where coal is to be mined, through which CPP it will be processed and the location of the overburden emplacement areas and the quantity of overburden emplaced in the year. Other information required to estimate dust emissions such as the sizes of trucks and the number of hours that dozers will operate for, etc., has also been provided by the mine planners.

7.1 Estimation techniques

Emissions inventories have been prepared for each of the years 2006, Scenario A (indicative of year 2010), Scenario B1 (indicative of year 2014) and Scenario C1 (indicative of year 2019). Emissions have been estimated using emission factor equations published in AP-42 (US EPA (1985) and updates from the US EPA website) and from studies undertaken by the coal industry in the Hunter Valley and published in a report prepared for the National Energy Research and Development and Demonstration Council (NERDDC, 1988). The detailed calculations are provided in *Appendix C*, which provides information on the equations used, the basic assumptions about material properties (e.g. moisture content, silt content etc), information on the way in which equipment will be used to undertake different mining operations and the quantities of materials that would be handled in each operation.

In addition to emissions data, the ISCST3 dispersion model requires information on particle size distributions in the emitted dust. Data from the State Pollution Control Commission (SPCC, 1986) have been used for this (see *Section 8.1* for more detailed discussion).

7.2 Summary of estimated emissions

Table summarises the dust emissions inventory for each of the years for which modelling has been undertaken.

Table 10. Estimated TSP emissions (µg/m^3) for modelled years

Activity		**2006**	**Scenario A**	**Scenario B1**	**Scenario C1**
OB - Drilling	Cheshunt	13,035	15,384	25,523	29,719
	Riverview	13,149	2,867	16,153	-
	Riverview South East Extension	-	20,418	-	-
	South Lemington (Pit 1) (see Figure 4)	-	-	279	-
OB - Blasting	Cheshunt	14,975	17,673	29,321	34,141
	Riverview	15,106	3,294	18,557	-
	Riverview South East Extension	-	23,457	-	-
	South Lemington Pit 1	-	-	321	-
OB - Dragline	Cheshunt	-	-	-	-
	Riverview	231,832	127,795	1,142,025	-
	Riverview South East Extension	-	1,033,980	-	-
	South Lemington Pit 1	-	-	19,750	-
OB - Sh/Ex/FELs loading	Cheshunt	88,674	103,520	172,172	202,143
	Riverview	36,969	3,919	341	-
	Riverview South East Extension	-	31,710	-	-

Table 10. Estimated TSP emissions (µg/m³) for modelled years

Activity		2006	Scenario A	Scenario B1	Scenario C1
	South Lemington Pit 1	-	-	6	-
OB - Hauling to emplacement - from:	Cheshunt	1,329,522	1,108,651	1,843,879	1,169,021
	Riverview	395,915	41,973	3,649	216,485
	Riverview South East Extension	-	271,683	-	-
	South Lemington Pit 1	-	-	50	-
OB - Emplacing at dumps	Cheshunt	88,674	103,520	172,172	181,929
	Riverview	36,969	3,919	341	20,214
	Riverview South East Extension	-	31,710	-	-
	South Lemington Pit 1	-	-	-	-
OB - Dozers on O/B	Cheshunt	226,295	469,218	325,111	343,558
	Riverview	159,086	46,571	275,712	38,173
	Riverview South East Extension	-	376,800	-	-
	South Lemington Pit 1	-	-	-	-
CL - Drilling	Cheshunt	2,206	3,426	7,430	7,430
	Riverview	1,935	140	2,972	-
	Riverview South East Extension	-	3,846	-	-
	South Lemington Pit 1	-	-	35	-
CL - Blasting	Cheshunt	2,218	3,444	7,468	7,468
	Riverview	3,335	161	3,414	-
	Riverview South East Extension	-	4,418	-	-
	South Lemington Pit 1	-	-	40	-
CL - Dozers ripping	Cheshunt	375,123	357,216	774,575	774,575
	Riverview	56,690	14,580	309,830	-
	Riverview South East Extension	-	400,957	-	-
	South Lemington Pit 1	-	-	3,645	-
CL - Loading ROM to trucks	Cheshunt	213,138	331,011	717,754	717,754
	Riverview	186,954	13,511	287,101	-
	Riverview South East Extension	-	371,543	-	-
	South Lemington Pit 1	-	-	3,378	-
CL - Hauling ROM coal to dump hopper	Cheshunt	184,048	142,917	309,896	309,896
	Riverview	184,500	5,833	123,958	-
	Riverview South East Extension	-	68,750	-	-
	South Lemington Pit 1	-	-	1,250	-
CL - unloading ROM coal at pile/hopper - All pits		59,226	106,000	149,250	106,250
CL - ROM rehandle pile to hopper (FEL)		5,923	10,600	14,925	10,625
CL - Handling coal at CPP		74,243	132,876	187,092	133,189
CL - Dozer/FEL pushing ROM coal		-	-	-	-
CL - Dozers pushing product coal		-	-	-	-
CL - Loading rejects		-	-	-	-
CL - Transporting rejects		-	-	-	-
CL - Unloading rejects		-	-	-	-
CL - Loading product coal stockpile		920	1,646	2,318	1,650
WE - OB spoil area	Cheshunt	1,737,984	1,397,395	844,814	1,611,840
	Riverview	819,936	904,733	934,166	-

Table 10. Estimated TSP emissions (µg/m^3) for modelled years					
Activity		**2006**	**Scenario A**	**Scenario B1**	**Scenario C1**
	Riverview South East Extension	-	147,869	-	-
	South Lemington Pit 1	-	276,816	504,226	-
WE - Open pit	Cheshunt	1,737,984	1,236,912	1,492,704	1,590,816
	Riverview	819,936	567,648	325,872	-
	Riverview South East Extension	-	77,088	-	-
	South Lemington Pit 1	-	101,616	105,120	-
WE - ROM stockpiles		-	15,267	15,267	15,267
WE - Product stockpiles		-	16,285	16,285	16,285
Loading coal to trains		920	1,646	2,318	1,650
Grading roads		28,755	28,755	28,755	28,755
Total		9,146,175	10,582,971	11,221,224	7,568,834
TSP/ROM coal ratio (kg of TSP/t of ROM coal)		1.54	1.00	0.75	0.71

OB – overburden
CL – coal loading
WE – wind erosion
TSP – total suspended particulate (matter)
ROM – run of mine

8 APPROACH TO MODELLING

8.1 Overview

In August 2005, the DECC published new guidelines for the assessment of air pollution sources using dispersion models (DECC, 2005). The guidelines specify how assessments based on the use of air dispersion models should be undertaken. This includes guidelines for the preparation of meteorological data to be used in dispersion models, the way in which emissions should be estimated and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the proposal. The approach taken in this assessment follows as closely as possible the approaches suggested by the guidelines.

This section is provided so that technical reviewers can appreciate how the modelling of different particle size categories was carried out.

The model used was a modified version of the US EPA ISC model (see *Section 8.2*). The ISC model is fully described in the user manual and the accompanying technical description (US EPA, 1995A and 1995B). The modelling has been based on the use of three particle-size categories (0 to 2.5 μm - referred to as $PM_{2.5}$ (fine particulate matter FP), 2.5 to 10 μm - referred to as CM (coarse matter) and 10 to 30 μm - referred to as the Rest). Emission rates of TSP have been calculated using emission factors derived from US EPA (1985) and NERDDC (1988) work (see *Appendix B*).

The distribution of particles has been derived from measurements in the SPCC (1986) study. The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 4.68% of the TSP;
- $PM_{2.5\text{-}10}$ (CM) is 34.4% of TSP; and
- $PM_{10\text{-}30}$ (Rest) is 60.9% of TSP.

Modelling was done using three ISC source groups. Each group corresponded to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 μm. The predicted concentration in the three plot output files for each group were then combined according to the weightings above to determine the concentration of PM_{10} and TSP.

The ISC model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions on mining or quarry operations where wind speed is an important factor in determining the rate at which dust is generated.

For the current study, the operations were represented by a series of volume sources located according to the location of activities for the modelled scenario. *Figure 9* shows the location of the modelled sources for each year of assessment. Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. It is important to do this in the ISC model to ensure that long-term average emission rates are not combined with worst case dispersion conditions, which are associated with light winds. Light winds at a mine site would correspond with periods of low dust generation (because wind erosion and other wind dependent emissions rates will be low) and also correspond with periods of poor dispersion. If these measures are not taken then the model has the potential to significantly overstate impacts.

Dust concentrations and deposition rates have been predicted over the area shown in the figures. Local terrain has been included in the modelling.

The modelling has been performed using the meteorological data discussed in *Section 6* and the dust emission estimates from *Section 7*. Dust emissions from wind erosion sources have been modelled for 24 hours per day in all modelling scenarios. Model predictions have been made at 344 discrete locations within the modelling domain, including residential locations, located in the study area. These locations have been chosen to provide finer resolution closer to the dust sources.

The ISC model input files will be provided in electronic form on request and an example file is provided in *Appendix C*.

8.2 Prediction of 24-hour PM_{10} concentrations

It has been apparent for a number of years that the ISC model has a tendency to overestimate the 24-hour PM_{10} concentrations, while still predicting the longer term average concentrations reasonably accurately. In recent years, the DECC has permitted the use of a calibration factor to correct for the tendency of ISC to over-predict 24-hour average PM_{10} concentrations. In most instances, the DECC has required that a site-specific calibration factor be developed from local model and monitoring results.

One of the earliest calibration studies was undertaken as part of the EIS for the Warkworth mine in the Hunter Valley (Holmes Air Sciences, 2002). The calibration was done by comparing the predicted maximum 24-hour average PM_{10} concentrations at the several mine operated monitors. The maximum measured PM_{10} concentrations were then determined by inspection of the monitoring data. From these investigations the average extent of over-prediction was found to be a factor of 2.6; that is, unadjusted model predictions appear to over predict 24-hour PM_{10} concentrations by 260%. This factor was used to adjust the model predictions for the Warkworth EIS downwards to obtain a calibrated prediction of the worst case 24-hour PM_{10} concentrations for all scenarios that were assessed. Other studies undertaken at other locations have derived different calibration factors, both larger and smaller than 2.6. Further studies to develop a more scientifically robust methodology for dealing with the over-prediction of short-term concentrations by the ISC model have been conducted as part of the approval conditions for the Mt Owen Mine (Holmes Air Sciences, 2006).

Comparisons between ISC and AUSPLUME (see Holmes Air Sciences, 2005 for example) have suggested that a correction factor is appropriate for short term (that is, 24-hour average) ISC predictions. Although the comparison between AUSPLUME and ISC shows varying difference, AUSPLUME has consistently predicted almost 50% lower than uncorrected ISC predictions. Thus, AUSPLUME may have some advantages over ISC in that it more accurately predicts 24-hour average concentrations of PM_{10}, which are known to be consistently overestimated by ISC.

Results from a simplified model comparison of AUSPLUME and ISC suggested that 1-hour average PM_{10} concentrations downwind of a source and along the plume centreline were between 2.8 and 3.5 times higher using ISC than for AUSPLUME (see Appendix C of Holmes Air Sciences, 2005). The difference between the models depends on the meteorological conditions. Different results from the two models were largely explained by the way in which each model has interpreted the plume dispersion curves.

These studies, and the recently completed calibration study undertaken as part of the Mt Owen Mine's conditions of approval, have led to a better understanding of the reasons for the over-prediction. It appears that a substantial fraction of effect is due to the fact that the dispersion curves used in the ISC model have not been adjusted for differences in averaging times and the effects of the aerodynamic roughness. For most model runs for a particular site these will be different from the conditions where the original dispersion curves were developed.

To overcome this difficulty the ISC model has been modified to create a model that will be referred to as ISCMOD. ISCMOD is identical to ISC except that the horizontal plume spreading dispersion curves have been modified to adopt the recommendations of the American Meteorological Society's (AMS) expert panel on dispersion curves (Hanna, 1977) and the suggestions made by Arya (1999). The suggested changes were recommended because, as the AMS panel notes, the original horizontal dispersion curves relate to an averaging time of three minutes and they recommend that these be adjusted to the one hour curves required by ISC. The change involves increasing the horizontal plume widths by a factor of 1.82 (60 minutes / 3 minute)$^{0.2}$.

A similar adjustment has been applied to account for the local surface roughness being different in the Hunter Valley compared with the site where the original curves were developed. The Hunter Valley has been taken to have a surface roughness of 0.3 m compared with 0.03 m for the original curves. The adjustment leads to an increase in the horizontal and vertical curves by a factor of (0.3 m/ 0.03 m)$^{0.2}$ namely 1.6.

9 MODEL PREDICTIONS AND ASSESSMENT OF IMPACTS

The modified version of the ISC model (ISCMOD) has been used, with estimated emissions for Years 2006, 2010, 2014 and 2019 and meteorological data for 2002, to model the dispersion and deposition of emissions for these years.

The area covered by the model predictions is shown in *Figures 10* to *41*. The results show the estimated:

- maximum 24-hour PM_{10} concentrations;
- annual average PM_{10} concentrations;
- annual average TSP concentrations; and
- annual average dust (insoluble solids) deposition rates

for each of the years or scenarios.

Twenty two assessment locations were considered representative of the most exposed residences surrounding the mine. All these locations are private residential properties. These locations are shown in *Figure 4* and in *Figures 10* to *41*.

The years selected for presentation are intended to illustrate the area affected by the mine over its lifetime. The significance of the predicted levels has been assessed by comparing the values with the DECC's assessment criteria. In each case, the predictions show the contribution that will be made by emissions from the HVO opencut mines. In the case of the predicted maximum 24-hour PM_{10} concentrations, the predicted levels can be compared with the DECC's 50 $\mu g/m^3$ 24-hour PM_{10} assessment criterion. This is provided the mines employ best-practice dust controls, which include real-time management for mitigating short-term impacts. Similarly, DECC's annual average increment of 2 g/m^2/month for dust (insoluble solids) deposition may be interpreted as the limit that applies to the effect of the project by itself. However, for all the other assessment criteria the predicted values due to the project must be combined with the estimated ambient concentrations due to all other sources of dust including other mines and other non-mining sources. For sources not explicitly included in the model, the annual average background PM_{10} concentrations have been taken to be 5 $\mu g/m^3$. For annual average TSP concentrations, the value has been taken to be 27 $\mu g/m^3$ and for annual average deposition (insoluble solids) the value has been taken to be 0.5 g/m^2/month.

Background dust levels would be expected to change as other mining projects or extensions are brought into production.

9.1 Year 2006

The predictions for 2006 are different from those presented for the other years in that there is monitoring data available to compare the predictions against. For the predictions in future years, this is of course not possible. The predictions provide a useful benchmark for assessing the accuracy of the model. Rather than comparing the predictions against air quality at assessment locations the predictions have been extracted for monitoring sites.

In ideal circumstances, meteorological data for 2006 would have been used in the comparison but these data do not record a parameter (e.g. sigma-theta, cloud cover or temperature gradient) that would allow atmospheric stability to be derived. In practice, of course this is not a significant disadvantage because the data used in the remainder of the assessment for the future mining years is also from a different year to the year to which the simulation applies.

In 2006 mining occurs in the Cheshunt and Riverview Pits.

Figures 10 to *17* show respectively the predicted:

- Maximum 24-hour average PM_{10} concentrations;

- Predicted annual average PM_{10} concentrations;
- Predicted annual average TSP concentrations;
- Predicted annual average (insoluble solids) deposition levels;
- Maximum 24-hour average PM_{10} concentrations with other mines;
- Predicted annual average PM_{10} concentrations with other sources;
- Predicted annual average TSP concentrations with other sources, and;
- Predicted annual average (insoluble solids) deposition levels.

Note there is a deliberately introduced distinction between the maximum predicted 24-hour cumulative PM_{10} concentrations and the predicted annual average cumulative values for the annual averages. The 24-hour predictions only include the effects of other mines. Unpredictable events such as the smoke from bushfires or dust from remote dust storms are not included. By contrast, for the predicted annual averages, an attempt has been made to allow for the contribution that non-mining sources make to the background PM_{10}, TSP and deposition levels. *Table* shows the predicted levels and the monitored data (which is shown in brackets) when these are available.

The comparison of the maximum 24-hour PM_{10} appears to indicate reasonable agreement between predicted levels and measured levels. In five of the six cases where the 24-hour PM_{10} predictions could be compared with the maximum measured 24-hour PM_{10} concentration for the year, the model over-predicted the value. However, two issues should be taken into account. Firstly, measurements are made every sixth day and not continuously. This means that there is the potential to miss the worst case day in any given year and this could account for some of the conservativeness. Secondly, the predictions contain no allowance for the unpredictable background (e.g. effects of bushfires and dust storms), whereas the measurements do include these effects. This would make the model even more conservative than it appears to be. Both of these factors should be noted when comparing the predictions with the measurements.

The predicted annual average PM_{10} concentrations (including a 5 $\mu g/m^3$ allowance to account for remote sources) compare well with the measured values and again, on balance, the model over predicts the annual average PM_{10} levels by a small margin. However, as noted earlier, annual average TSP concentrations are significantly under predicted, even when the background of 10 $\mu g/m^3$ is added to account for the annual average TSP levels that might apply if no mining took place in the Hunter Valley. This is possibly due to the fact that local sources such as dust from local roads used to access residences, stock movements, agricultural activity, and the like are not in the model and these may contribute significantly to TSP concentrations. To improve the agreement between the predicted annual average TSP concentrations and measured values the assumed annual average background level has been set at 27 $\mu g/m^3$ rather than 10 $\mu g/m^3$. Fortunately, annual average TSP concentrations are not the critical factor in determining the areas of impact. As will be seen later, the critical assessment criteria are the 24-hour PM_{10} and annual average PM_{10} concentrations.

Table 11. Predicted and (measured) dust concentration and deposition level for 2006

ID	Annual average deposition (insoluble solids) g/m^2/month	Maximum 24-hour average PM_{10} concentration - $\mu g/m^3$	Annual average PM_{10} concentration - $\mu g/m^3$	Annual average TSP concentration - $\mu g/m^3$
Stapleton	1.0	(39.1) 52.7	(22.2) 20.4	27.6
Cheshunt-Barry	3.4	122.5	46.2	66.0
Moxey	1.4	(90.6) 93.9	(20.4) 22.0	(55.5) 30.4
Knodlers Lane	1.9	116.5	26.4	36.1
HV2	2.4	114.3	29.8	(53.5) 41.0
Previous Warkworth School	2.1	(95.2) 85.9	(30.6) 33.6	(60.4) 46.3
Wandewoi-Moses	0.9	(57.9) 98.4	(15.6) 22.4	(45.1) 29.7
Oaklands	1.1	(64.6) 65.2	(23.0) 23.7	31.8
D1	0.0	0.0	0.0	0.0
D101	1.1	86.4	24.6	33.1

Table 11. Predicted and (measured) dust concentration and deposition level for 2006

ID	Annual average deposition (insoluble solids) g/m^2/month	Maximum 24-hour average PM_{10} concentration - $\mu g/m^3$	Annual average PM_{10} concentration - $\mu g/m^3$	Annual average TSP concentration - $\mu g/m^3$
D102	1.0	74.6	21.4	29.0
D103	1.1	84.2	26.6	34.9
D104	1.2	93.6	28.8	37.6
D105	10.9	275.7	94.8	143.3
D107	5.0	159.8	43.5	66.0
D110	1.2	100.1	25.1	35.5
D112	0.9	97.7	22.3	29.5
D114	3.9	149.6	50.3	70.3
D116	2.7	102.8	38.6	54.1
D15	0.0	0.0	0.0	0.0
D16	0.0	0.0	0.0	0.0
D19	3.2	116.9	44.1	62.7
D2A	0.0	0.0	0.0	0.0
D3	0.0	0.0	0.0	0.0
D32	1.5	61.0	28.1	37.9
D33	1.1	54.9	22.4	30.8
D34	1.1	61.5	22.6	31.0
D5	1.4	99.4	25.0	37.5
D7A	1.1	84.7	24.9	33.0
D8	0.0	0.0	0.0	0.0
D9	18.7	278.1	114.0	204.3
DCL	0.0	0.0	0.0	0.0
DL1	1.3	67.6	27.5	36.4
DL10	1.4	92.9	22.9	31.4
DL14	1.4	94.3	22.1	30.5
DL17	3.5	175.7	35.6	50.0
DL2	1.0	54.9	21.1	28.3
DL21	1.9	107.0	26.0	36.1
DL22	1.8	107.4	25.4	34.7
DL23	1.7	103.1	24.3	33.2
DL30	2.1	86.0	32.9	44.2
DL4	0.9	51.9	18.3	25.3
DL43	2.9	201.3	56.2	72.9
DL44	2.6	177.8	45.1	61.0
DL45	1.2	86.3	19.8	27.5
Knodlers Lane	1.7	96.7	23.5	32.6
Moses Crossing	0.8	61.6	17.5	24.3
Jerrys Plains	0.7	(27.9) 41.1	(14.3) 14.5	20.8

Note: The annual average values in the table include the effects of dust from all mining sources and the dust from non-mining sources. The allowances are 5 $\mu g/m^3$ for annual average PM_{10} and 10 $\mu g/m^3$ for TSP. For all subsequent tables and for all figures showing cumulative annual average TSP concentrations, the allowance for the contribution from remote sources has been set at 27 $\mu g/m^3$. This was done because it gives a better agreement between predicted and measured values. The predicted 24-hour values do not include any allowance for emissions from remote sources.

9.2 *Mine Plan Scenario A (Approximately Year 2010)*

In the mine plan for Scenario A, mining will be occurring in the Cheshunt and Riverview Pits and South Lemington Pit 2. The Cheshunt Pit will be producing approximately 4.9 Mtpa and the Riverview Pit and South Lemington Pit 2 approximately 5.7 Mtpa of ROM coal (combined) (see *Section 4.3*).

Figures 18 to *25* show respectively the predicted:

- Maximum 24-hour average PM_{10} concentrations;
- Predicted annual average PM_{10} concentrations;
- Predicted annual average TSP concentrations;
- Predicted annual average (insoluble solids) deposition levels;
- Maximum 24-hour average PM_{10} concentrations with other mines;
- Predicted annual average PM_{10} concentrations with other sources;
- Predicted annual average TSP concentrations with other sources, and;
- Predicted annual average (insoluble solids) deposition levels.

Table 2 summarises the impacts at all assessment locations.

Table 12. Summary of predicted air quality impacts for Scenario A[9]

ID	Maximum 24-hour PM_{10} concentration due to HVO South in isolation - µg/m^3	Annual average PM_{10} concentration due to HVO South in isolation- µg/m^3	Annual average TSP concentration due to HVO South in isolation - µg/m^3	Annual average dust (insoluble solids) deposition due to HVO South in isolation – g/m^2/month	Maximum 24-hour PM_{10} concentration due to HVO South and other sources - µg/m^3	Annual average PM_{10} concentration due to HVO South and other sources µg/m^3	Annual average TSP concentration due to HVO South and other sources - µg/m^3	Annual average dust (insoluble solids) deposition due to HVO South and other sources – g/m^2/month
3	34.8	3.6	4.4	0.1	n/a	22.4	51.2	1.3
4	25.2	2.7	3.2	0.1	n/a	23.7	52.6	1.4
5	**78.6**	9.8	12.5	0.8	n/a	27.2	58.5	2.3
7[1]	27.8	1.9	2.1	0.0	n/a	22.6	51.3	1.4
8[2]	24.2	5.0	5.6	0.1	n/a	27.3	56.7	1.6
10[1]	39.7	8.5	10.3	0.4	n/a	28.6	58.1	1.5
13	18.4	3.0	3.6	0.1	n/a	19.3	47.6	1.2
16	**80.7**	10.3	13.1	0.9	n/a	29.0	59.7	2.0
17	**70.8**	9.7	12.3	0.8	n/a	26.6	57.2	2.0
19	34.7	3.5	4.1	0.1	n/a	22.8	51.7	1.3
23[1]	22.3	2.3	2.8	0.1	n/a	39.5	74.2	2.8
24	**72.8**	9.9	12.7	0.8	n/a	26.7	57.6	2.1
31	29.8	3.1	3.6	0.1	n/a	23.5	52.4	1.4
32	**80.6**	10.9	13.9	0.9	n/a	28.8	59.7	2.1
33[2]	38.6	4.3	5.4	0.3	n/a	42.9	76.8	2.5
34	**68.9**	9.4	11.9	0.7	n/a	26.3	56.7	2.0
36	30.4	3.1	3.7	0.1	n/a	23.7	52.8	1.4
38[1]	35.9	4.3	5.4	0.3	n/a	50.7	85.5	2.8
43[2]	42.3	5.0	6.3	0.4	n/a	41.8	75.4	2.5
45[1]	38.7	4.3	5.3	0.3	n/a	41.6	75.8	2.5
47	**74.4**	7.6	9.4	0.5	n/a	25.2	56.1	2.1
61	**77.4**	8.8	11.1	0.6	n/a	26.3	57.3	2.2

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. These residences are owned by mining companies other than CNA.
3. No prediction is available for maximum 24-hour PM10 concentration due to HVO South and other sources.
4. Bold numbers indicate exceedance of limits where applicable for private residences not currently within a zone of affectation or owned by mining companies other than CNA.

[9] Note, the cumulative annual average PM_{10}, TSP and deposition levels include allowances of 5 µg/m^3 27 µg/m^3 and 0.5 g/m^2/month to allow for non-modelled background source respectively.

It can be seen that there are some predicted exceedances (bolded) of the 50 $\mu g/m^3$ 24-hour PM_{10} concentration at Locations 5, 16, 17, 24, 32, 34, 47 and 61. Inspection of *Figure 18* shows that these residences are located in the Maison Dieu area to the southeast. A real time air quality monitoring programme is already in place at Maison Dieu. This will need to be continued and refined to deal with these exceedances to protect air quality under unfavourable conditions.

The annual average 30 $\mu g/m^3$ assessment criterion for PM_{10} is also predicted to be exceeded at Locations 23, 33, 38, 43 and 45. This is a result of the cumulative effects of emissions from all sources but in particular Wambo, Warkworth and HVO South. HVO South is predicted to contribute no more than 5.0 $\mu g/m^3$ (i.e. 17% of the assessment criterion). It is important to note that all five of these residences are either within a zone of affectation, subject to a private land holder's agreement with mines other than HVO or owned by mining companies other then CNA.

9.3 Mine Plan Scenario B1 (Approximately Year 2014)

In the mine plan for Scenario B1, mining will continue in the Cheshunt and Riverview Pit and South Lemington Pit 1. The pits will be producing approximately 10.6, 4.3 and 0.05 Mtpa.of ROM coal (see *Section 4,4*).

Figures 26 to *33* show respectively the predicted:

- Maximum 24-hour average PM_{10} concentrations;
- Predicted annual average PM_{10} concentrations;
- Predicted annual average TSP concentrations;
- Predicted annual average (insoluble solids) deposition levels;
- Maximum 24-hour average PM_{10} concentrations with other mines;
- Predicted annual average PM_{10} concentrations with other sources;
- Predicted annual average TSP concentrations with other sources, and;
- Predicted annual average (insoluble solids) deposition levels.

In the following three tables, no value is provided for the predicted maximum 24-hour cumulative PM_{10} concentrations. This is because the very highest values are likely to be determined by emissions from bushfires and other unusual events not associated with mining or other sources that can be reliably modelled. However, model predictions of the maximum concentrations likely to arise due to emissions from mining and source have been present as contour plots. These show only the effects of mining emissions and do not include any effects from other sources. They should not be compared with days in the future when bushfire or distant dust storms are having a significant effect on air quality.

Table 3 summarises the impacts at all assessment locations.

Table 13. Summary of predicted air quality impacts for Scenario B1[10]

ID	Maximum 24-hour PM_{10} concentration due to HVO South in isolation - µg/m³	Annual average PM_{10} concentration due to HVO South in isolation- µg/m³	Annual average TSP concentration due to HVO South in isolation - µg/m³	Annual average dust (insoluble solids) deposition due to HVO South in isolation – g/m²/month	Maximum 24-hour PM_{10} concentration due to HVO South and other sources - µg/m³	Annual average PM_{10} concentration due to HVO South and other sources µg/m³	Annual average TSP concentration due to HVO South and other sources - µg/m³	Annual average dust (insoluble solids) deposition due to HVO South and other sources – g/m²/month
3	48.1	5.5	6.5	0.2	n/a	16.8	40.5	0.8
4	40.9	4.4	5.0	0.1	n/a	16.7	40.4	0.8
5	**85.3**	12.9	15.5	0.7	n/a	22.8	48.1	1.3
7[1]	42.5	4.1	4.5	0.1	n/a	17.3	40.7	0.8
8[2]	49.2	9.7	10.7	0.2	n/a	23.3	47.4	1.0
10[1]	57.8	11.4	13.4	0.4	n/a	24.3	49.0	1.0
13	29.8	4.4	5.1	0.1	n/a	13.9	37.3	0.7
16	**134.1**	24.0	30.0	1.6	n/a	**33.9**	62.4	2.2
17	**95.0**	16.9	20.5	0.9	n/a	26.5	52.6	1.5
19	**50.2**	5.3	6.3	0.1	n/a	17.0	40.8	0.8
23[1]	31.2	3.8	4.4	0.1	n/a	28.0	55.0	1.6
24	**84.3**	15.4	18.8	0.9	n/a	25.1	51.0	1.5
31	48.0	4.9	5.7	0.1	n/a	17.1	40.9	0.8
32	**138.0**	23.2	28.6	1.4	n/a	**33.1**	61.0	2.0
33[2]	47.2	6.9	8.1	0.3	n/a	33.2	60.7	1.8
34	**101.5**	17.2	20.8	0.9	n/a	26.7	52.8	1.6
36	49.7	5.2	6.0	0.1	n/a	17.5	41.4	0.8
38[1]	46.7	6.6	7.9	0.3	n/a	39.6	67.8	1.9
43[2]	50.8	7.9	9.4	0.4	n/a	32.9	60.1	1.7
45[1]	42.4	7.0	8.2	0.3	n/a	32.6	60.3	1.8
47	**81.9**	9.6	11.3	0.4	n/a	19.7	44.0	1.0
61	**84.1**	11.2	13.3	0.5	n/a	21.1	45.9	1.2

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. These residences are owned by mining companies other than CNA.
3. No prediction is available for maximum 24-hour PM10 concentration due to HVO South and other sources.
4. Bold numbers indicate exceedance of limits where applicable for private residences not currently within a zone of affectation or owned by mining companies other than CNA.

It can be seen that there are predicted exceedances (bolded) of the 50 µg/m³ 24-hour PM_{10} concentration at Location No's 5, 10, 16, 17, 19, 24, 32, 34, 47 and 61. Inspection of *Figure 26* shows that these residences are located in the Maison Dieu area to the south east with exception of Location No. 19 which is located towards Jerrys Plains. As noted, the existing real time monitoring programme will need to be continued and refined to protect air quality under unfavourable conditions.

The annual average 30 µg/m³ assessment criterion for PM_{10} is also predicted to be exceeded at Location No's 16, 32, 33, 38, 43 and 45. This again is a result of the cumulative effects of emissions from all sources but in particular Wambo, Warkworth and HVO South. It should be noted that only Location No.16 and 32 are privately owned.

[10] Note, the cumulative annual average PM_{10}, TSP and deposition levels include allowances of 5 µg/m³ 27 µg/m³ and 0.5 g/m²/month to allow for non-modelled background source respectively.

9.4 Mine Plan Scenario C1 (Approximately Year 2019)

In mine plan Scenario C1 mining will continue in the Cheshunt Pit. The Cheshunt Pit will be producing approximately 10.6 Mtpa of ROM coal and mining in the Riverview and South Lemington Pits will be completed (see *Section 4.5*).

Figures 34 to *41* show respectively the predicted:

- Maximum 24-hour average PM_{10} concentrations;
- Predicted annual average PM_{10} concentrations;
- Predicted annual average TSP concentrations;
- Predicted annual average (insoluble solids) deposition levels;
- Maximum 24-hour average PM_{10} concentrations with other mines;
- Predicted annual average PM_{10} concentrations with other sources;
- Predicted annual average TSP concentrations with other sources; and
- Predicted annual average (insoluble solids) deposition levels.

Table 4 summarises the impacts at all assessment locations.

Table 14. Summary of predicted air quality impacts for Scenario C1[11]

ID	Maximum 24-hour PM_{10} concentration due to HVO South in isolation - µg/m^3	Annual average PM_{10} concentration due to HVO South in isolation- µg/m^3	Annual average TSP concentration due to HVO South in isolation - µg/m^3	Annual average dust (insoluble solids) deposition due to HVO South in isolation – g/m^2/month	Maximum 24-hour PM_{10} concentration due to HVO South and other sources - µg/m^3	Annual average PM_{10} concentration due to HVO South and other sources µg/m^3	Annual average TSP concentration due to HVO South and other sources - µg/m^3	Annual average dust (insoluble solids) deposition due to HVO South and other sources – g/m^2/month
3	19.7	1.7	2.0	0.0	n/a	14.0	19.0	1.1
4	16.6	1.4	1.6	0.0	n/a	13.7	18.7	1.1
5	**77.6**	6.3	7.8	0.4	n/a	19.2	24.2	1.4
7[1]	16.1	1.2	1.4	0.0	n/a	17.6	22.6	1.1
8[2]	16.0	2.7	3.0	0.1	n/a	17.4	22.4	1.1
10[1]	33.2	4.2	5.0	0.2	n/a	16.9	21.9	1.2
13	15.3	1.6	1.9	0.1	n/a	13.6	18.6	1.1
16	**74.9**	10.0	12.8	0.8	n/a	22.9	27.9	1.9
17	**59.8**	8.0	10.1	0.6	n/a	20.7	25.7	1.6
19	18.5	1.6	1.9	0.0	n/a	13.9	18.9	1.1
23[1]	17.5	1.4	1.6	0.0	n/a	22.0	27.0	1.4
24	**67.2**	7.7	9.8	0.6	n/a	20.4	25.4	1.6
31	16.1	1.5	1.7	0.0	n/a	13.9	18.9	1.1
32	**72.3**	10.2	13.0	0.8	n/a	23.0	28.0	1.9
33[2]	26.1	2.4	2.9	0.1	n/a	25.2	30.2	1.6
34	**55.4**	8.0	10.1	0.6	n/a	20.6	25.6	1.6
36	17.0	1.6	1.8	0.0	n/a	14.0	19.0	1.1
38[1]	26.8	2.4	3.0	0.1	n/a	32.3	37.3	1.9
43[2]	29.0	2.7	3.3	0.1	n/a	24.8	29.8	1.6
45[1]	24.3	2.4	2.8	0.1	n/a	22.9	27.9	1.5
47	49.4	4.2	5.0	0.2	n/a	17.2	22.2	1.3
61	**69.1**	5.4	6.5	0.3	n/a	18.2	23.2	1.3

1. These private residences are currently inside a zone of affectation or subject to a private land holder's agreement with mines other than HVO.
2. These residences are owned by mining companies other than CNA.
3. No prediction is available for maximum 24-hour PM10 concentration due to HVO South and other sources.
4. Bold numbers indicate exceedance of limits where applicable for private residences not currently within a zone of affectation or owned by mining companies other than CNA.

It can be seen that there are seven predicted exceedances of the 50 µg/m^3 24-hour PM_{10} concentration comprising Locations 5, 16, 17, 24, 32, 34 and 61. Inspection of *Figure 34* shows that these residences are located in the Maison Dieu area and the existing real-time management system will need to be continued and refined to protect air quality under unfavourable conditions.

[11] Note, the cumulative annual average PM_{10}, TSP and deposition levels include allowances of 5 µg/m^3 27 µg/m^3 and 0.5 g/m^2/month to allow for non-modelled background source respectively.

10 MITIGATION MEASURES AND COMMITMENTS

10.1 Air quality management

The management of air quality across HVO South is governed by CNA Environmental Management System (EMS) procedures and management plans. In addition, current development consents have required specific management practices.

EMS Procedures include:

- 8.1 - CPP Dust Management; and

- 8.2 - Dust Management, Mobile Equipment.

The key objective of Procedure 8.1 is to ensure that dust emissions from the use of fixed plant and equipment is appropriately managed and minimised. The procedure requires the implementation of management procedures for dust generation at ROM coal hoppers, coal stockpiles (during stacking and reclaiming), rail loading facilities, mobile equipment operations, dust suppression on trafficable areas and dust suppression and maintenance activities. The procedure includes photographic examples of acceptable and unacceptable dust generation during operations. In addition, roles and responsibilities for dust management are outlined.

The objectives of Procedure 8.2 are:

- to ensure that visible dust is kept to a practicable minimum and is consistently controlled by best practice dust management systems;

- to minimise dust nuisance to neighbouring residents;

- to keep the concentration of respirable dust in the work place below NHMRC guidelines; and

- to specify the dust management measures to be taken at all CNA sites.

The procedure requires the implementation of measures for dust suppression on haul roads, work areas and dumps, dragline operations, drilling operations and blasting and dust management on public roads. The requirement to cease operational components during adverse weather conditions is also stipulated and responsibility for management delegated throughout the document. Other mitigation measures include:

- awareness through environmental inductions to ensure that relevant employees are aware of potential impacts from equipment and its operation on sensitive locations;

- ensuring that dust emissions from the use of fixed plant and equipment is appropriately managed and minimised;

- minimising the area of disturbance with restrictions on clearing, topsoil stripping and access to disturbed areas;

- progressive rehabilitation of disturbed areas;

- applying dust suppression on trafficable areas, active exposed areas and during operations that generate dust as required by weather conditions at the time; and

- keeping the concentration of respirable dust in the work place below regulatory guidelines.

In addition, an air quality management plan has been required by past approval conditions. This plan will be further amended to reflect commitments relating to this proposal.

The objectives of the Air Quality Management Plan are:

- ensure that statutory requirements and corporate standards are met;
- manage the operations in a way that minimises air quality impacts to environment and neighbours, and limits interference to mining production;
- minimise dust generation from mining activities;
- review emissions from operations against model predictions and modify activities to ensure limits are not exceeded; and
- keep the local community and regulators informed of activities where required and respond quickly and effectively to issues and complaints.

The plan outlines air quality related key environmental issues, performance criteria, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures. It also provides broad management measures to be implemented to mitigate potential impacts resulting from dust generated during construction and operation.

Further, the mine plan has been developed with a view to controlling dust emissions and keeping emissions to the lowest levels practicable. Exposed areas will be kept to the minimum practicable, haul roads will be kept to the shortest routes practicable and material handling will be kept to the minimum levels practicable. Most of these measures are automatically applied as part of the efficient design of the mine.

10.2 Monitoring

CNA EMS Procedure 1.10 – Monitoring and Measurement outlines methods for the monitoring and measurement of air quality to ensure it provides credible data for performance measurement and to confirm compliance with regulatory requirements and corporate objectives and targets. In addition, a repository of air quality emission data supports planning, performance improvement, community relations and occupational health and safety initiatives.

CNA will regularly measure dust deposition, TSP and PM_{10} concentrations at nearby locations and the meteorological conditions that apply in the area. These data are assessed against the criteria in *Section 5*. The current programme covers the Cheshunt and Riverview Pits as shown on *Figure 4*.

A real time air quality monitoring programme is currently in place at Maison Dieu. This will be continued and refined to protect air quality under unfavourable conditions.

10.3 Research

CNA is a sponsor, with other companies, of a research programme to develop a meteorological prediction system that will provide detailed weather forecasts for the Hunter Valley. The research is being undertaken within the Australian Coal Association Research Program (ACARP) with special funds being provided by a consortium of coal mining companies in the Hunter Valley to purchase an acoustic sounder and radio acoustic sounding system (RASS).

The acoustic sounder and RASS will provide detailed temperature and wind profiles in the vertical up to a height of approximately 1 km at a site located on CNA land near the Carrington Pit. Data from this system and from the other network of meteorological monitors in the Hunter Valley will be used with the MM5 medium scale meteorological model to refine standard Bureau of Meteorology forecasts to take account of detailed terrain, landuse and particular conditions that apply in the Hunter Valley.

The objective of the system is to provide mining companies with detailed information on wind and temperature conditions, as they are likely to develop in the short-term, over a six to 12-hour time frame. The forecast data will extend to heights of up to 1 km (approximately) and will provide mine operators with valuable data on the likely transport of dust from blasting and surface sources. It will also assist in the better management of blast overpressure and noise because it will provide information on inversion strengths and the expected break up times of inversions.

11 SUMMARY AND CONCLUSIONS

The assessment includes model predictions of air quality for 2006. The predictions have been compared with monitoring results for the same period. This allows the performance of the model to be assessed. The remainder of the assessment focuses on impacts for three future operational scenarios representing cases that would be expected to give rise to the worst case impacts on neighbouring residential areas.

Air quality impacts have been assessed in accordance with the principles set out in the DECC's approved methods for the assessment of air quality impacts using dispersion modelling (DECC, 2005). Predicted 24-hour average PM_{10} concentrations, annual average PM_{10}, TSP concentrations, and annual average dust (insoluble solids) deposition levels have been compared with the DECC's assessment criteria.

The assessment has been conducted using a modified version of the ISCMOD, with local meteorological data and estimates of the emissions associated with mining. Model predictions include emissions from a range of nearby mines and an allowance for background emissions of particulate matter from non-mining sources.

The model results are summarised in *Table 5*, which identifies those locations which are predicted to experience exceedances of the DECC's assessment criteria.

The air quality impact assessment predicts that some residences in the Maison Dieu area will experience some exceedances of the DECC's 50 $\mu g/m^3$ 24-hour assessment criterion due to emissions from HVO South alone. These will need to be managed via the real time monitoring and air quality management system. The predicted annual average PM_{10}, TSP and deposition levels in the Maison Dieu area all comply with the relevant assessment criteria.

Some residences in the Warkworth Village area are also predicted to experience 24-hour PM_{10} levels above the DECC's 50 $\mu g/m^3$ 24-hour assessment criterion. However, on this occasion, the exceedances are due to cumulative effects and emissions from HVO South play a relatively minor role in the total exceedances. The same locations are also predicted to experience exceedances of the 30 $\mu g/m^3$ annual average PM_{10} assessment criterion and again these exceedances are largely a result of cumulative effects with HVO South's emissions playing a relatively minor role. It is important to note that residences within Warkworth Village are either within a zone of affectation, subject to a private land holder's agreement with mines other than HVO or owned by mining companies other then CNA.

The emissions from the project or from the project and cumulative effects of other sources are not predicted to experience exceedances of the assessment criteria at locations to the west and in the Jerrys Plains area. However, occasional exceedances of the DECC's 24-hour PM_{10} concentration criteria of 50 $\mu g/m^3$ will occur from time to time as occurs over most of Australia as a result of bushfire smoke and remote dust storms.

Table 15. Summary of locations predicted to exceed indicated assessment criteria

Location.	2006				Mine Plan A (approximately 2010)				Mine Plan B1 (approximately 2014)				Mine Plan C1 (approximately 2019)			
	24-hour PM_{10}	Annual. average PM_{10}	Annual average TSP	Annual average deposition	24-hour PM_{10}	Annual average PM_{10}	Annual average TSP	Annual average deposition	24-hour PM_{10}	Annual average PM_{10}	Annual average TSP	Annual average depositions	24-hour PM_{10}	Annual average PM_{10}	Annual average TSP	Annual average deposition
3																
4																
5	X				X				X				X			
7																
8																
10									X							
13																
16	X				X				X	X			X			
17	X				X				X				X			
19									X							
23		X				X										
24	X				X				X				X			
31																
32	X				X				X	X			X			
33		X			X	X				X						
34	X				X				X				X			
36														X		
38		X			X	X				X						
43		X				X			X	X						
45		X				X				X						
47	X				X				X							
61	X				X				X				X			

Note: A cross indicates a predicted exceedance of the relevant DECC assessment criterion. A blank cell indicates that the predicted level is less than the DECC criterion.

12 REFERENCES

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APPENDIX A
EMISSION FACTOR EQUATIONS USED IN ESTIMATING DUST EMISSIONS

Dragline operations

The US EPA AP42 emissions factor equation for a dragline moving overburden is presented as Equation 1 (see Chapter 11 Section 9 Table 11.9-2).

Equation 1.

$$E_{TSP} = 0.0046 \times \left(\frac{d^{1.1}}{M^{0.3}} \right) \qquad \text{kg/bcm}$$

$$\begin{aligned} &\text{where,} \\ &d = \text{drop height (m)} \\ &M = \text{moisture content (\%)} \\ &[\text{where } 0.2 \le M \le 16.3 \\ &\text{and d is between } 1.5 \text{ to } 30.5 \text{ m}] \end{aligned}$$

If the moisture content of the overburden is taken to be 1% and the drop height 7 m the estimated TSP emission is 0.039 kg/bcm.

Loading and unloading overburden from trucks

The US EPA AP42 emissions factor equation for the transfer of material is including overburden is presented as Equation 2 (see Chapter 11.2, Table 11.9-2).

Equation 2

$$E_{TSP} = k \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2} \right)^{1.3}}{\left(\frac{M}{2} \right)^{1.4}} \right) \qquad \text{kg/t}$$

$$\begin{aligned} &\text{where,} \\ &k = 0.74 \\ &U = \text{wind speed (m/s)} \\ &M = \text{moisture content (\%)} \\ &[\text{where } 0.25 \le M \le 4.8] \end{aligned}$$

The equation includes the effects of wind speed. For the meteorological data used in the modelling (data from the HVO Corporate Centre meteorological station for 2002) the annual average of $(U/2.2)^{1.3}$ was 1.643. Assuming that the moisture content of the overburden is 1%, the TSP emission factor will be 0.002 kg/t.

Transporting coal or overburden

The uncontrolled emission factor for trucks hauling coal or overburden is 4 kg/VKT. For this study, it has been assumed that 75% control can be achieved via the application of water to the haul roads using water carts. The TSP emission factor after controls would then be 1 kg/VKT.

Dozers on overburden

The US EPA AP42 emissions factor equation for a dozer working on overburden is presented as Equation 3 (see Chapter 11.2, Table 11.9-2).

Equation 3.

$$E_{TSP} = 2.6 \times \frac{s^{1.2}}{M^{1.3}} \qquad \text{kg/hour}$$

where,
$s = \text{silt content (\%), and}$
$M = \text{moisture content (\%)}$

Taking M to be 2% and s to be 10%, the emission factor is estimated to be approximately 16.7 kg/hour.

Dozers ripping coal and partings
The US EPA emission factor equation for a dozer working on coal or partings is presented as Equation 4 (see Chapter 11 Section 9 Table 11.9-2).

Equation 4

$$E_{TSP} = 35.6 \times \frac{s^{1.2}}{M^{1.4}} \qquad \text{kg/hour}$$

where,
$s = \text{silt content (\%), and}$
$M = \text{moisture content (\%)}$

Taking M to be 5% and s to be 10%, the emission factor is estimated to be approximately 59.3 kg/hour.

Loading coal to trucks
The US EPA emission factor equation for coal being loaded to trucks is is presented as Equation 5 (see Chapter 11.2, Table 11.9-2).

Equation 5

$$E_{TSP} = \frac{0.580}{M^{1.2}} \qquad \text{kg/hour}$$

where,
$M = \text{moisture content (\%)}$

Taking M to be 5%, the emission factor is estimated to be approximately 0.084 kg/hour

Graders on roads
The US EPA emission factor equation for a dozer working on coal or partings is presented as Equation 4 (see Chapter 11.2, Table 11.9-2).

Equation 4

$$E_{TSP} = 0.0034 \times S^{2.5} \qquad \text{kg/vkt}$$

where $S = \text{speed of the grader in km/h}$

Assuming an average speed of 8 km/h, the emission factor is 0.62 kg/VKT.

Blasting O/B

TSP emissions from blasting can be estimated using the US EPA (1985) emission factor equation given in Equation 5.

Equation 5

$$E_{TSP} = 0.00022 \times A^{1.5} \qquad \text{kg/blast}$$

where :

A = area to be blasted in m^2

Wind erosion

The estimation of TSP emissions due to wind erosion have been calculated using the single-value factor of 0.4 kg/ha/hour developed by the State Pollution Control Commission (**SPCC, 1983**).

APPENDIX B:
Joint wind speed, wind direction and stability class tables and other data

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.010875	0.002060	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.013164
NE	0.008585	0.002060	0.000114	0.000114	0.000000	0.000000	0.000000	0.000000	0.010875
ENE	0.010760	0.001717	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.012592
E	0.013049	0.006639	0.001374	0.000000	0.000000	0.000000	0.000000	0.000000	0.021062
ESE	0.023466	0.031136	0.019689	0.010875	0.002976	0.000801	0.000000	0.000000	0.088942
SE	0.031250	0.065362	0.056548	0.031822	0.005838	0.000458	0.000000	0.000000	0.191277
SSE	0.031250	0.066850	0.036401	0.006181	0.000229	0.000000	0.000000	0.000000	0.140911
S	0.013278	0.013965	0.005266	0.000572	0.000114	0.000000	0.000000	0.000000	0.033196
SSW	0.006410	0.002175	0.000916	0.000000	0.000000	0.000000	0.000000	0.000000	0.009501
SW	0.006868	0.002633	0.000229	0.000229	0.000000	0.000000	0.000000	0.000000	0.009959
WSW	0.006410	0.002404	0.001030	0.000114	0.000000	0.000000	0.000000	0.000000	0.009959
W	0.016598	0.015911	0.006983	0.004350	0.002175	0.001145	0.000458	0.000000	0.047619
WNW	0.027129	0.050595	0.067651	0.030792	0.018887	0.008585	0.003549	0.001259	0.208448
NW	0.019689	0.030678	0.044872	0.028846	0.015682	0.007555	0.001946	0.000687	0.149954
NNW	0.012706	0.006868	0.005952	0.005151	0.003205	0.001145	0.000343	0.000000	0.035371
N	0.011103	0.003777	0.001832	0.000458	0.000000	0.000000	0.000000	0.000000	0.017170
CALM									0.000000
TOTAL	0.249428	0.304831	0.249199	0.119505	0.049107	0.019689	0.006296	0.001946	1.000000

MEAN WIND SPEED (m/s) = 3.06
NUMBER OF OBSERVATIONS = 8736

STATISTICS FOR FILE: C:\Jobs\HVOSouth\Met\2002.ISC
MONTHS: All
HOURS : All
OPTION: Frequency

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.002289	0.001603	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.004006
NE	0.002976	0.001030	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.004121
ENE	0.002404	0.001145	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003549
E	0.004579	0.004006	0.000458	0.000000	0.000000	0.000000	0.000000	0.000000	0.009043
ESE	0.004464	0.014538	0.003663	0.000229	0.000000	0.000000	0.000000	0.000000	0.022894
SE	0.004121	0.013393	0.004579	0.000343	0.000000	0.000000	0.000000	0.000000	0.022436
SSE	0.003663	0.004808	0.000687	0.000000	0.000000	0.000000	0.000000	0.000000	0.009158
S	0.002289	0.001488	0.000458	0.000000	0.000000	0.000000	0.000000	0.000000	0.004235
SSW	0.001374	0.000458	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.002060
SW	0.001488	0.000687	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.002289
WSW	0.001946	0.000572	0.000343	0.000114	0.000000	0.000000	0.000000	0.000000	0.002976
W	0.003320	0.002633	0.000229	0.000343	0.000000	0.000000	0.000000	0.000000	0.006525
WNW	0.003091	0.007212	0.002289	0.001030	0.000000	0.000000	0.000000	0.000000	0.013622
NW	0.005838	0.007326	0.002976	0.001030	0.000000	0.000000	0.000000	0.000000	0.017170
NNW	0.002862	0.002747	0.000687	0.000000	0.000000	0.000000	0.000000	0.000000	0.006296
N	0.003091	0.001603	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.004922
CALM									0.000000
TOTAL	0.049794	0.065247	0.017056	0.003205	0.000000	0.000000	0.000000	0.000000	0.135302

MEAN WIND SPEED (m/s) = 2.03
NUMBER OF OBSERVATIONS = 1182

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000229	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000343
NE	0.000343	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000458
ENE	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000343
E	0.000572	0.000458	0.000458	0.000000	0.000000	0.000000	0.000000	0.000000	0.001488
ESE	0.001374	0.005151	0.006410	0.001603	0.000000	0.000000	0.000000	0.000000	0.014538
SE	0.000801	0.011447	0.011561	0.003434	0.000000	0.000000	0.000000	0.000000	0.027244
SSE	0.000572	0.002060	0.002404	0.000114	0.000000	0.000000	0.000000	0.000000	0.005151
S	0.000458	0.000343	0.001145	0.000000	0.000000	0.000000	0.000000	0.000000	0.001946
SSW	0.000229	0.000114	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000458
SW	0.000229	0.000229	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000572
WSW	0.000114	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000229
W	0.000572	0.001603	0.000572	0.000572	0.000000	0.000000	0.000000	0.000000	0.003320
WNW	0.001946	0.006525	0.003549	0.003892	0.000000	0.000000	0.000000	0.000000	0.015911
NW	0.001030	0.004464	0.003892	0.002976	0.000000	0.000000	0.000000	0.000000	0.012363
NNW	0.000572	0.000687	0.001030	0.000916	0.000000	0.000000	0.000000	0.000000	0.003205
N	0.000114	0.000229	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.000687
CALM									0.000000
TOTAL	0.009501	0.033425	0.031708	0.013622	0.000000	0.000000	0.000000	0.000000	0.088255

MEAN WIND SPEED (m/s) = 3.14
NUMBER OF OBSERVATIONS = 771

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
NE	0.000229	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000572
ENE	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000229
E	0.000343	0.000229	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000687
ESE	0.001717	0.001603	0.003320	0.005723	0.000000	0.000000	0.000000	0.000000	0.012363

SE	0.001946	0.008814	0.012592	0.012821	0.000000	0.000000	0.000000	0.000000	0.036172
SSE	0.001030	0.008127	0.012706	0.003434	0.000000	0.000000	0.000000	0.000000	0.025298
S	0.000229	0.002175	0.001717	0.000114	0.000000	0.000000	0.000000	0.000000	0.004235
SSW	0.000572	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000687
SW	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
WSW	0.000343	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000458
W	0.000687	0.002289	0.000801	0.000343	0.000000	0.000000	0.000000	0.000000	0.004121
WNW	0.003663	0.009272	0.014995	0.011676	0.000000	0.000000	0.000000	0.000000	0.039606
NW	0.001374	0.004922	0.007097	0.008013	0.000000	0.000000	0.000000	0.000000	0.021406
NNW	0.000572	0.000458	0.000687	0.001259	0.000000	0.000000	0.000000	0.000000	0.002976
N	0.000229	0.000229	0.000572	0.000343	0.000000	0.000000	0.000000	0.000000	0.001374
CALM									0.000000
TOTAL	0.013278	0.038805	0.054602	0.043727	0.000000	0.000000	0.000000	0.000000	0.150412

MEAN WIND SPEED (m/s) = 3.57
NUMBER OF OBSERVATIONS = 1314

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001946	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001946
NE	0.000572	0.000229	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000916
ENE	0.001259	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001488
E	0.000801	0.000114	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.001145
ESE	0.002862	0.002976	0.005952	0.003320	0.002976	0.000801	0.000000	0.000000	0.018887
SE	0.007097	0.018544	0.027244	0.015224	0.005838	0.000458	0.000000	0.000000	0.074405
SSE	0.008127	0.028388	0.020147	0.002518	0.000229	0.000000	0.000000	0.000000	0.059409
S	0.001488	0.002633	0.001259	0.000343	0.000114	0.000000	0.000000	0.000000	0.005838
SSW	0.000687	0.000572	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.001603
SW	0.000916	0.000343	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.001374
WSW	0.001145	0.000458	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.001946
W	0.002175	0.003663	0.004579	0.003091	0.002175	0.001145	0.000458	0.000000	0.017285
WNW	0.007097	0.016369	0.040522	0.013507	0.018887	0.008585	0.003549	0.001259	0.109776
NW	0.002976	0.008814	0.027473	0.016598	0.015682	0.007555	0.001946	0.000687	0.081731
NNW	0.002518	0.001717	0.003320	0.002976	0.003205	0.001145	0.000343	0.000000	0.015224
N	0.002175	0.000916	0.000687	0.000114	0.000000	0.000000	0.000000	0.000000	0.003892
CALM									0.000000
TOTAL	0.043842	0.085966	0.132212	0.057807	0.049107	0.019689	0.006296	0.001946	0.396864

MEAN WIND SPEED (m/s) = 4.07
NUMBER OF OBSERVATIONS = 3467

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001374	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001488
NE	0.001030	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001145
ENE	0.001488	0.000114	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.001717
E	0.001603	0.001030	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.002747
ESE	0.004693	0.005380	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.010417
SE	0.008585	0.011561	0.000572	0.000000	0.000000	0.000000	0.000000	0.000000	0.020719
SSE	0.009386	0.020490	0.000458	0.000114	0.000000	0.000000	0.000000	0.000000	0.030449
S	0.002976	0.005266	0.000687	0.000114	0.000000	0.000000	0.000000	0.000000	0.009043
SSW	0.001488	0.000458	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.002175
SW	0.000687	0.000572	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.001374
WSW	0.000572	0.000458	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.001259
W	0.002747	0.002633	0.000801	0.000000	0.000000	0.000000	0.000000	0.000000	0.006181
WNW	0.005037	0.008013	0.006296	0.000687	0.000000	0.000000	0.000000	0.000000	0.020032
NW	0.002747	0.002862	0.003434	0.000229	0.000000	0.000000	0.000000	0.000000	0.009272
NNW	0.001946	0.000572	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.002747
N	0.001488	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001603
CALM									0.000000
TOTAL	0.047848	0.059753	0.013622	0.001145	0.000000	0.000000	0.000000	0.000000	0.122367

MEAN WIND SPEED (m/s) = 1.87
NUMBER OF OBSERVATIONS = 1069

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.005037	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005266
NE	0.003434	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003663
ENE	0.005037	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005266
E	0.005151	0.000801	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005952
ESE	0.008356	0.001488	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.009844
SE	0.008700	0.001603	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010302
SSE	0.008471	0.002976	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011447
S	0.005838	0.002060	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007898
SSW	0.002060	0.000458	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002518
SW	0.003434	0.000801	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004235
WSW	0.002289	0.000801	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003091
W	0.007097	0.003091	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010188
WNW	0.006296	0.003205	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.009501
NW	0.005723	0.002289	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008013
NNW	0.004235	0.000687	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004922
N	0.004006	0.000687	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004693
CALM									0.000000
TOTAL	0.085165	0.021635	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.106799

MEAN WIND SPEED (m/s) = 1.24
NUMBER OF OBSERVATIONS = 933

```
-------------------------------------------
FREQUENCY OF OCCURENCE OF STABILITY CLASSES
-------------------------------------------
  A : 13.5%
  B : 8.8%
  C : 15.0%
  D : 39.7%
  E : 12.2%
  F : 10.7%


------------------------------
STABILITY CLASS BY HOUR OF DAY
------------------------------
Hour   A    B    C    D    E    F
  01 0000 0000 0000 0185 0073 0106
  02 0000 0000 0000 0183 0090 0091
  03 0000 0000 0000 0167 0108 0089
  04 0000 0000 0000 0177 0084 0103
  05 0000 0000 0000 0160 0105 0099
  06 0030 0025 0075 0168 0034 0032
  07 0060 0034 0139 0131 0000 0000
  08 0072 0054 0147 0091 0000 0000
  09 0096 0068 0132 0068 0000 0000
  10 0103 0089 0105 0067 0000 0000
  11 0126 0084 0099 0055 0000 0000
  12 0145 0071 0081 0067 0000 0000
  13 0149 0069 0080 0066 0000 0000
  14 0147 0072 0072 0073 0000 0000
  15 0119 0087 0088 0070 0000 0000
  16 0089 0073 0127 0075 0000 0000
  17 0046 0045 0169 0104 0000 0000
  18 0000 0000 0000 0272 0068 0024
  19 0000 0000 0000 0251 0070 0043
  20 0000 0000 0000 0231 0074 0059
  21 0000 0000 0000 0224 0093 0047
  22 0000 0000 0000 0210 0094 0060
  23 0000 0000 0000 0189 0095 0080
  24 0000 0000 0000 0183 0081 0100

--------------------------------
STABILITY CLASS BY MIXING HEIGHT
--------------------------------
Mixing height    A    B    C    D    E    F
    <=500 m    0108 0070 0237 0723 1001 0909
   <=1000 m    0465 0305 0575 1250 0017 0011
   <=1500 m    0609 0396 0502 1248 0051 0013
   <=2000 m    0000 0000 0000 0191 0000 0000
   <=3000 m    0000 0000 0000 0049 0000 0000
    >3000 m    0000 0000 0000 0006 0000 0000
```

MIXING HEIGHT BY HOUR OF DAY

Hour	0000 to 0100	0100 to 0200	0200 to 0400	0400 to 0800	0800 to 1600	1600 to 3200	Greater than 3200
01	0119	0060	0022	0060	0093	0009	0001
02	0113	0068	0037	0043	0089	0013	0001
03	0124	0072	0035	0043	0076	0014	0000
04	0128	0055	0043	0045	0080	0013	0000
05	0292	0020	0007	0018	0026	0001	0000
06	0000	0197	0167	0000	0000	0000	0000
07	0000	0000	0274	0090	0000	0000	0000
08	0000	0000	0000	0364	0000	0000	0000
09	0000	0000	0000	0274	0090	0000	0000
10	0000	0000	0000	0092	0272	0000	0000
11	0000	0000	0000	0005	0359	0000	0000
12	0000	0000	0000	0000	0364	0000	0000
13	0000	0000	0000	0000	0364	0000	0000
14	0000	0000	0000	0000	0364	0000	0000
15	0000	0000	0000	0000	0364	0000	0000
16	0000	0000	0000	0000	0364	0000	0000
17	0000	0000	0000	0000	0364	0000	0000
18	0000	0000	0000	0000	0364	0000	0000
19	0051	0059	0012	0033	0164	0044	0001
20	0064	0069	0004	0034	0169	0023	0001
21	0065	0075	0007	0033	0170	0014	0000
22	0078	0074	0011	0039	0151	0011	0000
23	0096	0076	0021	0040	0118	0013	0000
24	0113	0068	0017	0038	0116	0012	0000

APPENDIX C:
Example of estimated emissions for modelled scenarios

(This appendix provides the details of the emissions calculation for 2006. Similar details can be provided on request for 2010, 2014 and 2019).

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
OB - Stripping topsoil - Cheshunt	-		h/y	14.0	kg/h						
OB - Stripping topsoil - Riverview	-		h/y	14.0	kg/h						
OB - Stripping topsoil - Riverview South East Extension	-		h/y	14.0	kg/h						
OB - Stripping topsoil - South Lemington	-		h/y	14.0	kg/h						
OB - Drilling - Cheshunt	13,035	22,094	holes/y	0.59	kg/hole						
OB - Drilling - Riverview	13,149	22,286	holes/y	0.59	kg/hole						
OB - Drilling - Riverview South East Extension	-		holes/y	0.59	kg/hole						
OB - Drilling - South Lemington	-		holes/y	0.59	kg/hole						
OB - Blasting - Cheshunt	14,975	414	blasts/y	36	kg/blast	3000	Area of blast m^2				
OB - Blasting - Riverview	15,106	418	blasts/y	36	kg/blast	3000	Area of blast m^2				
OB - Blasting - Riverview South East Extension	-		blasts/y	36	kg/blast	3000	Area of blast m^2				
OB - Blasting - South Lemington	-		blasts/y	36	kg/blast	3000	Area of blast m^2				
OB - Dragline - Cheshunt	-	0	bcm	0.03912	kg/t	7	drop distance in metres	2	moisture content in %		
OB - Dragline - Riverview	231,832	5,926,622	bcm	0.03912	kg/t	7	drop distance in metres	2	moisture content in %		
OB - Dragline - Riverview South East Extension	-		bcm	0.03912	kg/t	7	drop distance in metres	2	moisture content in %		
OB - Dragline - South Lemington	-		bcm	0.03912	kg/t	7	drop distance in metres	2	moisture content in %		
OB - Sh/Ex/FELs loading - Cheshunt	88,674	45,583,620	t/y	0.00195	kg/t	1.643	average of (wind	2	moisture content in %		

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
							speed/2.2)$^{1.3}$ in m/s				
OB - Sh/Ex/FELs loading - Riverview	36,969	19,003,920	t/y	0.00195	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Riverview South East Extension	-		t/y	0.00195	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - South Lemington	-		t/y	0.00195	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	2	moisture content in %		
OB - Hauling to emplacement - from Cheshunt	1,329,522	45,583,620	t/y	0.02917	kg/t	240	t/truck load	7	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Riverview	395,915	19,003,920	t/y	0.02083	kg/t	240	t/truck load	5	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Riverview South East Extension	-		t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from South Lemington	-		t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Emplacing at dumps - Cheshunt	88,674	45,583,620	t/y	0.00195	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	2	moisture content in %		
OB - Emplacing at dumps - Riverview	36,969	19,003,920	t/y	0.00195	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	2	moisture content in %		
OB - Emplacing at dumps - Riverview South East Extension	-		t/y	0.00195	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	2	moisture content in %		
OB - Emplacing at dumps - South Lemington	-		t/y	0.00195	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	2	moisture content in %		
OB - Dozers on O/B - Cheshunt	226,295	13,522	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
OB - Dozers on O/B - Riverview	159,086	9,506	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Riverview South East Extension	-		h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - South Lemington	-		h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
CL - Drilling - Cheshunt	2,206	3,739	holes/y	0.59	kg/hole						
CL - Drilling - Riverview	1,935	3,280	holes/y	0.59	kg/hole						
CL - Drilling - Riverview South East Extension	-		holes/y	0.59	kg/hole						
CL - Drilling - South Lemington	-		holes/y	0.59	kg/hole						
CL - Blasting - Cheshunt	2,218	70	blasts/y	36	kg/blast	3000	Area of blast m^2				
CL - Blasting - Riverview	3,335	92	blasts/y	36	kg/blast	3000	Area of blast m^2				
CL - Blasting - Riverview South East Extension	-		blasts/y	36	kg/blast	3000	Area of blast m^2				
CL - Blasting - South Lemington	-		blasts/y	36	kg/blast	3000	Area of blast m^2				
CL - Dozers ripping - Cheshunt	375,123	18,766	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Riverview	56,690	2,836	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Riverview South East Extension	-		h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - South Lemington	-		h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Loading ROM to trucks - Cheshunt	213,138	3,155,109	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Riverview	186,954	2,767,507	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Riverview South East Extension	-		t/y	0.06755	kg/t	6	moisture content of coal in %				

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
CL - Loading ROM to trucks - South Lemington	-		t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Hauling ROM coal to dump hopper - Cheshunt	184,048	3,155,109	t/y	0.05833	kg/t	240	t/load	14	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Riverview	184,500	2,767,507	t/y	0.06667	kg/t	240	t/load	16	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Riverview South East Extension	-		t/y	0.00000	kg/t	240	t/load	0	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - South Lemington	-		t/y	0.00000	kg/t	240	t/load	0	km/return trip	1.0	kg/VKT
CL - unloading ROM coal at pile/hopper - All pits	59,226	5,922,616	t/y	0.01	kg/t						
CL - ROM rehandle pile to hopper (FEL)	5,923	592,262	t/y	0.01	kg/t						
CL - Handling coal at CPP	74,243	35,535,696	t/y	0.00209	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	6	moisture content of coal in %		
CL - Dozer/FEL pushing ROM coal	-		h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers pushing product coal	-		h/y	7.5	kg/h	4	silt content in %	10	moisture content in %		
CL - Loading rejects	-		t/y								
CL - Transporting rejects	-		t/y	0.03333	kg/t	240	t/load	8	km/return trip	1.0	kg/VKT
CL - Unloading rejects	-		t/y								
CL - Loading product coal stockpile	920	4,500,212	t/y	0.00020	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	10	moisture content of coal in %		
WE - OB spoil area - Cheshunt	1,737,984	496	ha	3504.0	kg/ha/y						
WE - OB spoil area	819,936	234	ha	3504.0	kg/ha/y						

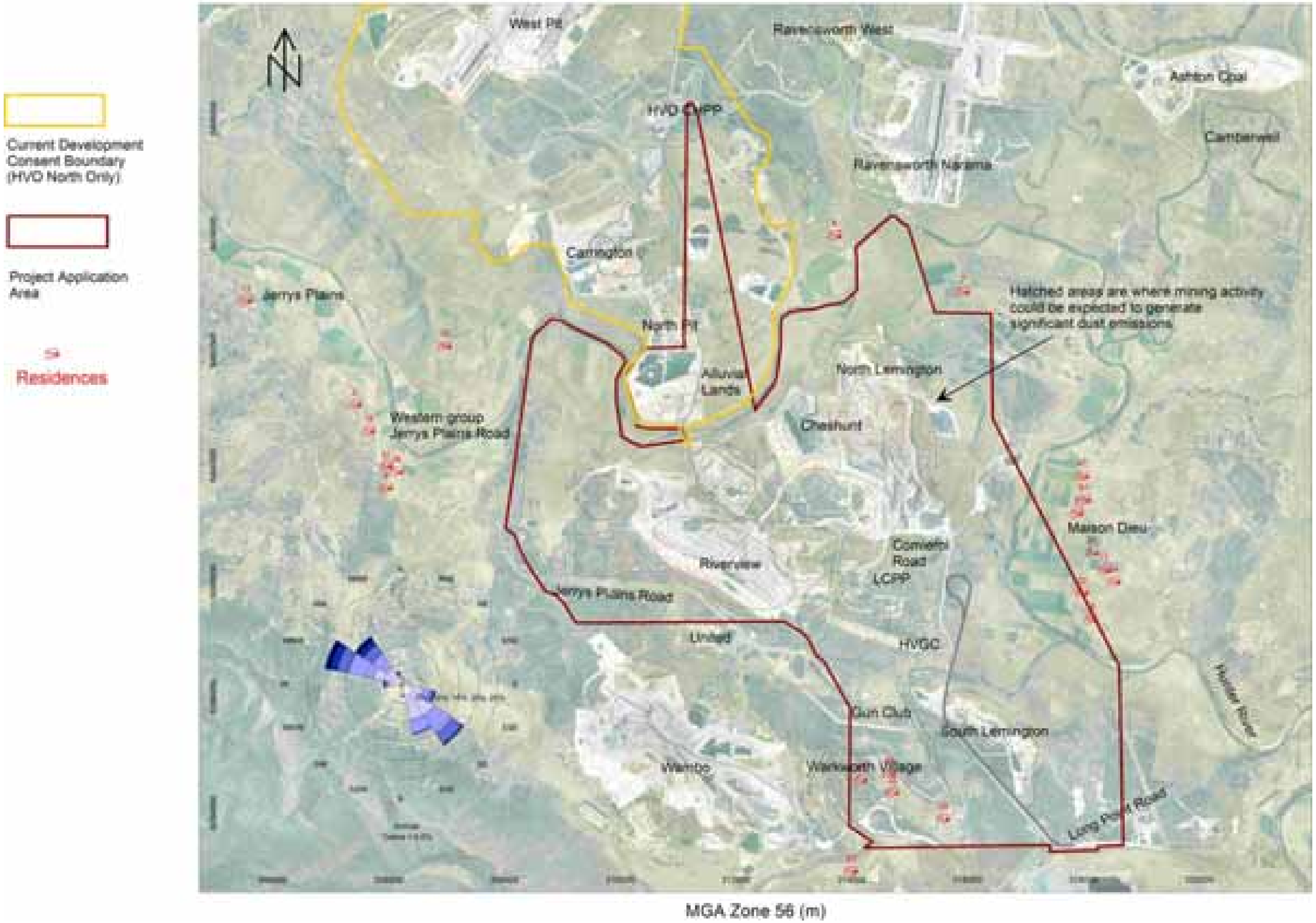
ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
- Riverview											
WE - OB spoil area - Riverview South East Extension	-		ha	3504.0	kg/ha/y						
WE - OB spoil area - South Lemington	-		ha	3504.0	kg/ha/y						
WE - Open pit - Cheshunt	1,737,984	496	ha	3504.0	kg/ha/y						
WE - Open pit - Riverview	819,936	234	ha	3504.0	kg/ha/y						
WE - Open pit - Riverview South East Extension	-		ha	3504.0	kg/ha/y						
WE - Open pit - South Lemington	-		ha	3504.0	kg/ha/y						
WE - ROM stockpiles	-	-	ha	3392.8	kg/ha/y	72.5	Average number of raindays	5	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Product stockpiles	-	-	ha	2714.2	kg/ha/y	72.5	Average number of raindays	4	silt content in %	17.6873	% of winds above 5.4 m/s
Loading coal to trains	920	4,500,212	t/y	0.00020	kg/t	1.643	average of (wind speed/2.2)$^{1.3}$ in m/s	10	moisture content of coal in %		
Grading roads	28,755	46,720	km	0.61547	kg/VKT	8	Speed of graders in km/h				
Total	9,146,175										
TSP/ROM coal ratio (kg of TSP/t of ROM coal)	1.54										

FIGURES

West - East (MGA coordinates - m)

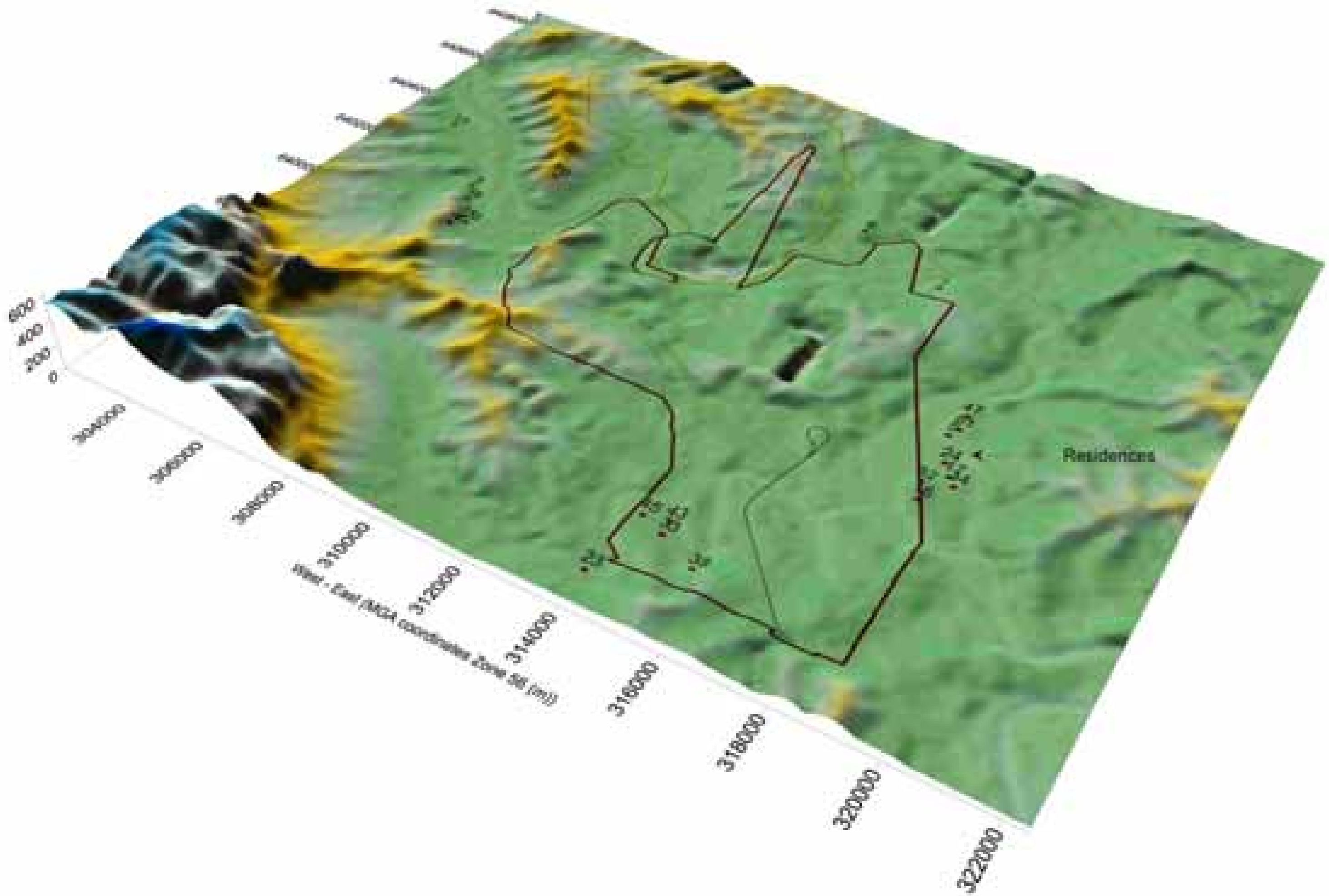
Location

Figure 1



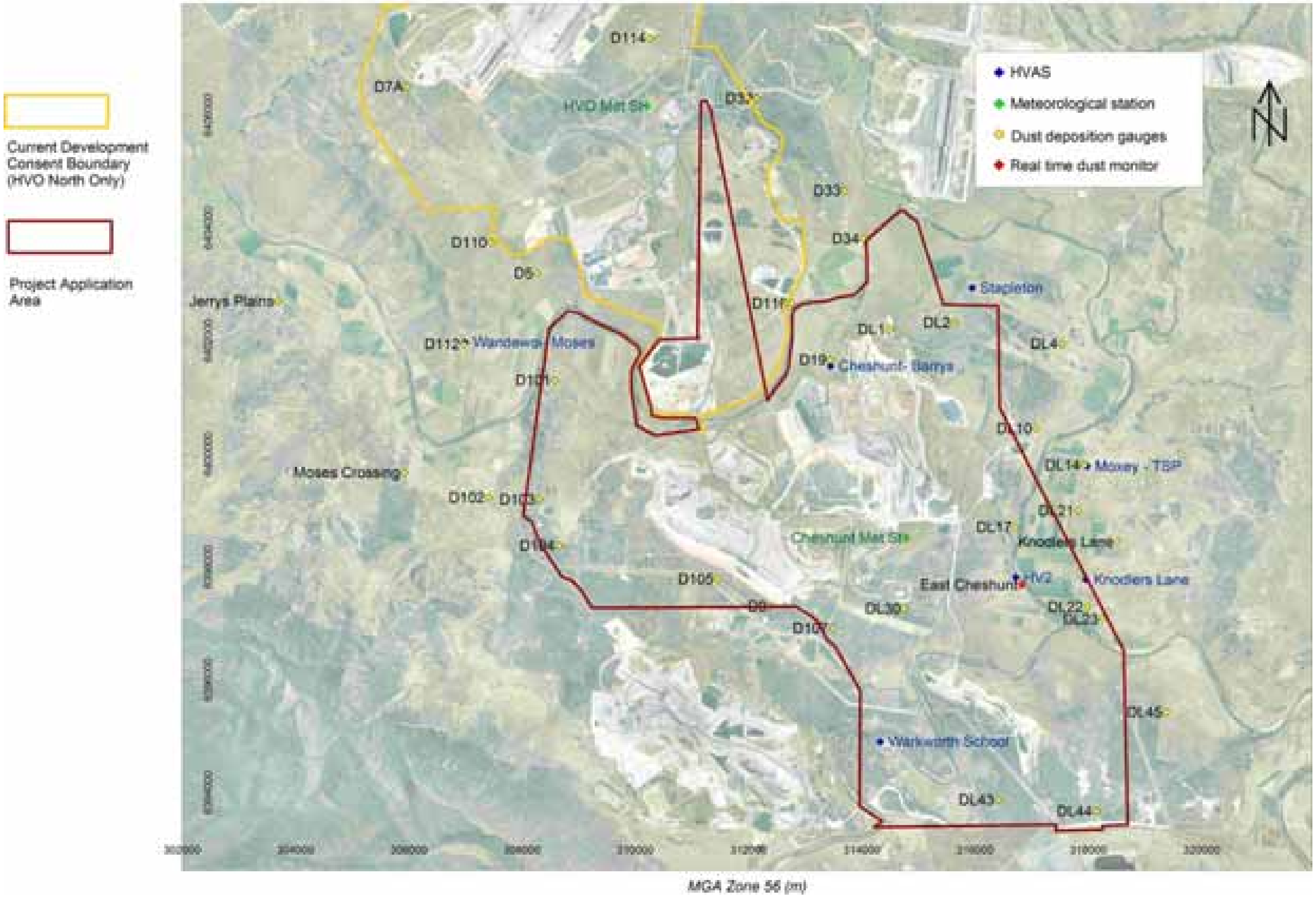
Project area, main infrastructure and locations of dust sensitive

Figure 2



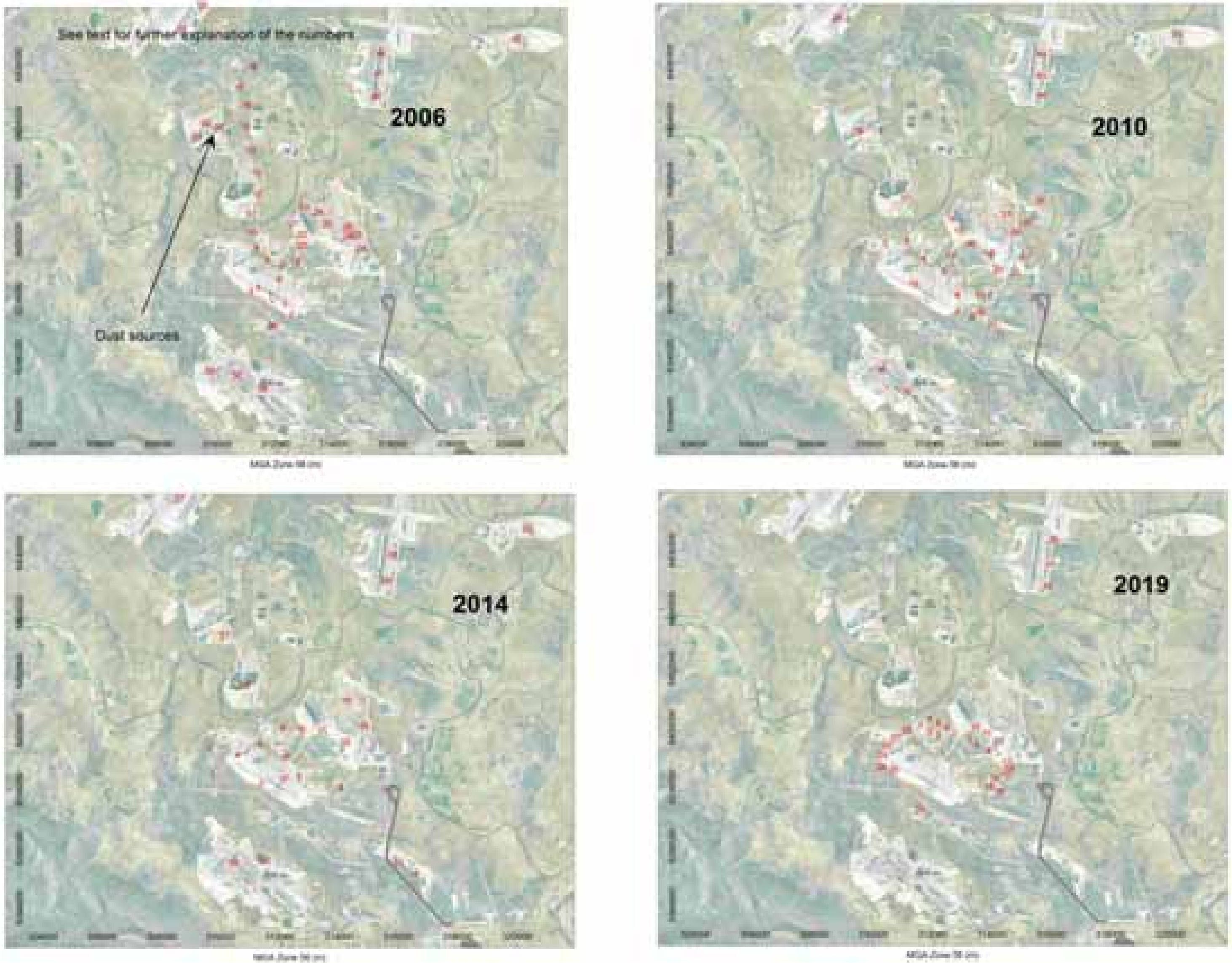
Terrain in the project area

Figure 3



Monitoring sites

Figure 4



Locations of sources used in the four modelling scenarios

Figure 5

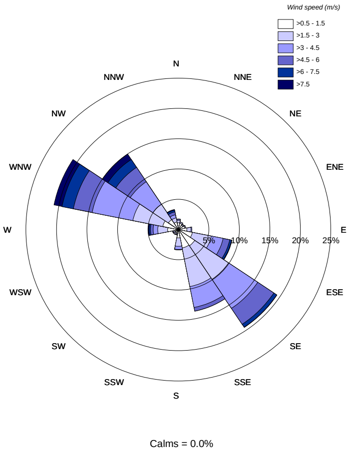
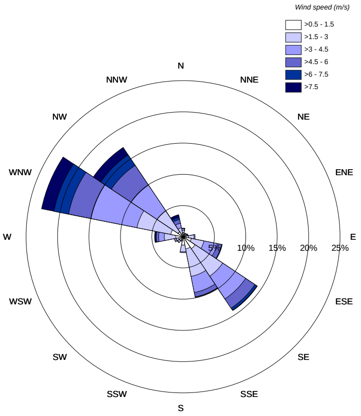
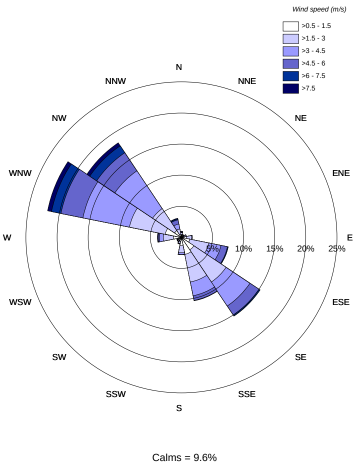
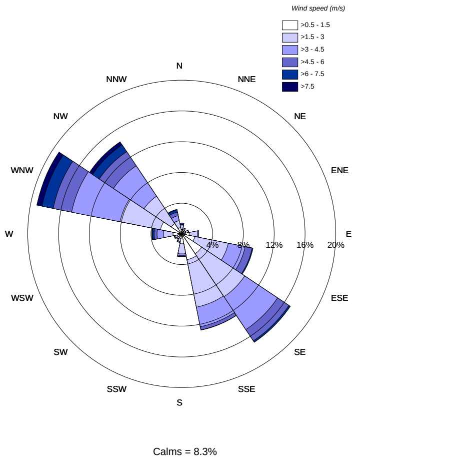
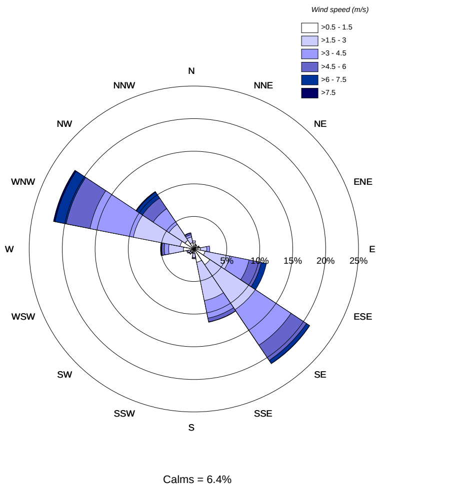
HVO annual wind roses	Cheshunt annual wind roses
 2002 (annual average wind speed 3.01 m/s)	
 2003 (annual average wind speed 3.11 m/s)	
 2004 (annual average wind speed 2.86 m/s)	

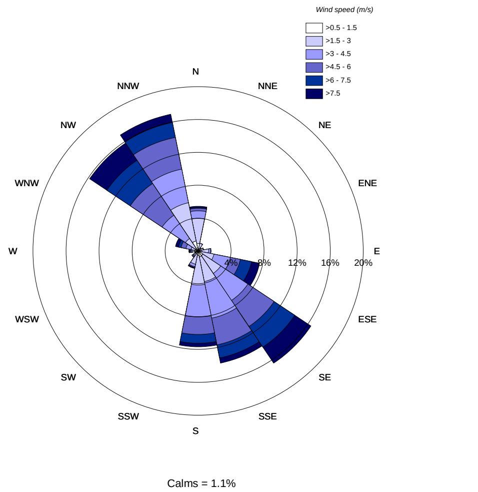
Figure 6



2005 (annual average wind speed 2.72 m/s)



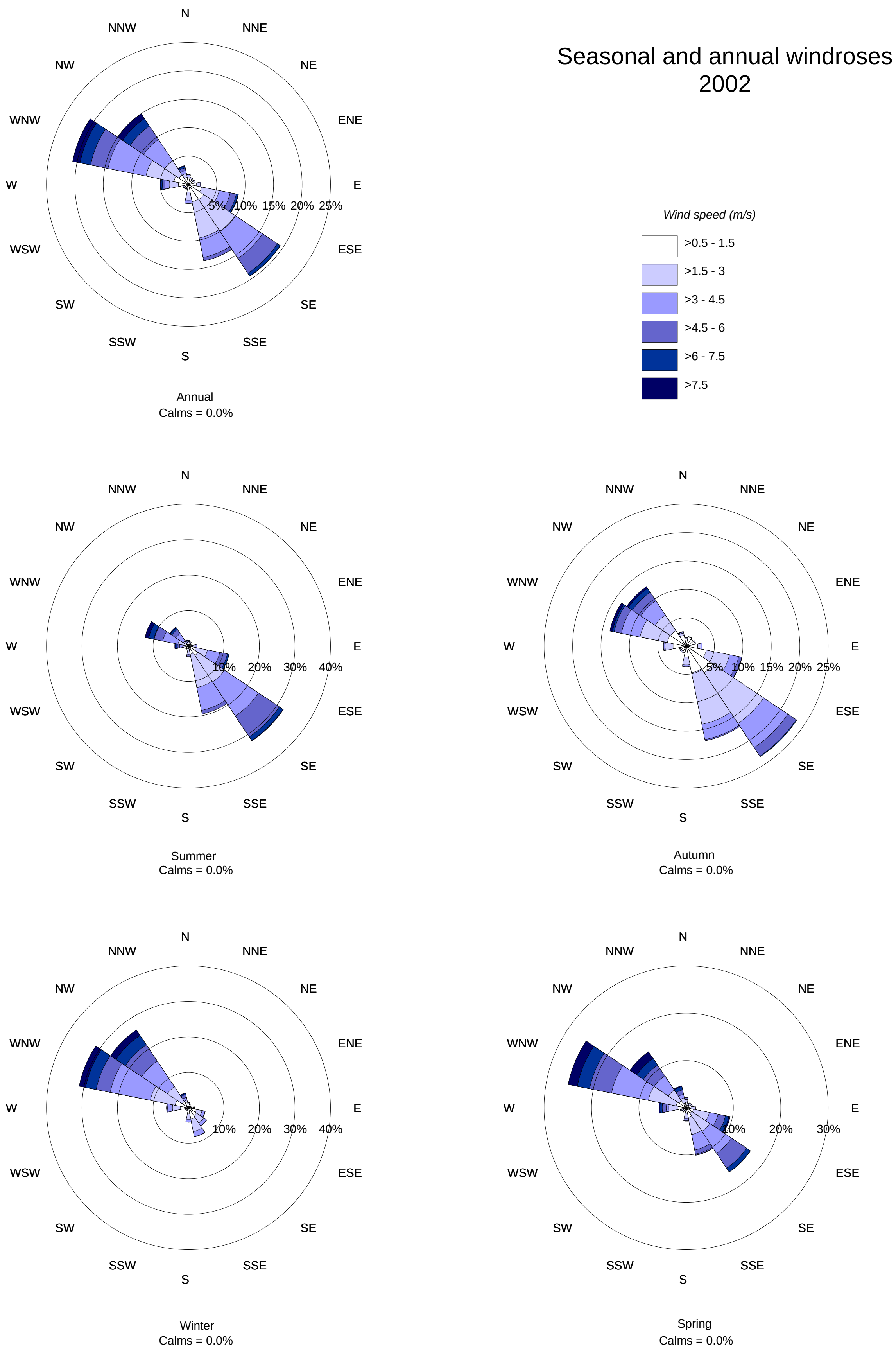
1 Jan 2006 to 3 Jul 2006 (annual average wind speed 2.85 m/s)



1 Jan 2006 to 3 July 2006 (annual average wind speed 4.3 m/s)

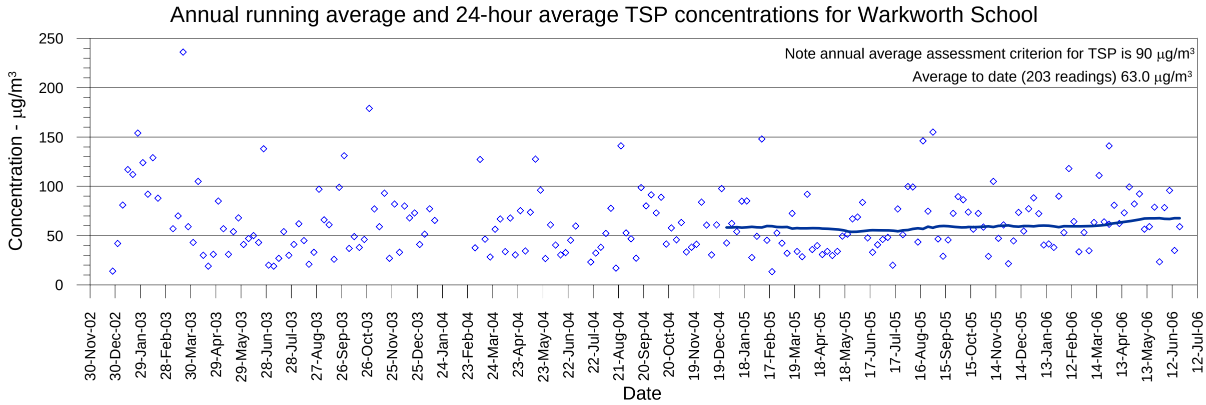
Comparison of annual wind rose from HVO and Cheshunt meteorological stations

Figure 6 (Continued)

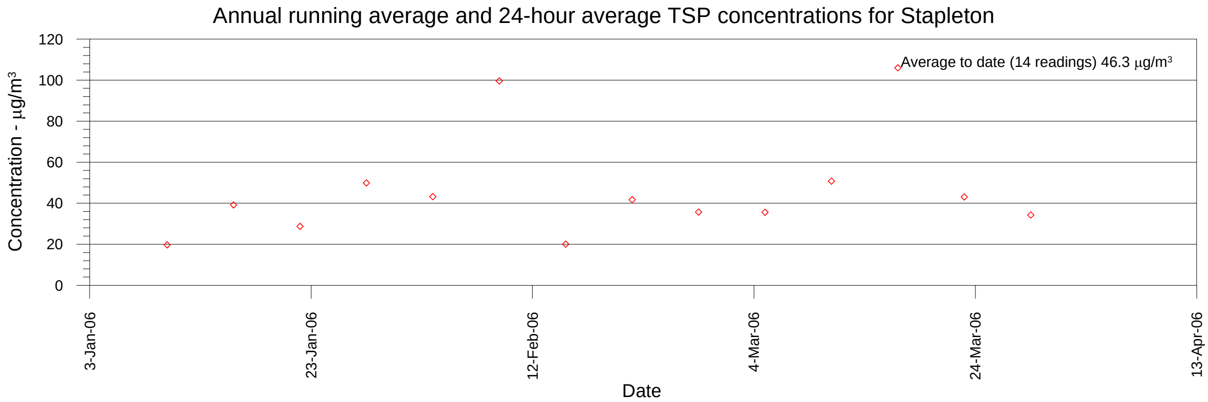


Seasonal and annual wind roses from Hunter Valley meteorological station for 2002

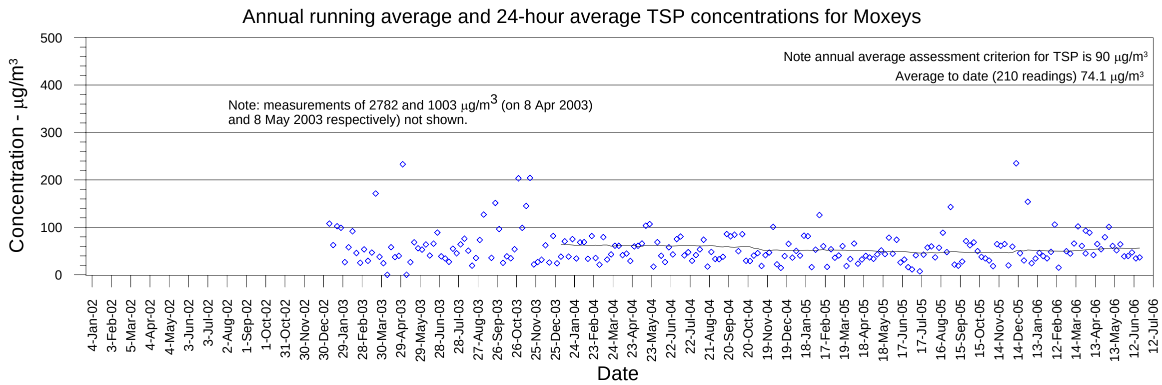
Figure 7



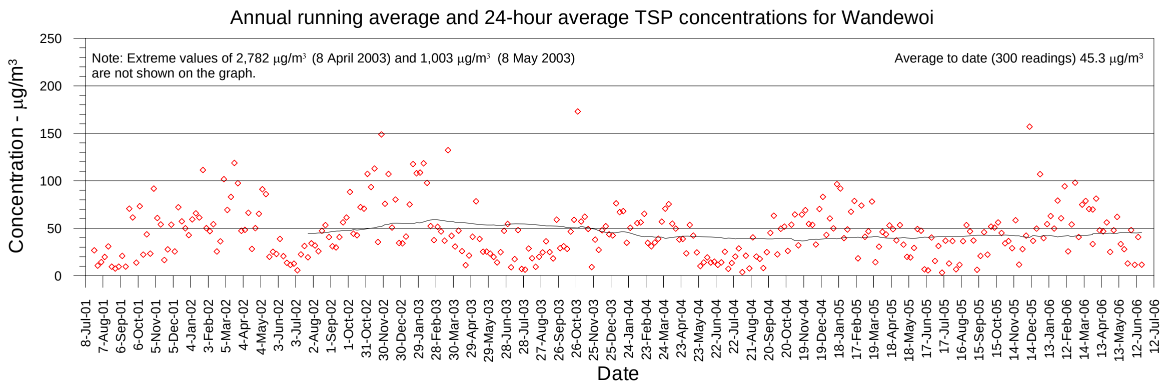
Annual running average and 24-hour average TSP concentrations for Warkworth School
Note annual average assessment criterion for TSP is 90 µg/m³
Average to date (203 readings) 63.0 µg/m³
Concentration - µg/m³
Date



Annual running average and 24-hour average TSP concentrations for Stapleton
Average to date (14 readings) 46.3 µg/m³
Concentration - µg/m³
Date

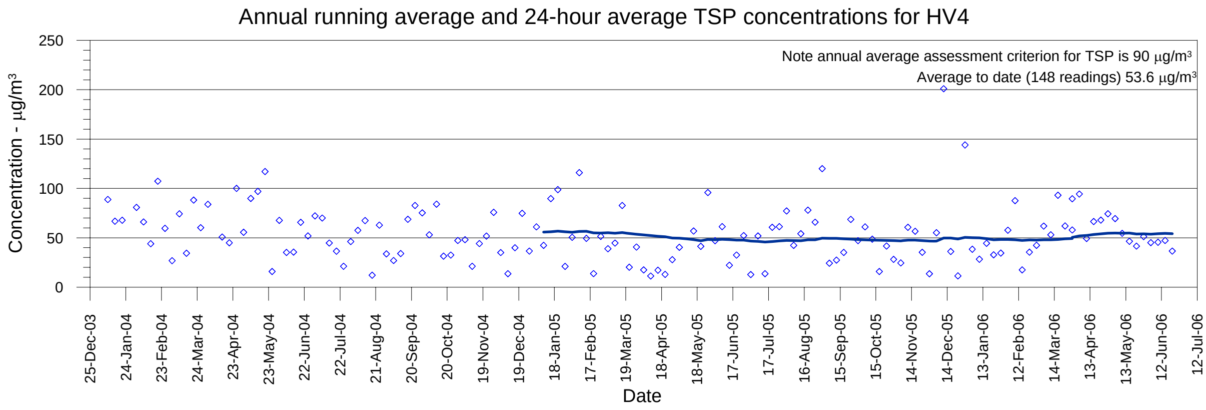


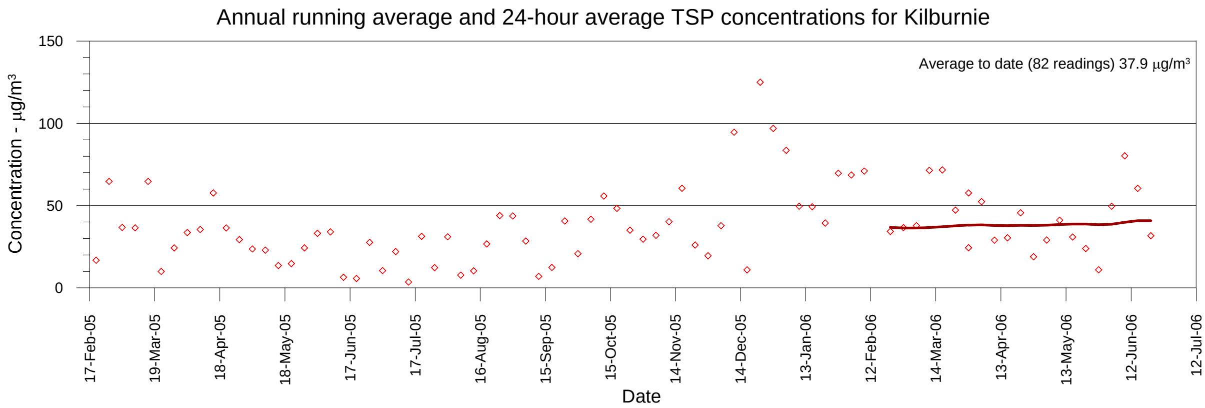
Annual running average and 24-hour average TSP concentrations for Moxeys
Note annual average assessment criterion for TSP is 90 µg/m³
Average to date (210 readings) 74.1 µg/m³
Note: measurements of 2782 and 1003 µg/m³ (on 8 Apr 2003)
and 8 May 2003 respectively) not shown.
Concentration - µg/m³
Date

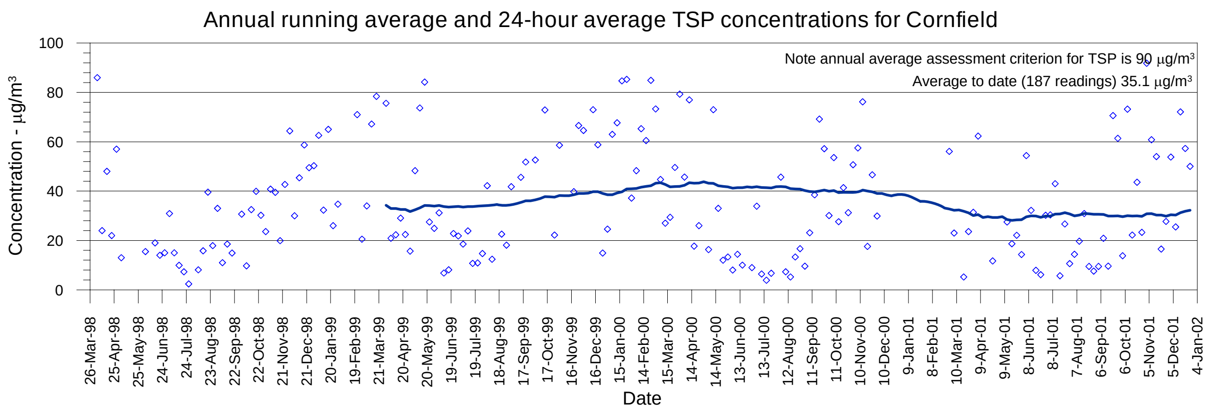


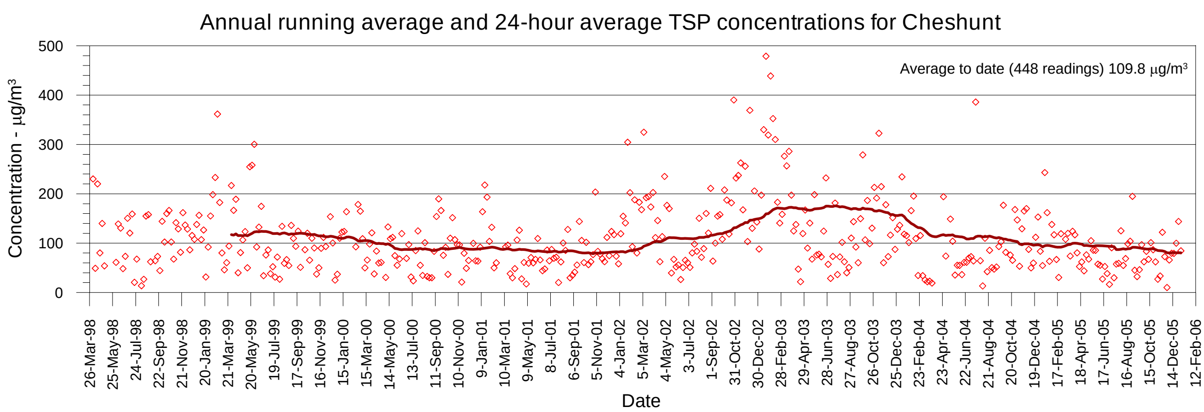
Annual running average and 24-hour average TSP concentrations for Wandewoi
Note: Extreme values of 2,782 µg/m³ (8 April 2003) and 1,003 µg/m³ (8 May 2003)
are not shown on the graph.
Average to date (300 readings) 45.3 µg/m³
Concentration - µg/m³
Date

Figure 8





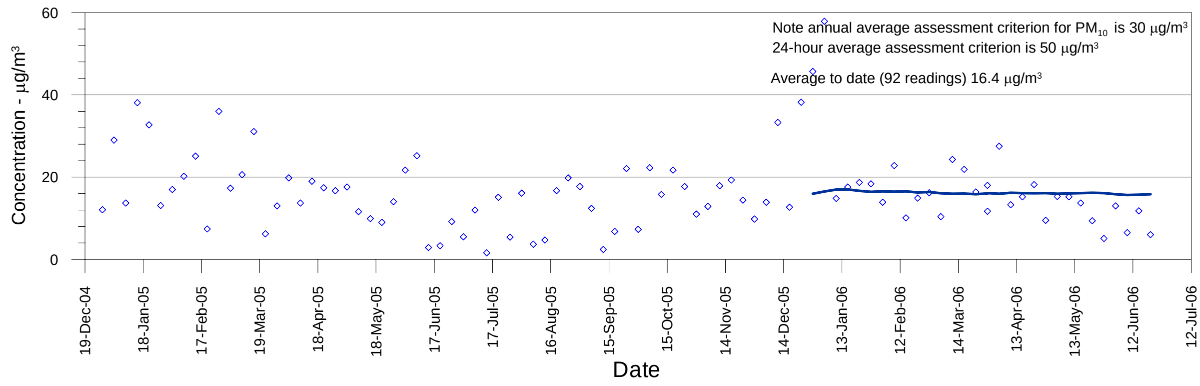




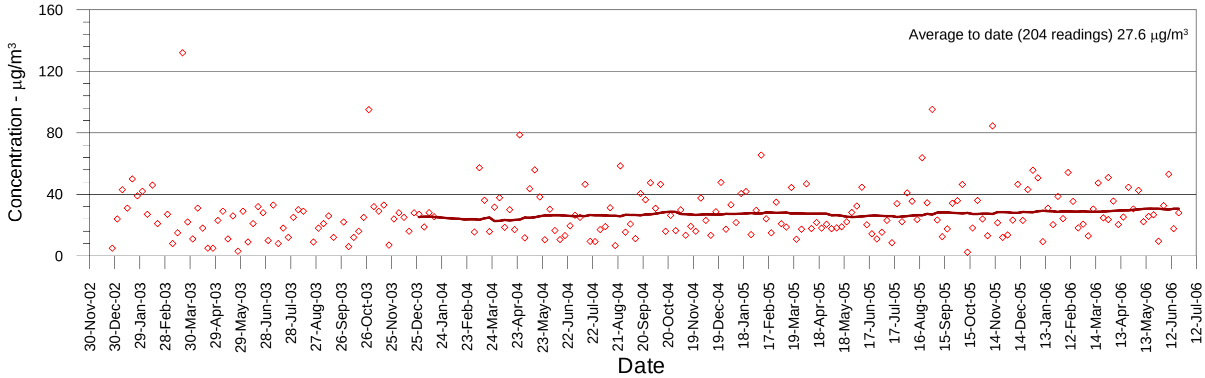
TSP monitoring data

Figure 8 (continued)

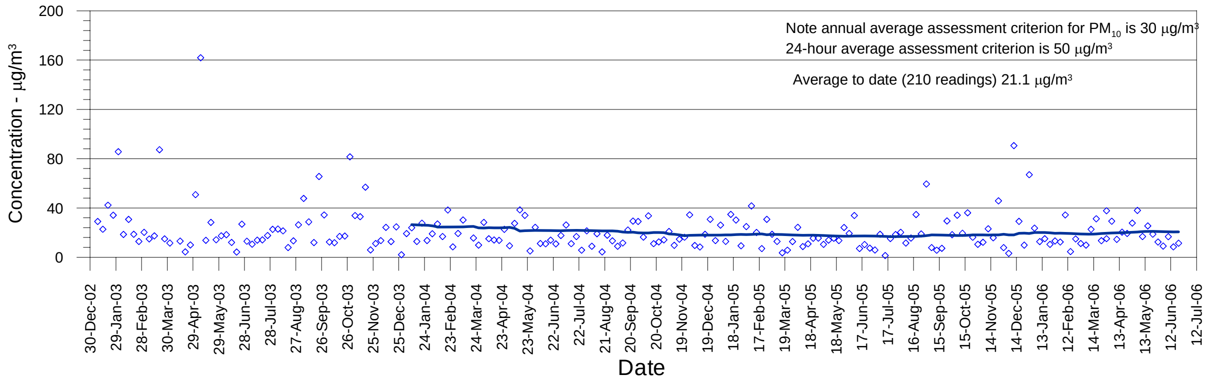
Annual running average and 24-hour average PM_{10} concentrations for Wandewoi



Annual running average and 24-hour average PM_{10} concentrations for Warkworth School



Annual running average and 24-hour average PM_{10} concentrations for Moxeys



Annual running average and 24-hour average PM_{10} concentrations for Oaklands

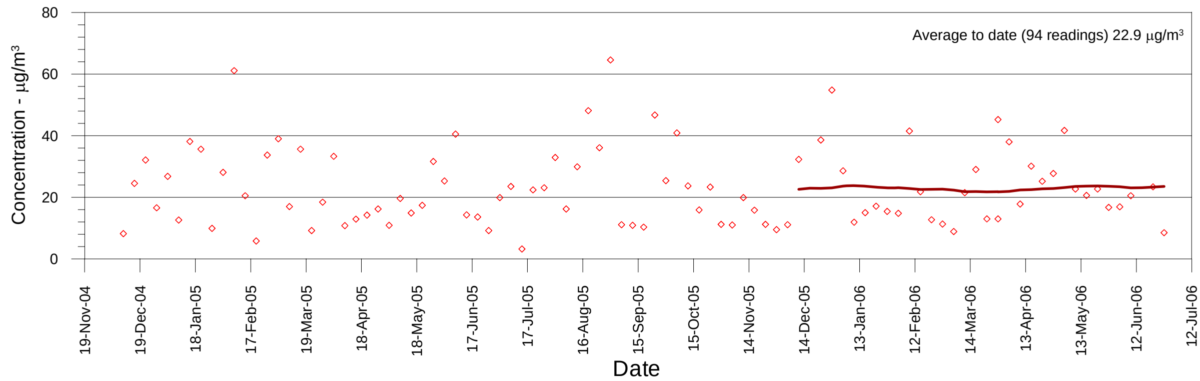
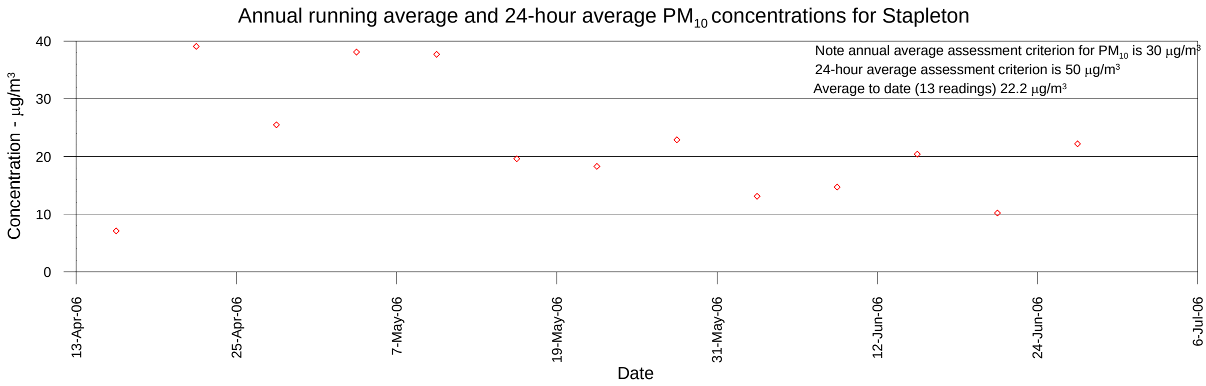


Figure 9



PM_{10} monitoring data

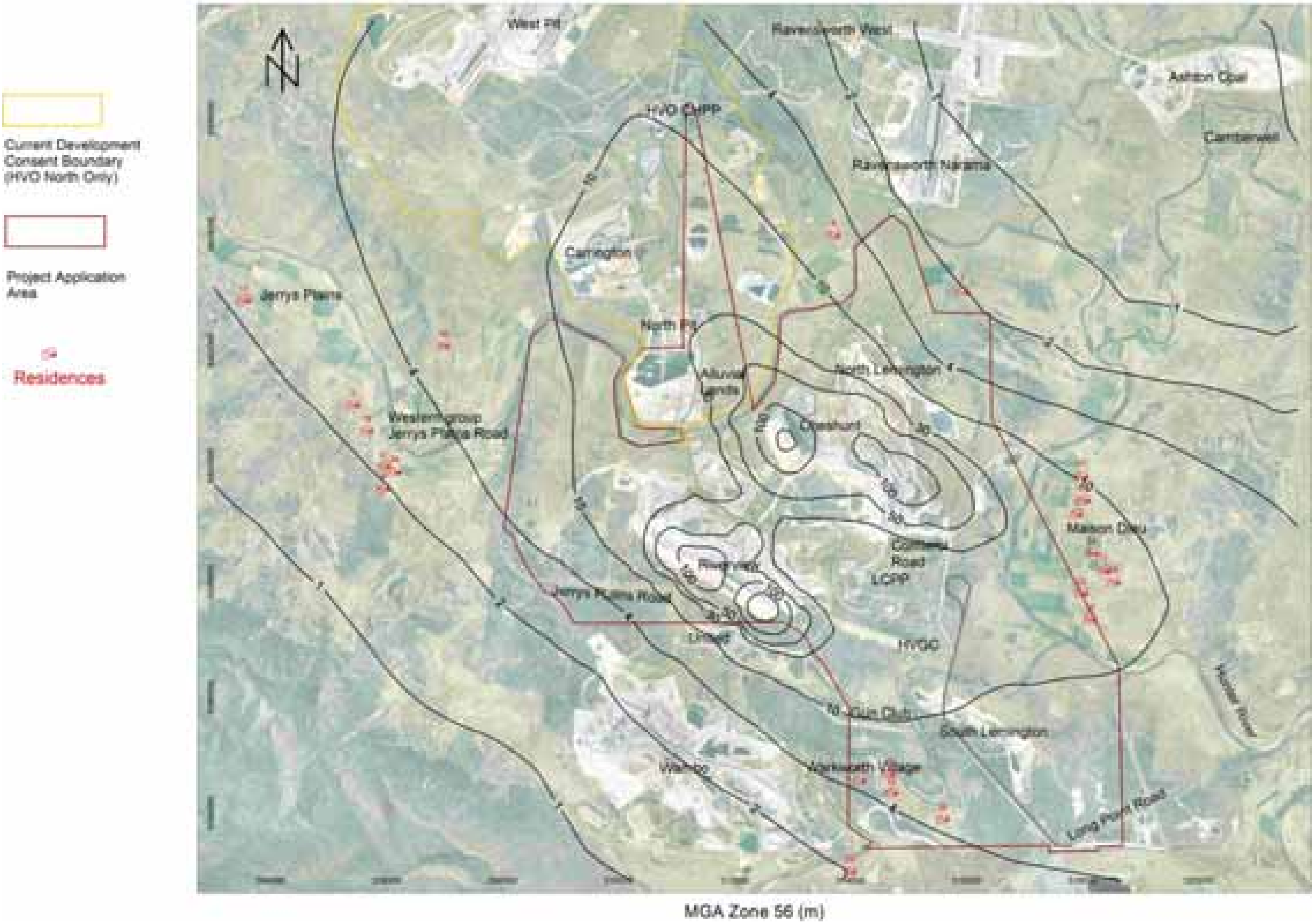
Figure 9 (continued)

Predicted maximum 24-hour average PM_{10} concentrations due to emissions from HVO South for 2006 - $\mu g/m^3$

Figure 10

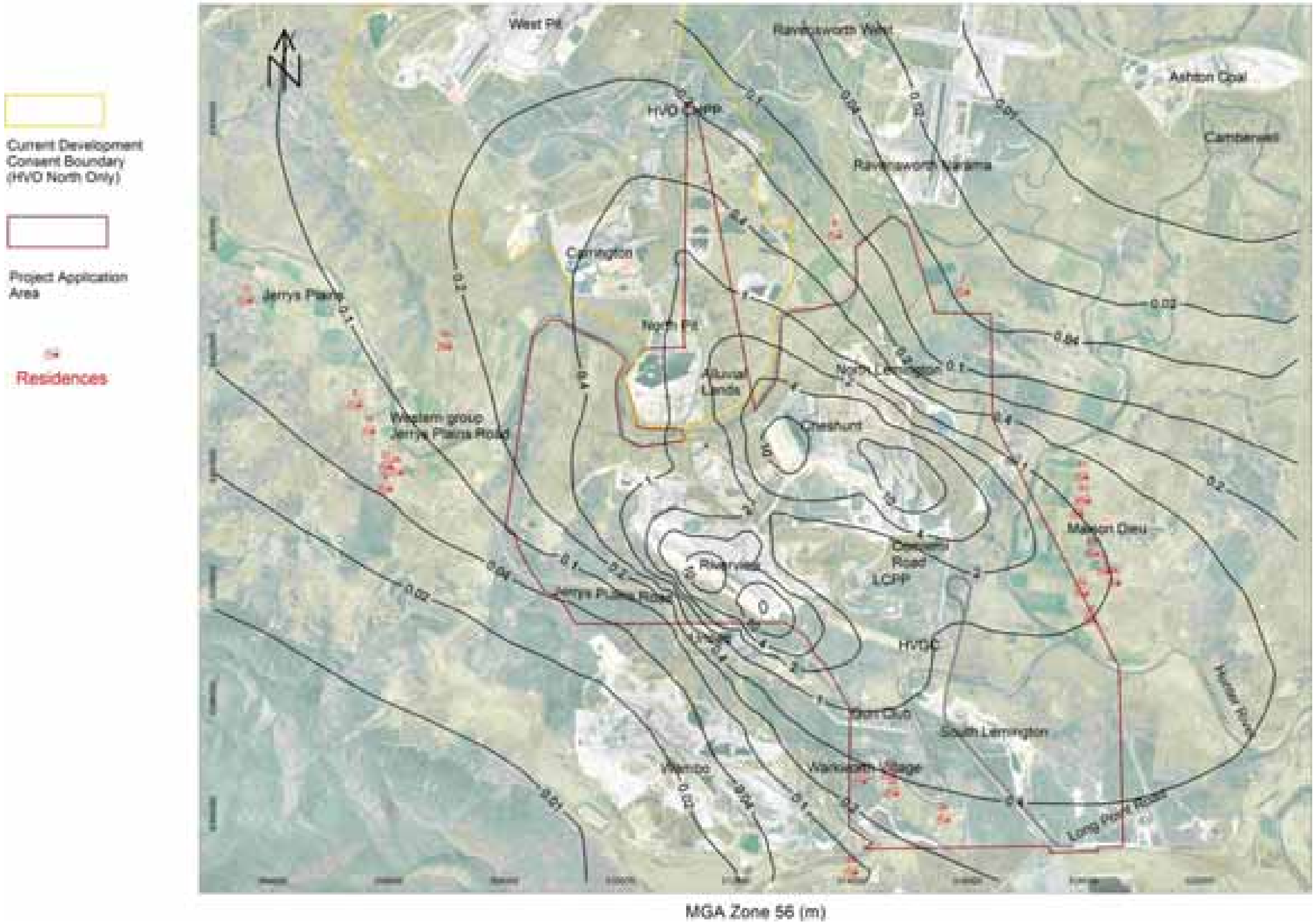
Predicted annual average PM_{10} concentrations due to emissions from HVO South for 2006 - $\mu g/m^3$

Figure 11



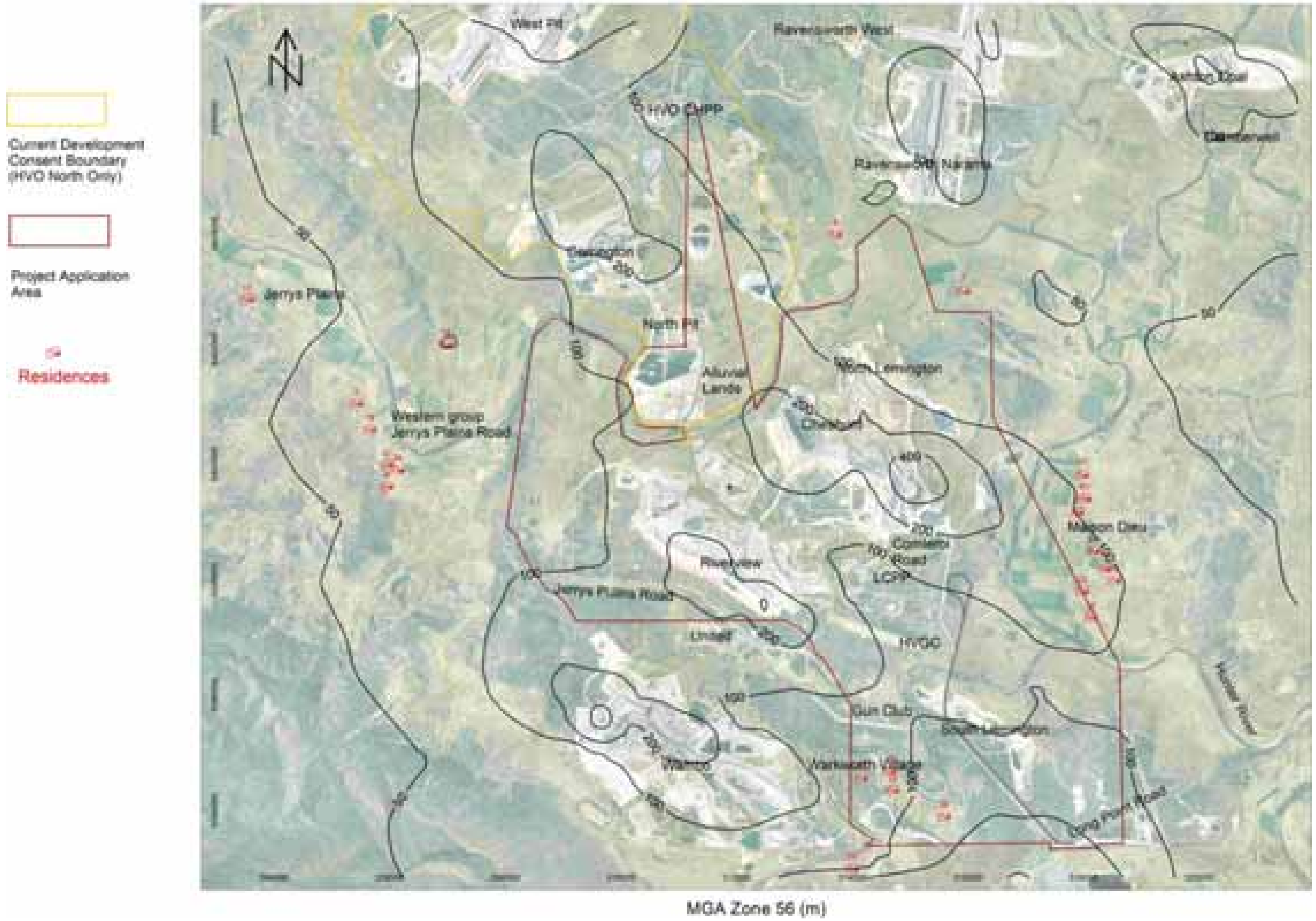
Predicted annual average TSP concentrations due to emissions from HVO South for 2006 - $\mu g/m^3$

Figure 12



Predicted annual average dust (insoluble solids) deposition level due to emissions from HVO South for 2006 - g/m^2/month

Figure 13

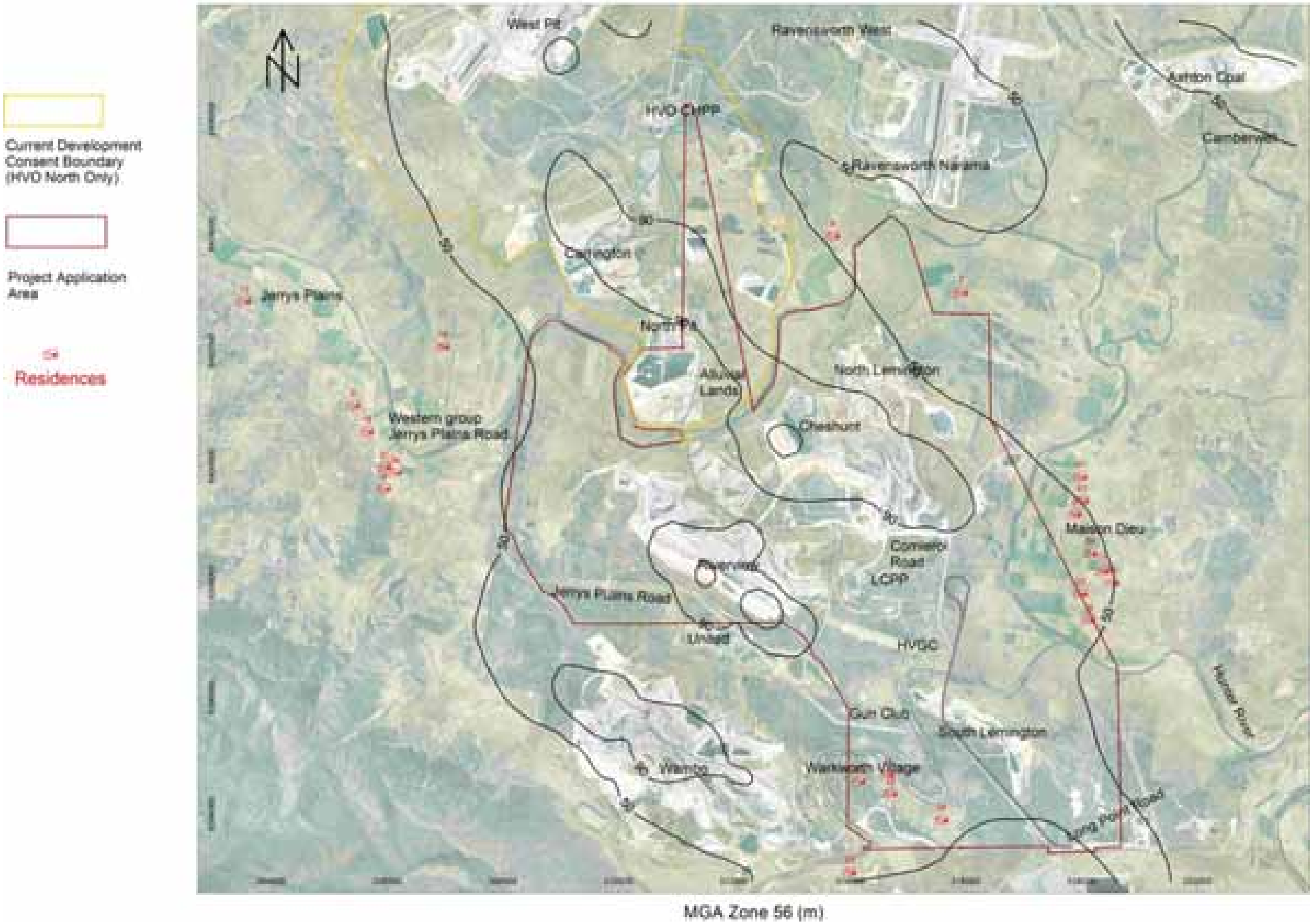


Predicted maximum 24-hour average PM_{10} concentrations due to emissions from HVO South and other mines and other dust sources for 2006 - $\mu g/m^3$

Figure 14

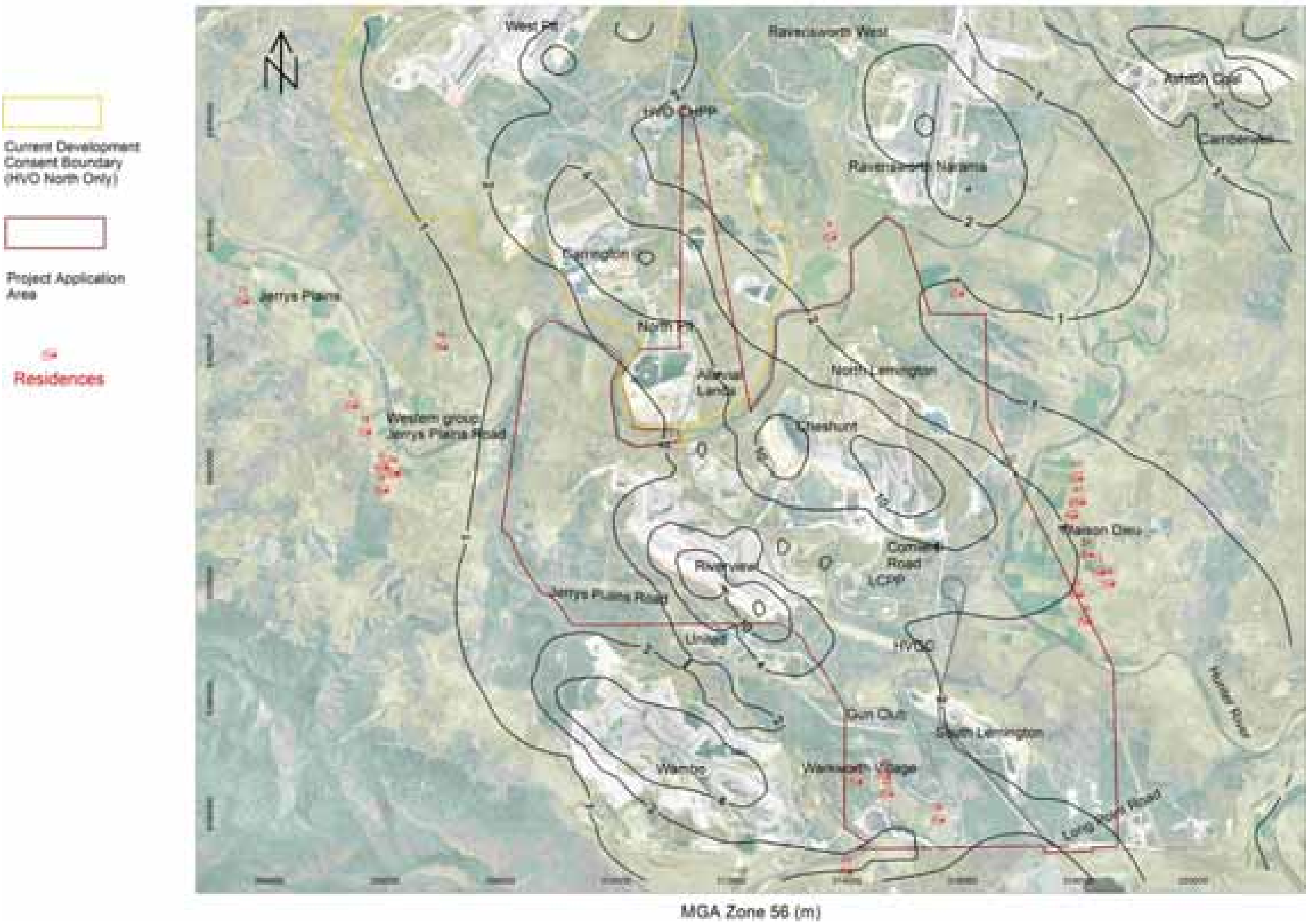
Predicted annual average PM_{10} concentrations due to emissions from HVO South and other mines and other dust sources for 2006 - $\mu g/m^3$

Figure 15



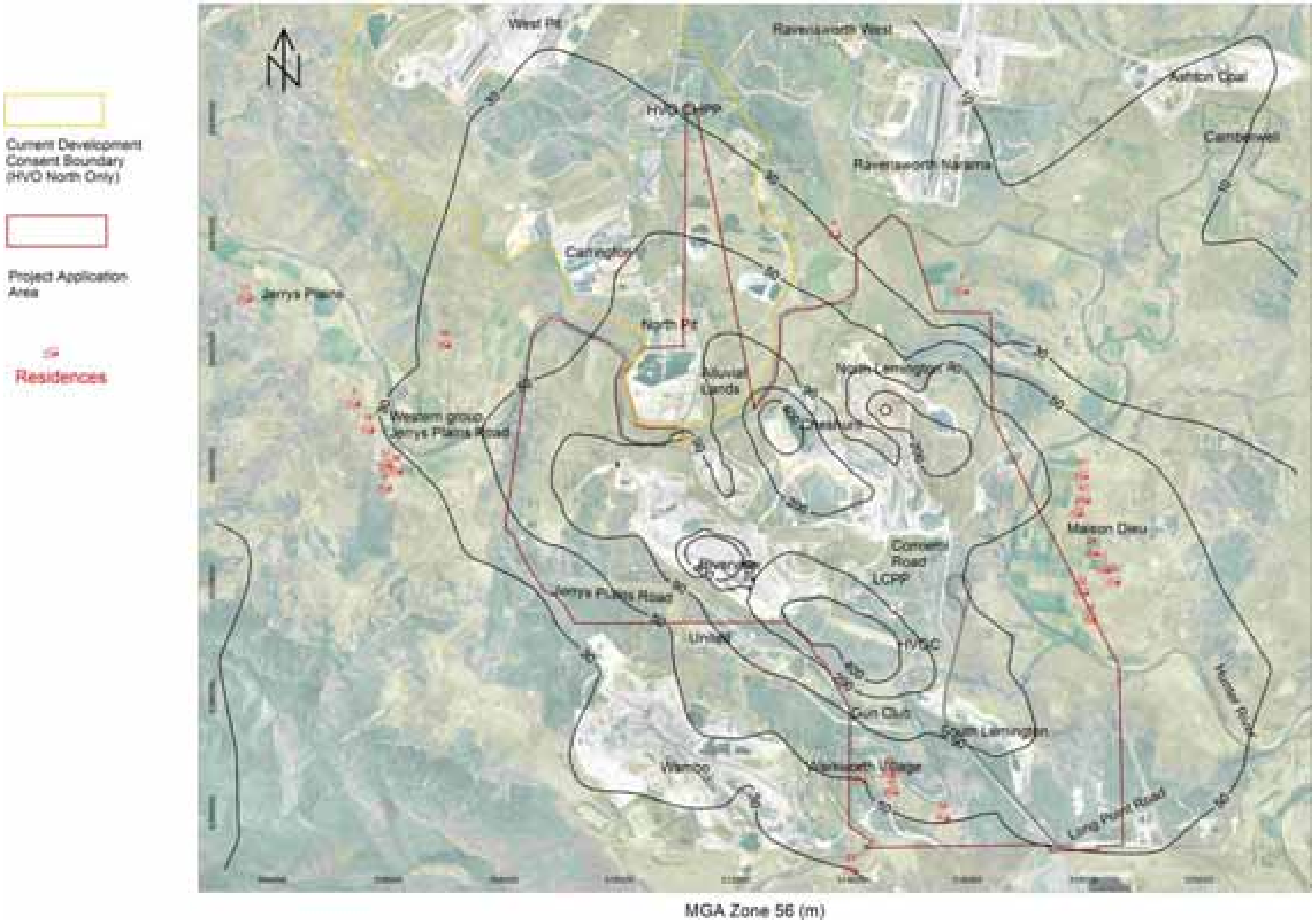
Predicted annual average TSP concentrations due to emissions from HVO South and other mines and other dust sources for 2006 - $\mu g/m^3$

Figure 16



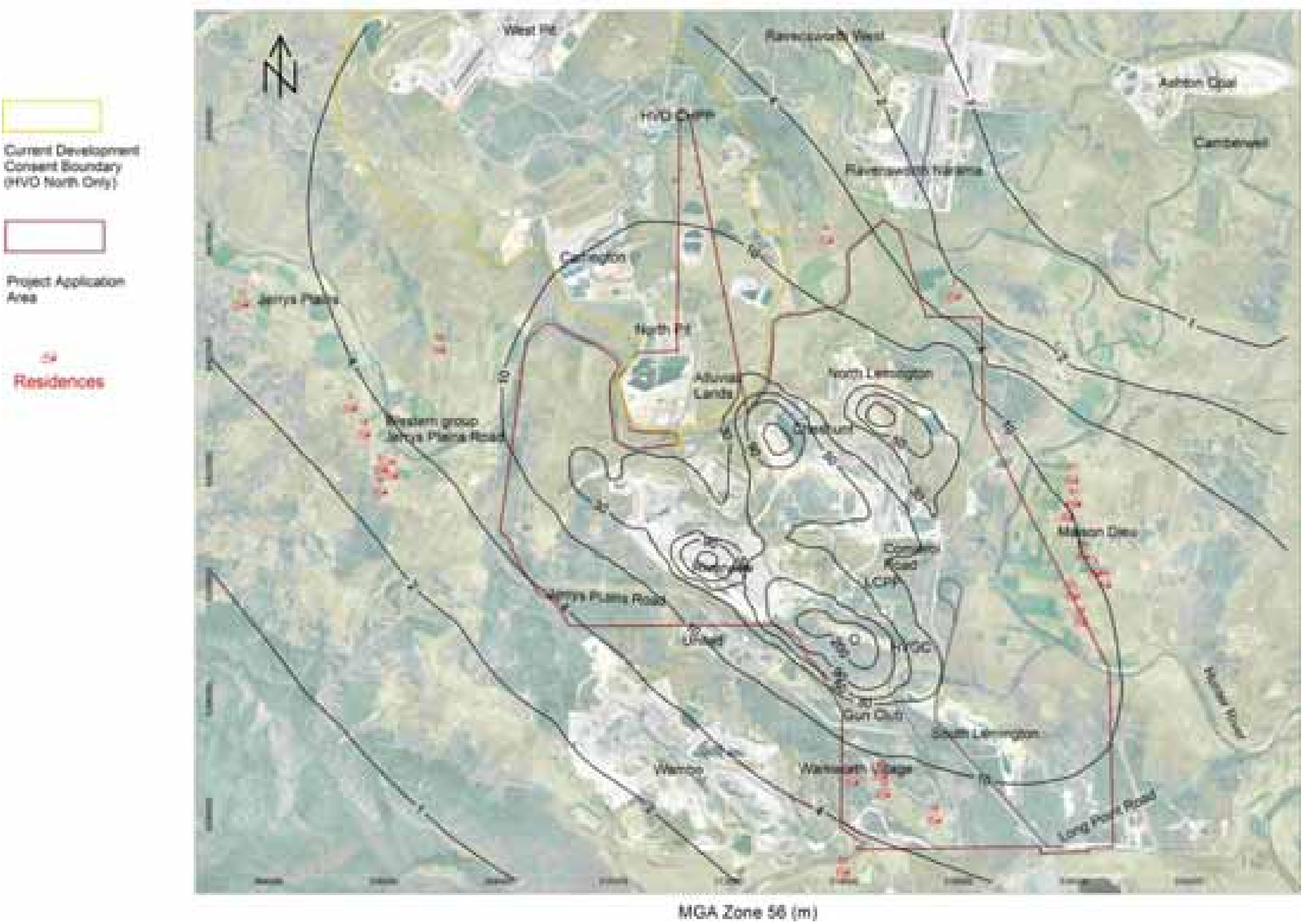
Predicted annual average dust (insoluble solids) deposition level due to emissions from HVO South and other mines and other dust sources for 2006 - $g/m^2/month$

Figure 17



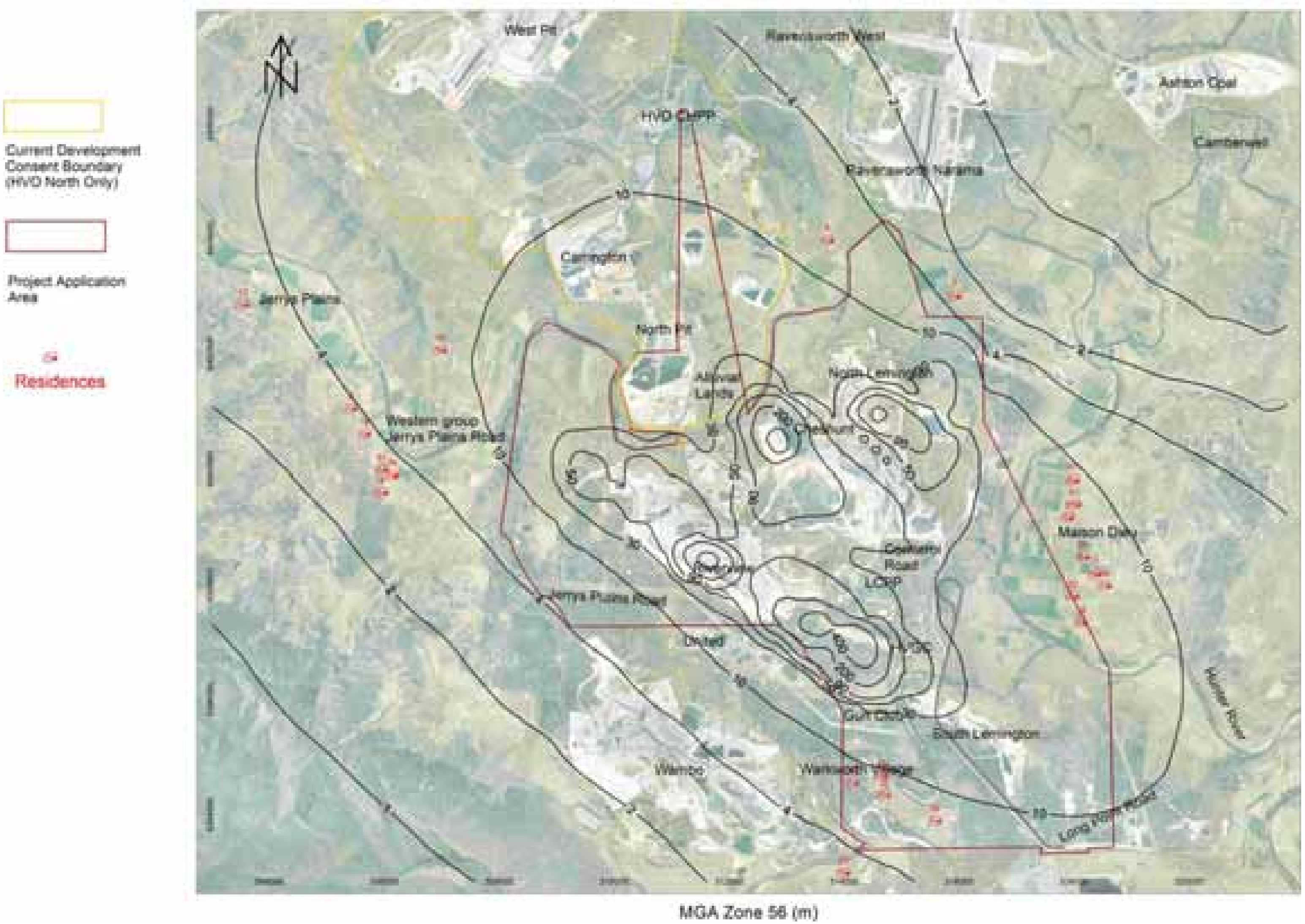
Predicted maximum 24-hour average PM_{10} concentrations due to emissions from HVO South for 2010 - $\mu g/m^3$

Figure 18



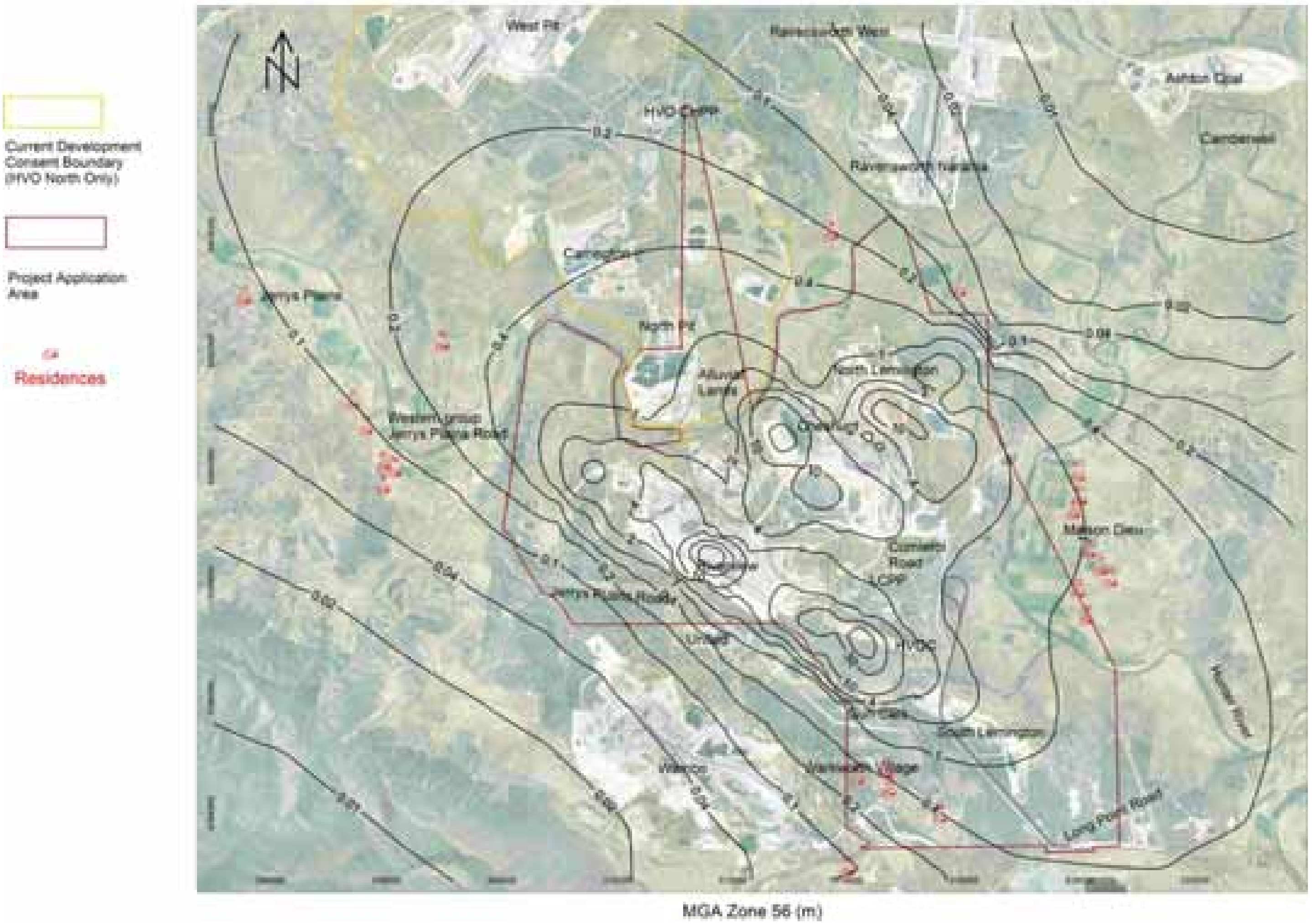
Predicted annual average PM_{10} concentrations due to emissions from HVO South for 2010 - $\mu g/m^3$

Figure 19



Predicted annual average TSP concentrations due to emissions from HVO South for 2010 - $\mu g/m^3$

Figure 20

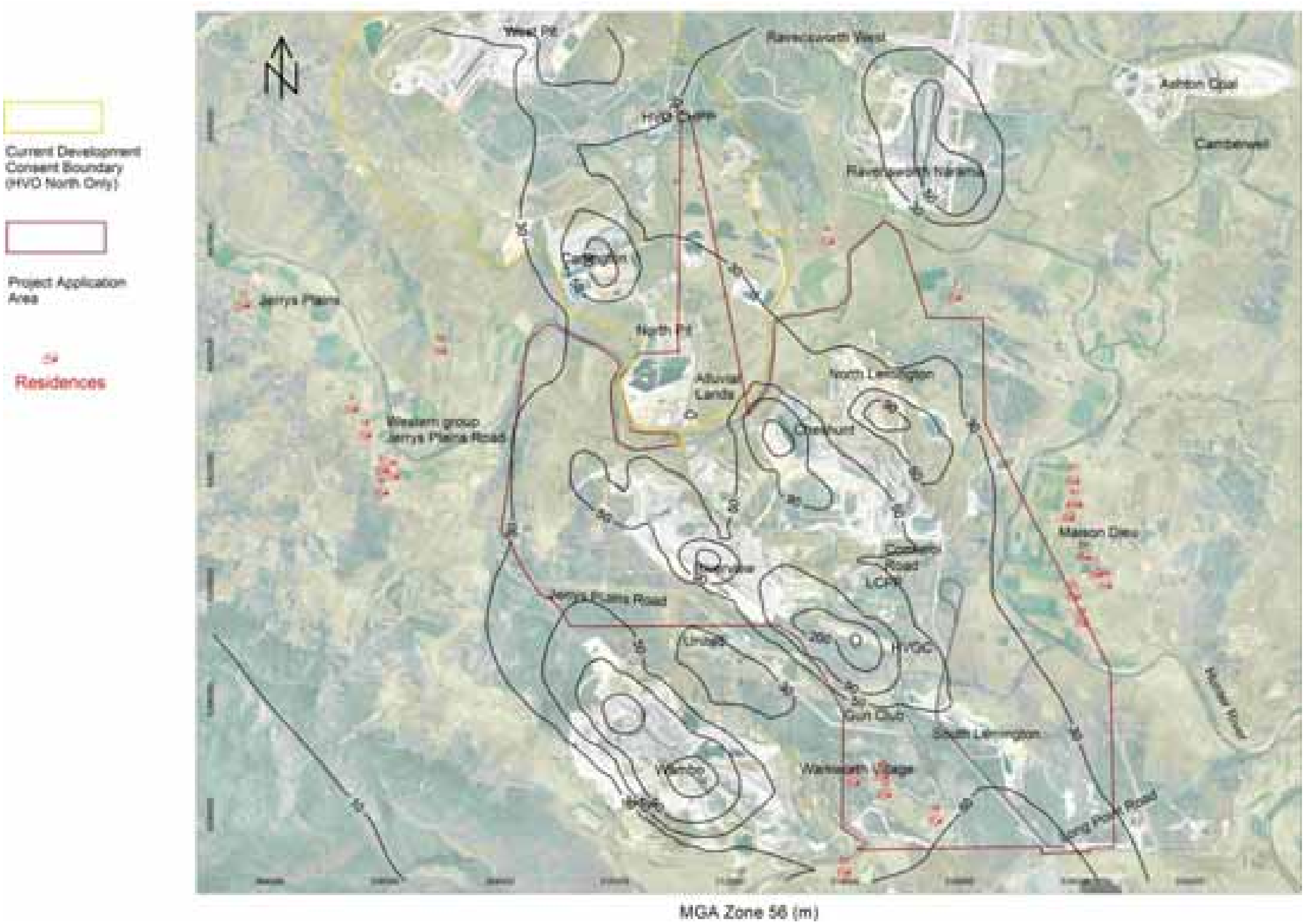


Predicted annual average dust (insoluble solids) deposition level due to emissions from HVO South for 2010 - g/m^2/month

Figure 21

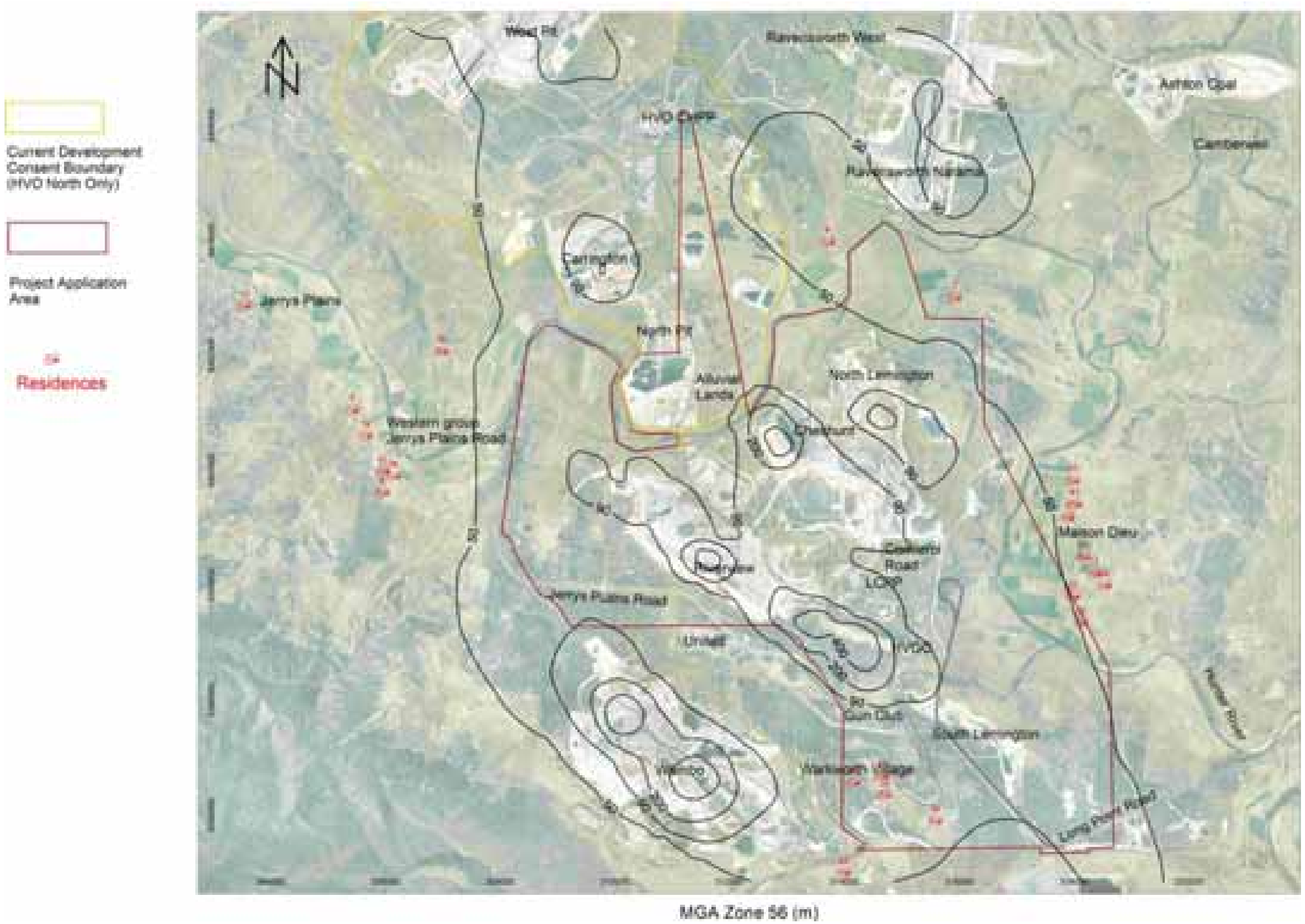
Predicted maximum 24-hour average PM_{10} concentrations due to emissions from HVO South and other mines for 2010 - $\mu g/m^3$

Figure 22



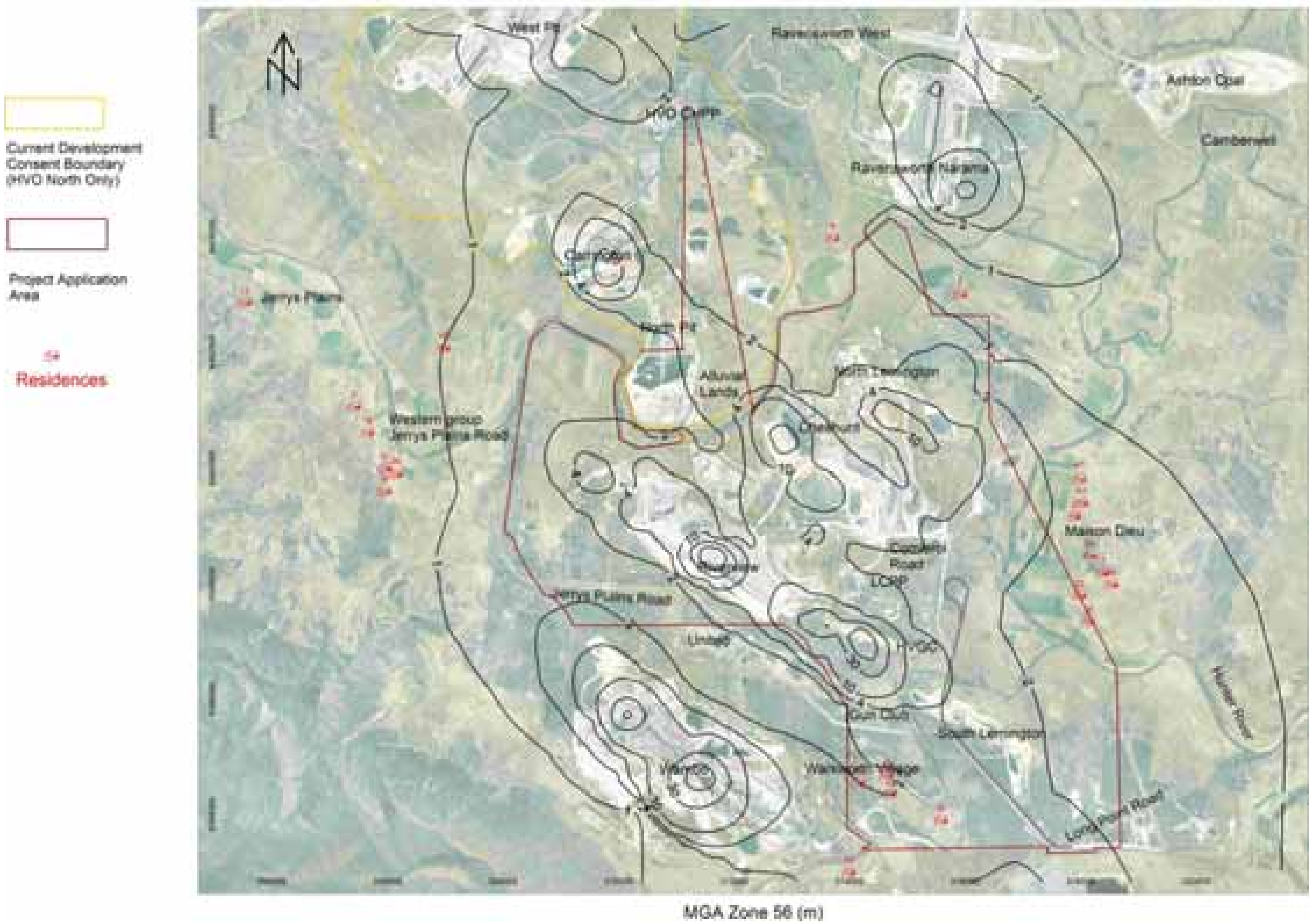
Predicted annual average PM_{10} concentrations due to emissions from HVO South and other mines and other dust sources for 2010 - $\mu g/m^3$

Figure 23



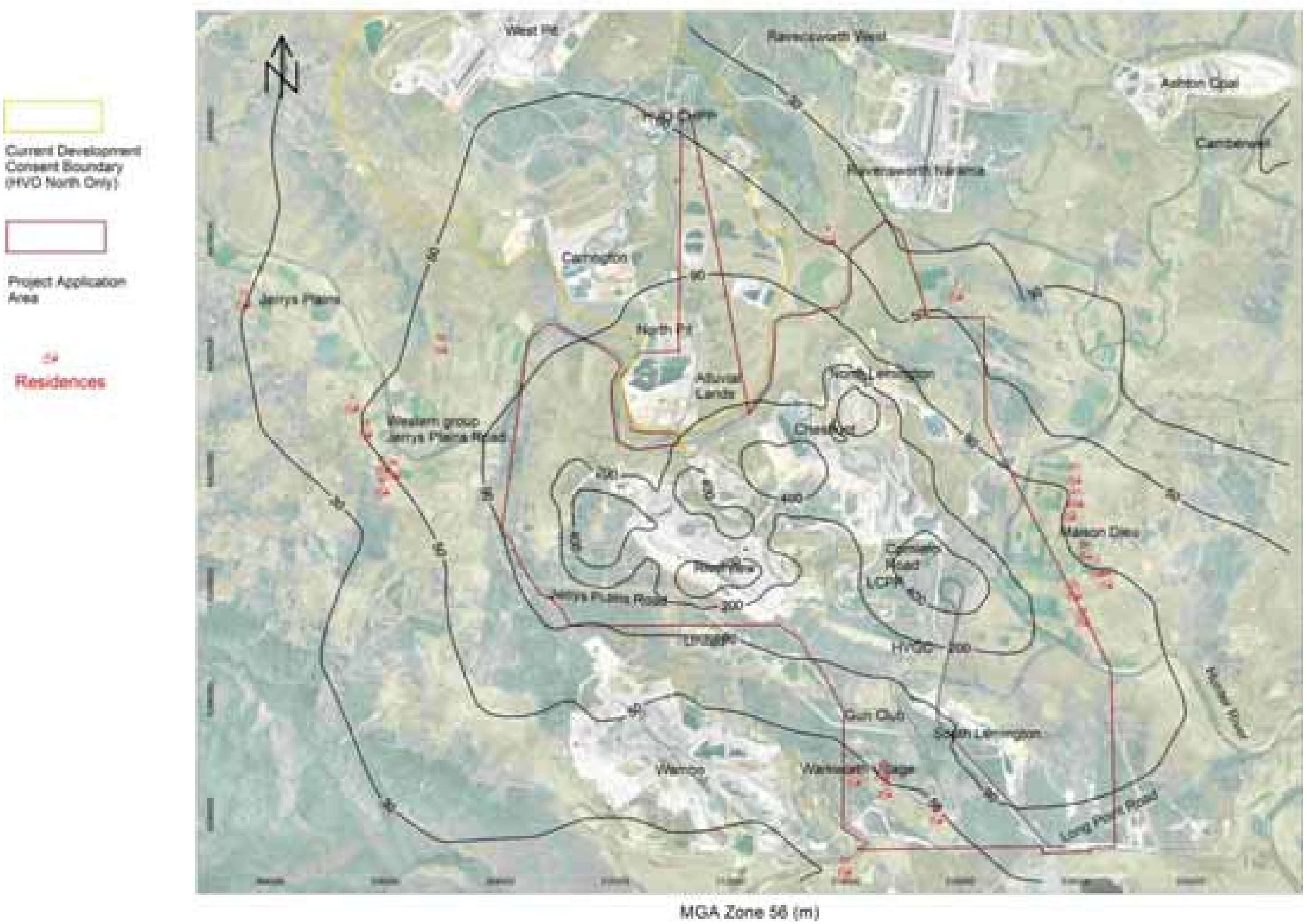
Predicted annual average TSP concentrations due to emissions from HVO South and other mines and other dust sources for 2010 - $\mu g/m^3$

Figure 24



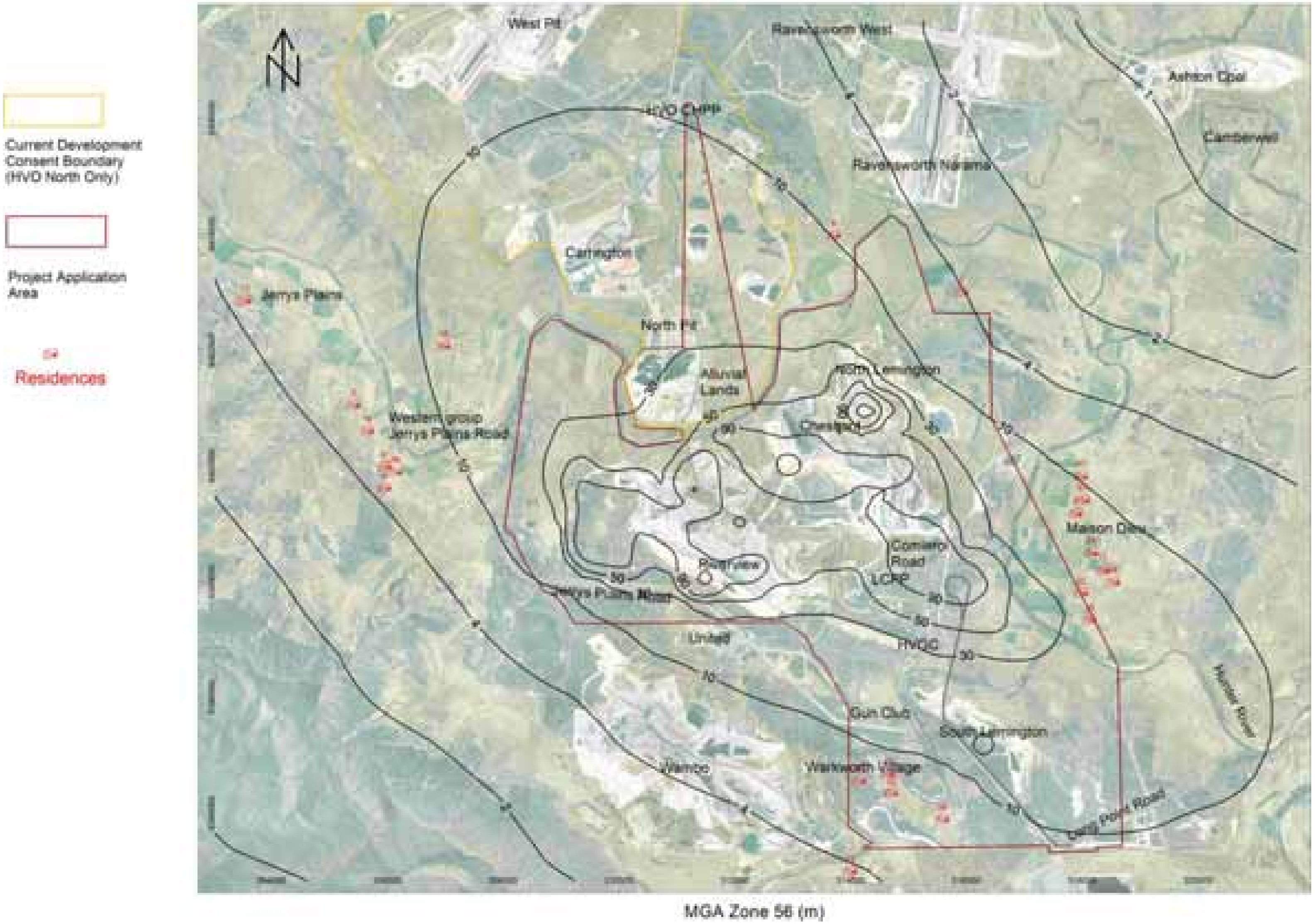
Predicted annual average dust (insoluble solids) deposition level due to emissions from HVO South and other mines and other dust sources for 2010 - g/m^2/month

Figure 25



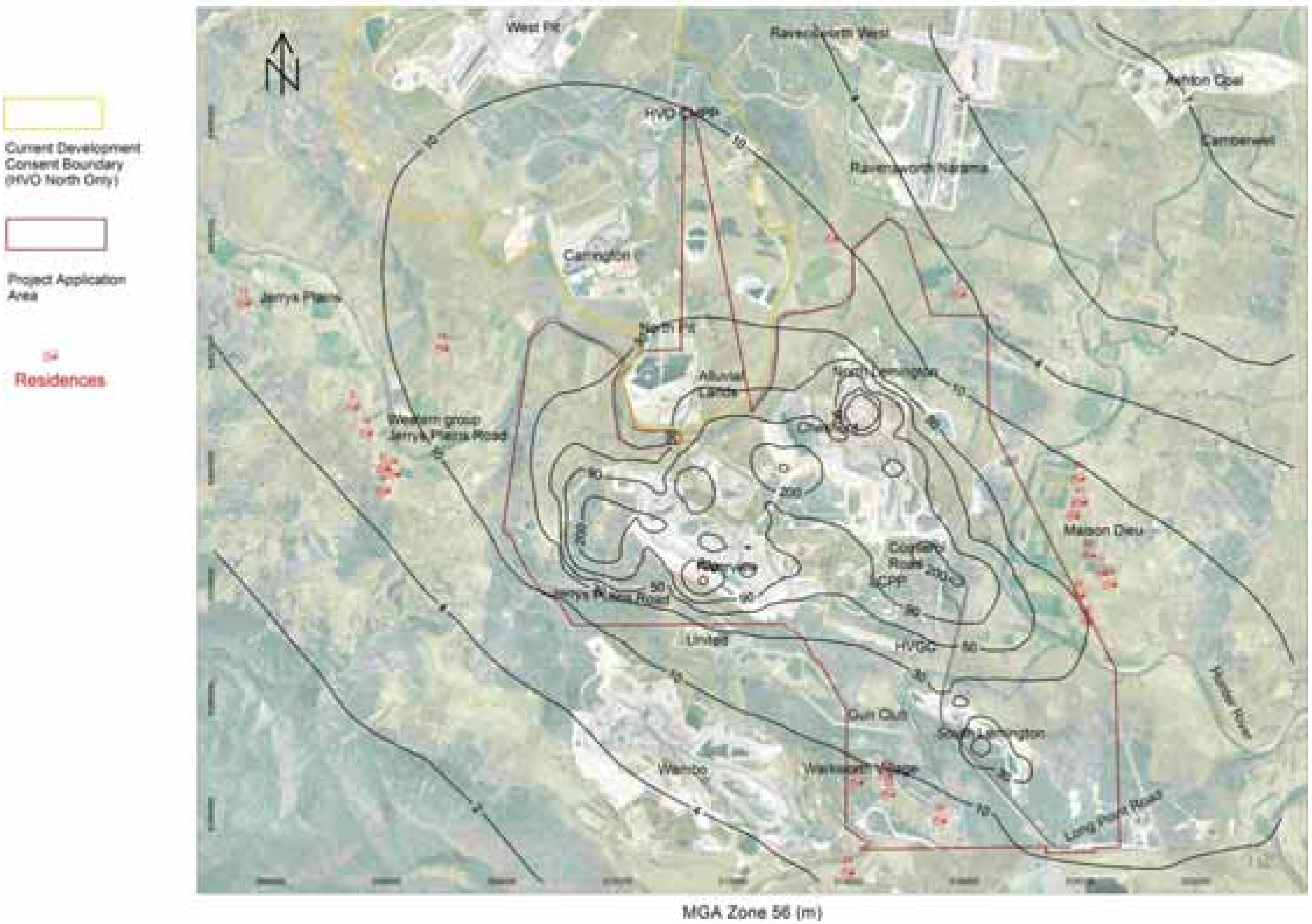
Predicted maximum 24-hour average PM_{10} concentrations due to emissions from HVO South for 2014 - $\mu g/m^3$

Figure 26



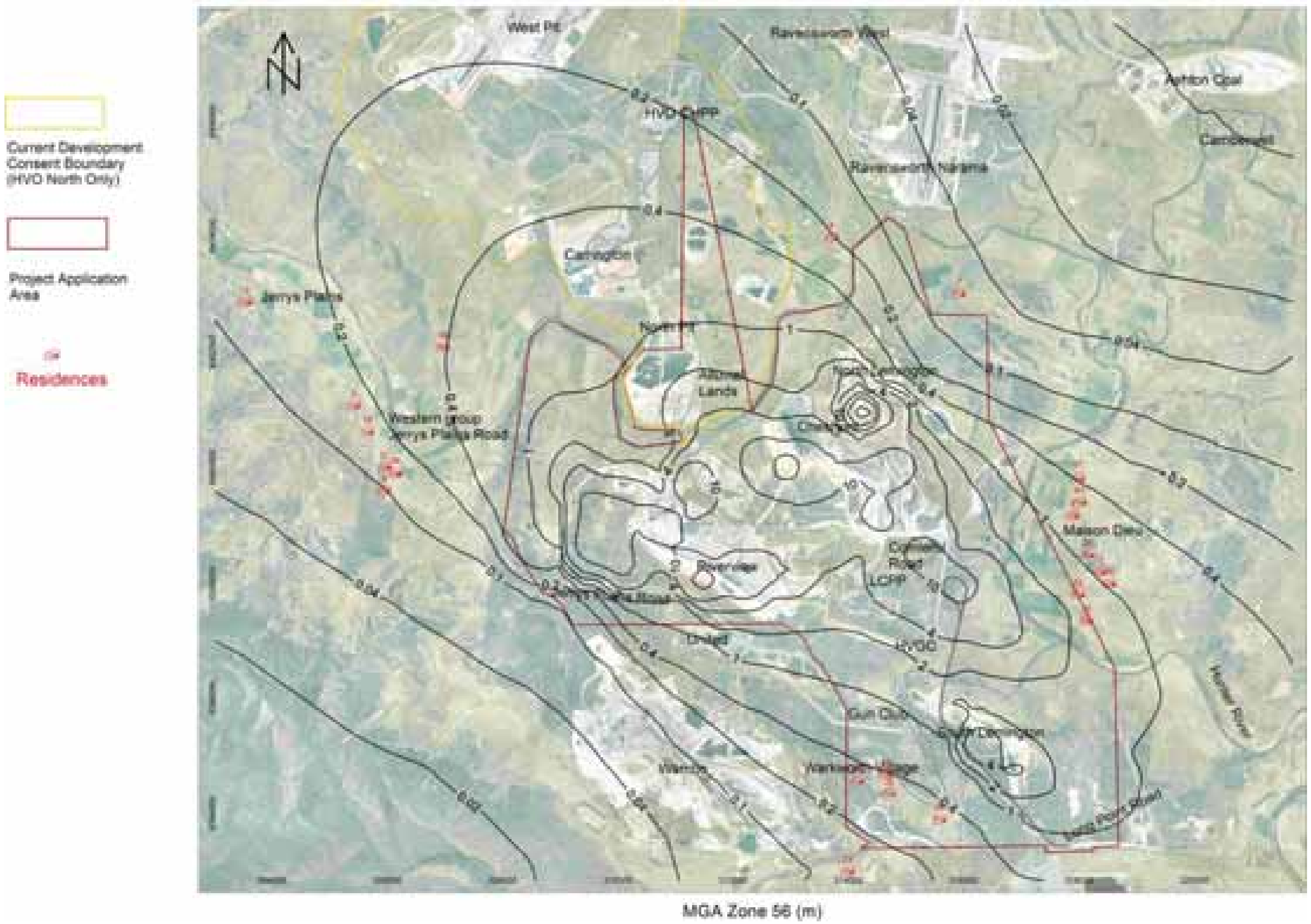
Predicted annual average PM_{10} concentrations due to emissions from HVO South for 2014 - $\mu g/m^3$

Figure 27



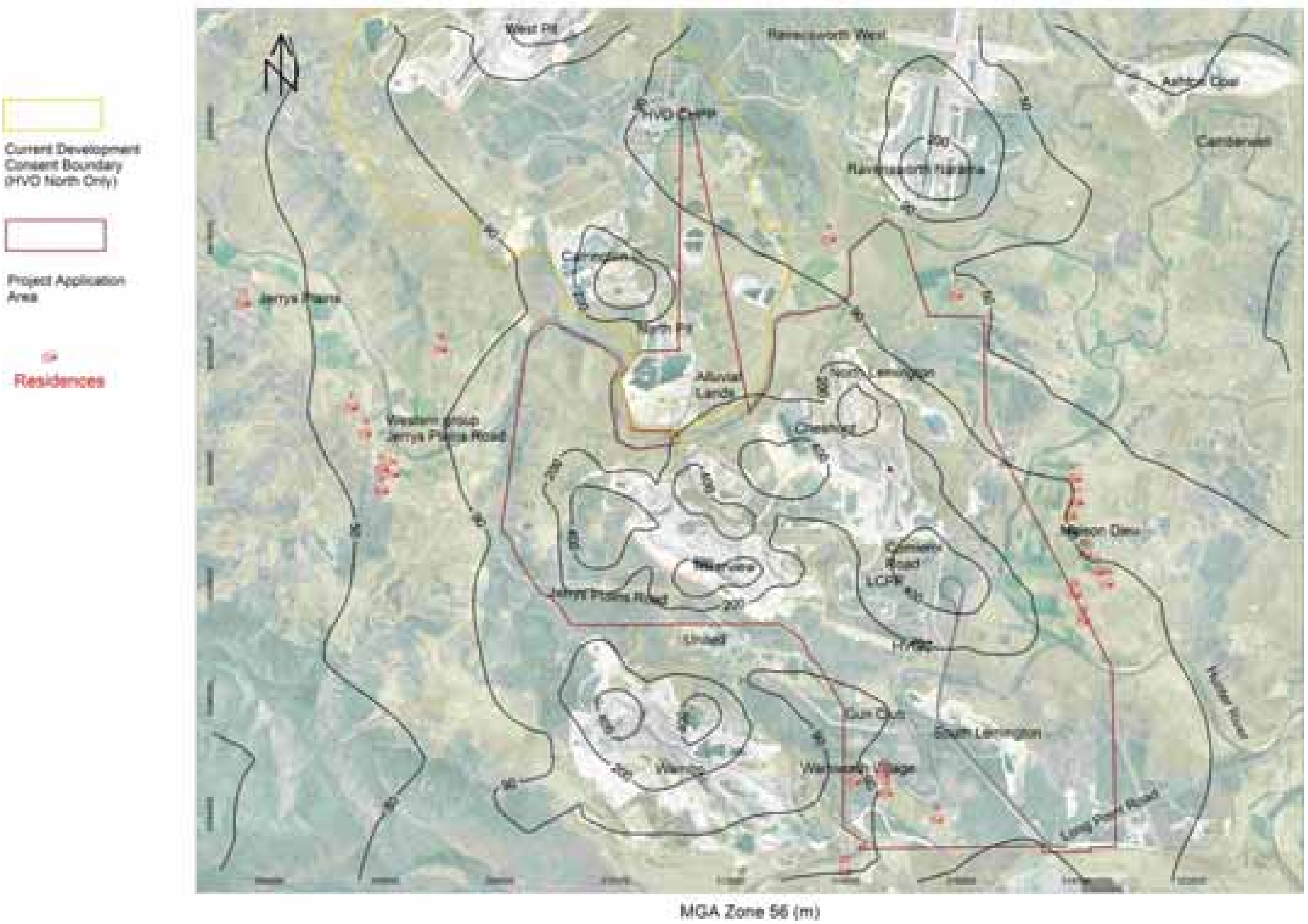
Predicted annual average TSP concentrations due to emissions from HVO South for 2014 - $\mu g/m^3$

Figure 28



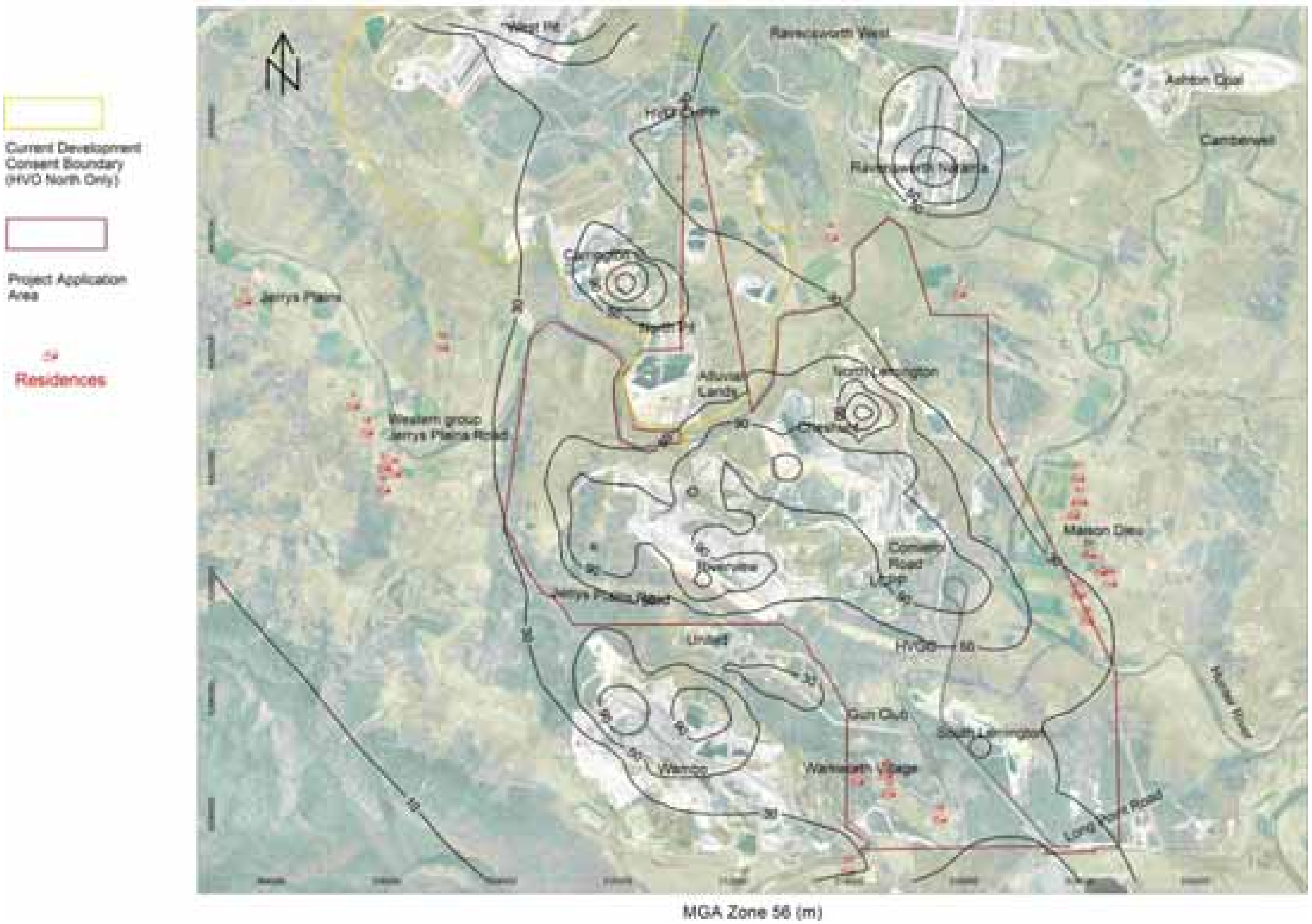
Predicted annual average dust (insoluble solids) deposition level due to emissions from HVO South for 2014 - g/m^2/month

Figure 29



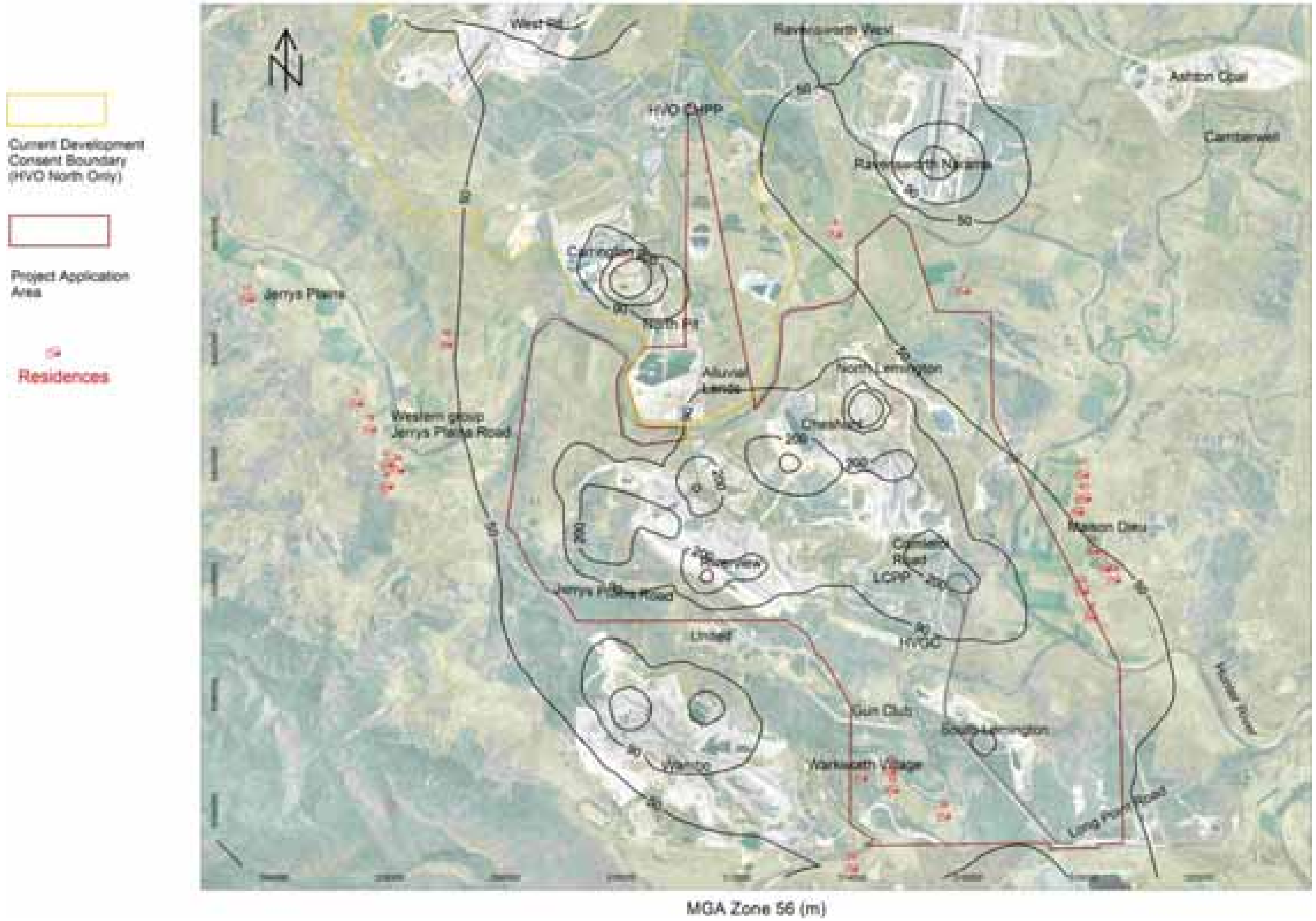
Predicted maximum 24-hour average PM_{10} concentrations due to emissions from HVO South and other mines for 2014 - $\mu g/m^3$

Figure 30



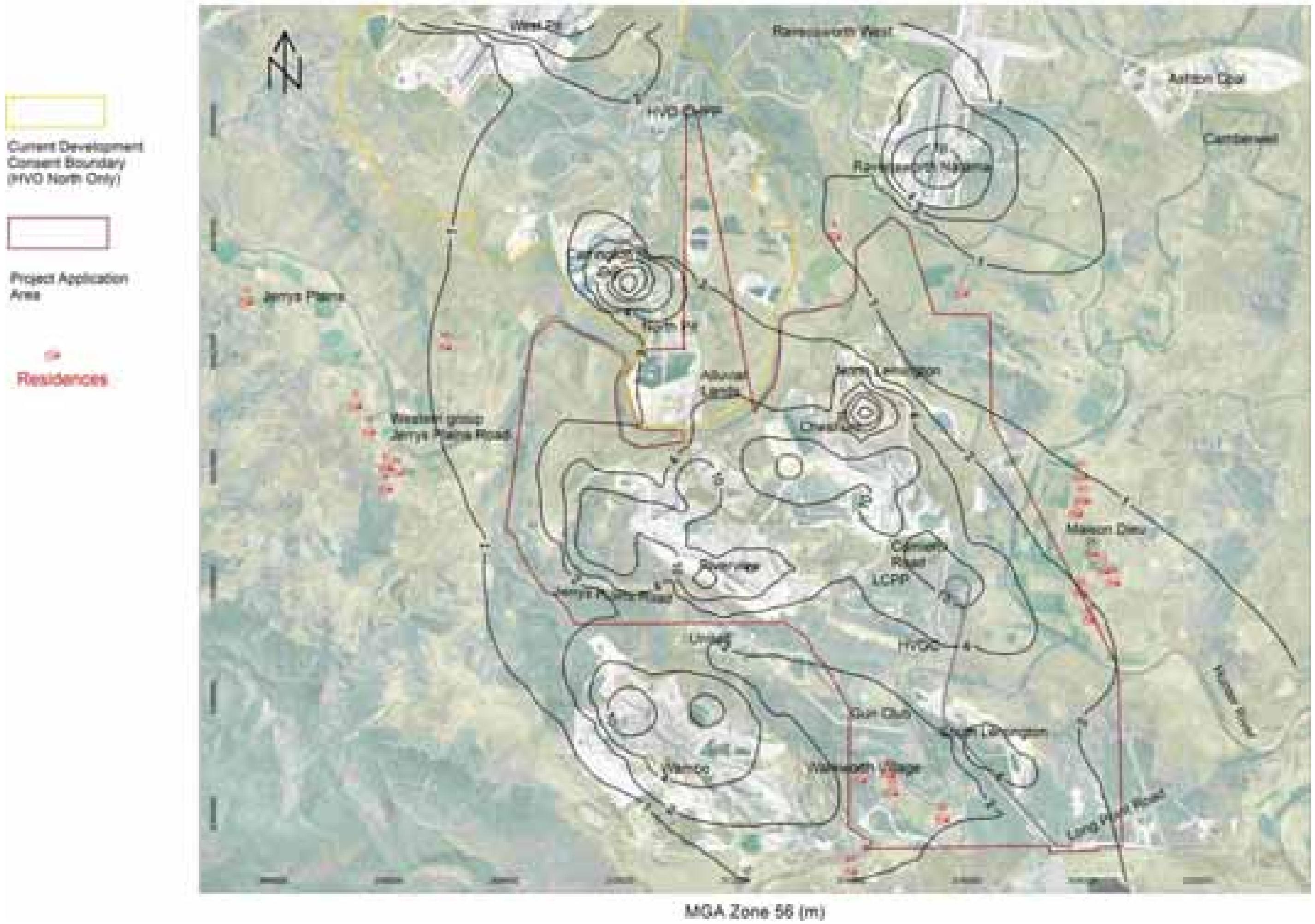
Predicted annual average PM_{10} concentrations due to emissions from HVO South and other mines and other dust sources for 2014 - $\mu g/m^3$

Figure 31



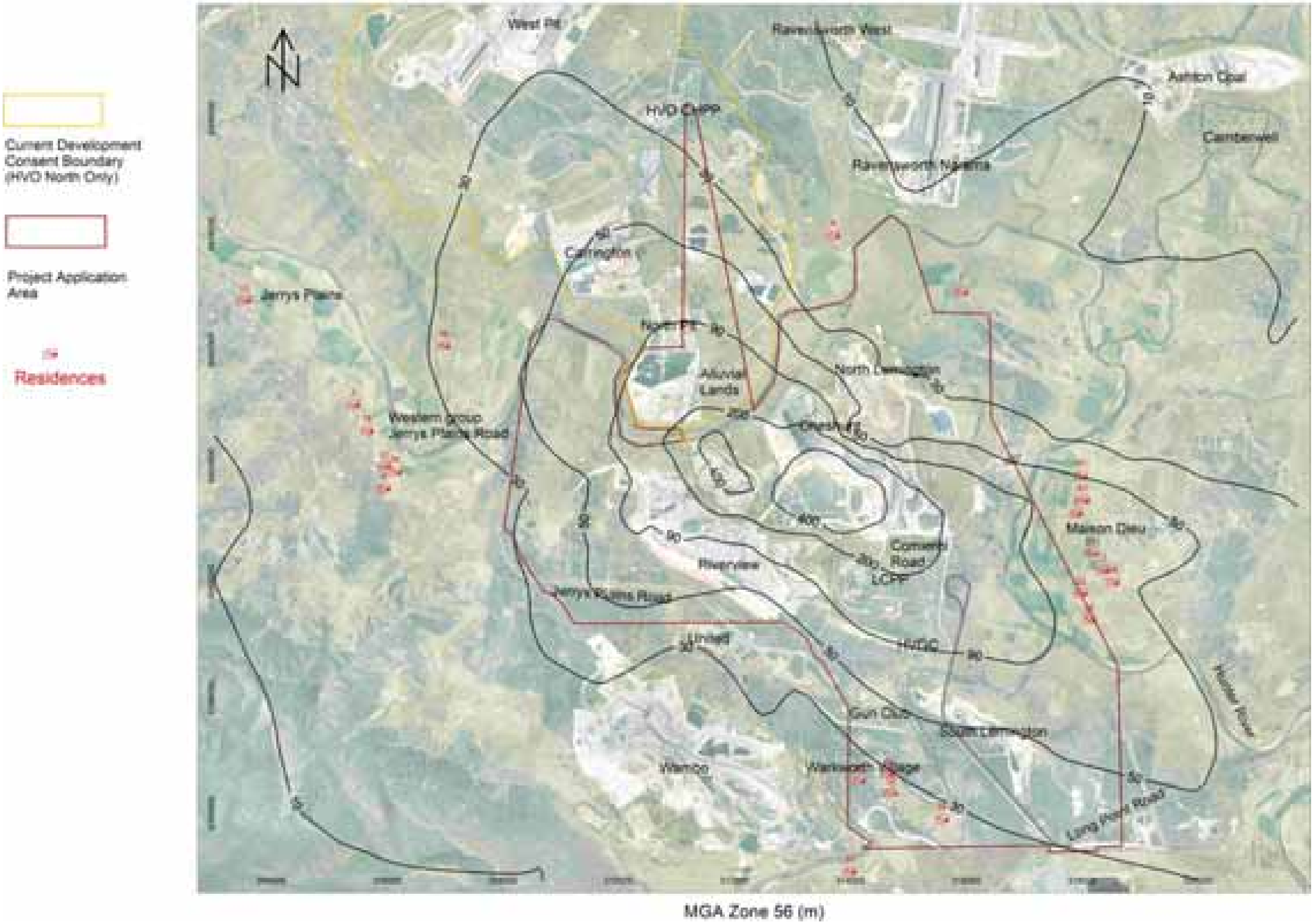
Predicted annual average TSP concentrations due to emissions from HVO South and other mines and other dust sources for 2014 - $\mu g/m^3$

Figure 32



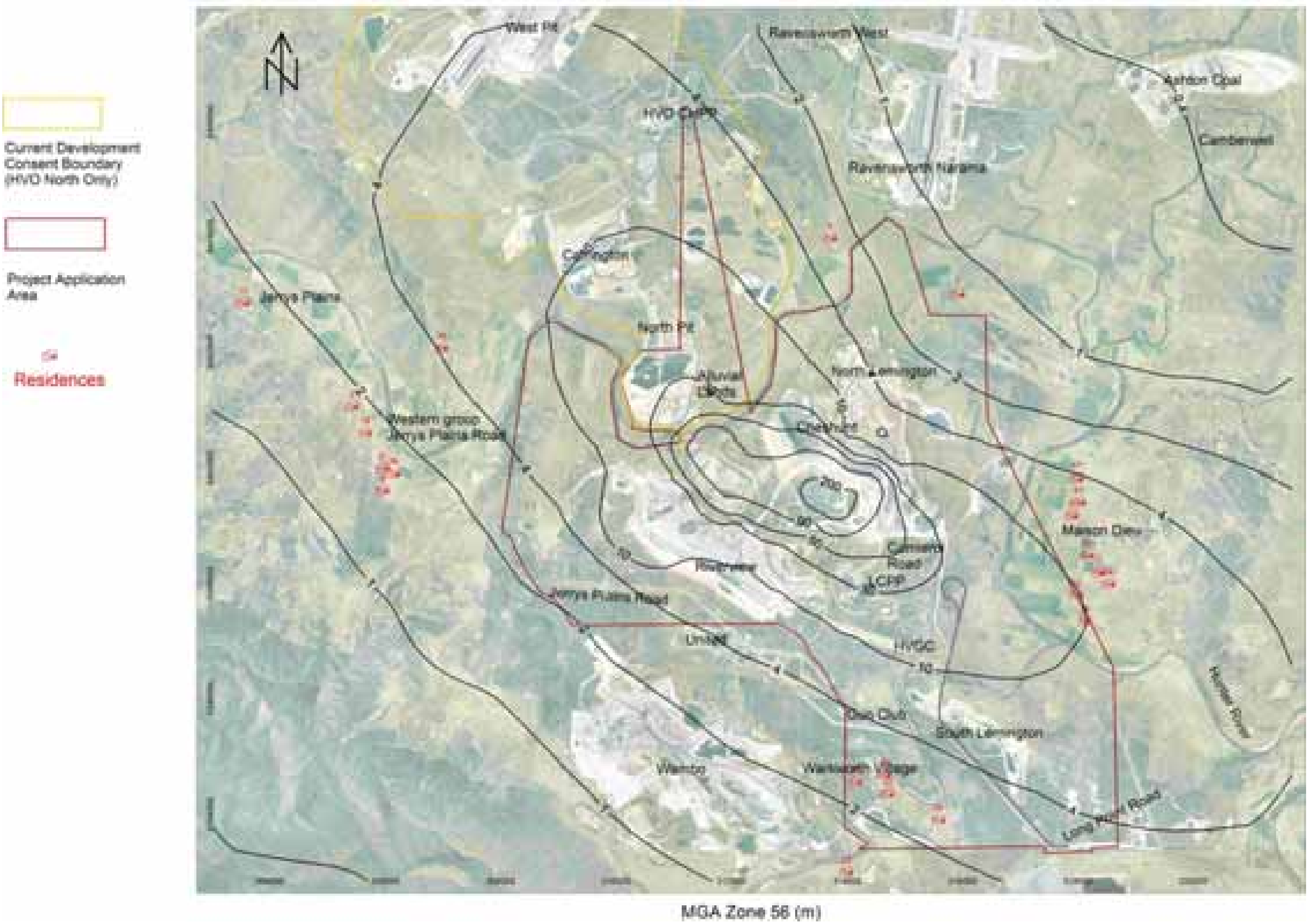
Predicted annual average dust (insoluble solids) deposition level due to emissions from HVO South and other mines and other dust sources for 2014 - g/m^2/month

Figure 33



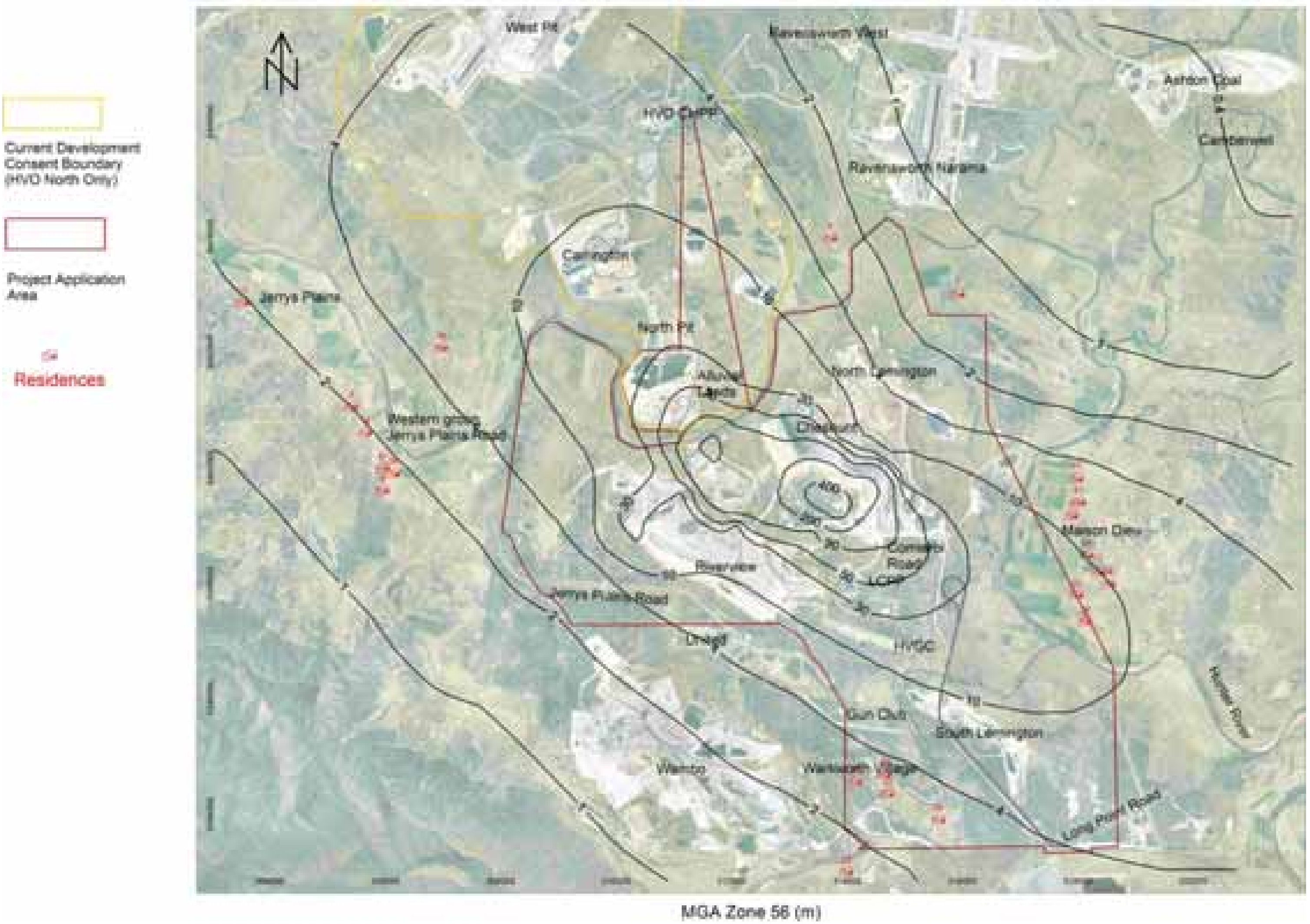
Predicted maximum 24-hour average PM_{10} concentrations due to emissions from HVO South for 2019 - $\mu g/m^3$

Figure 34



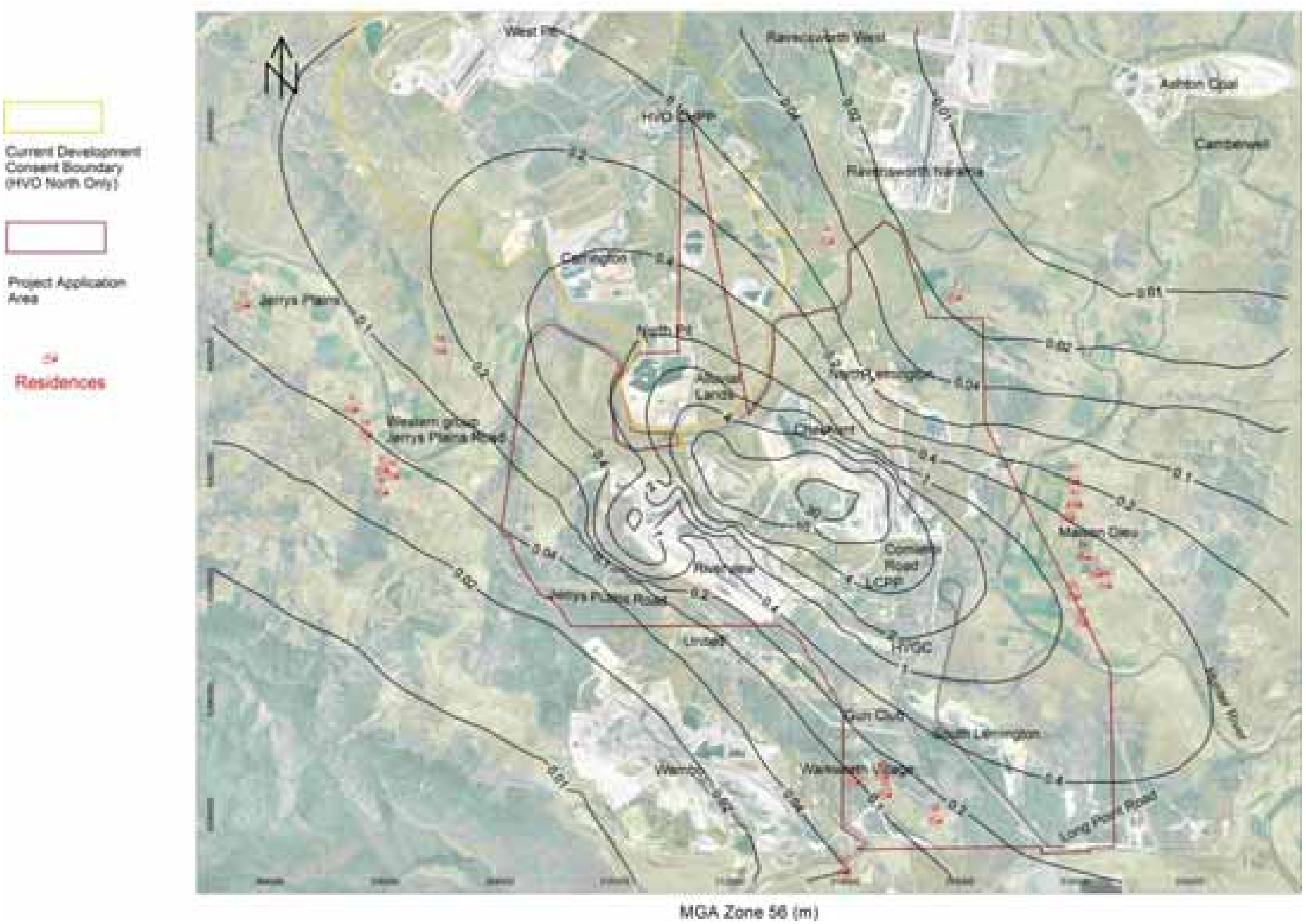
Predicted annual average PM_{10} concentrations due to emissions from HVO South for 2019 - $\mu g/m^3$

Figure 35



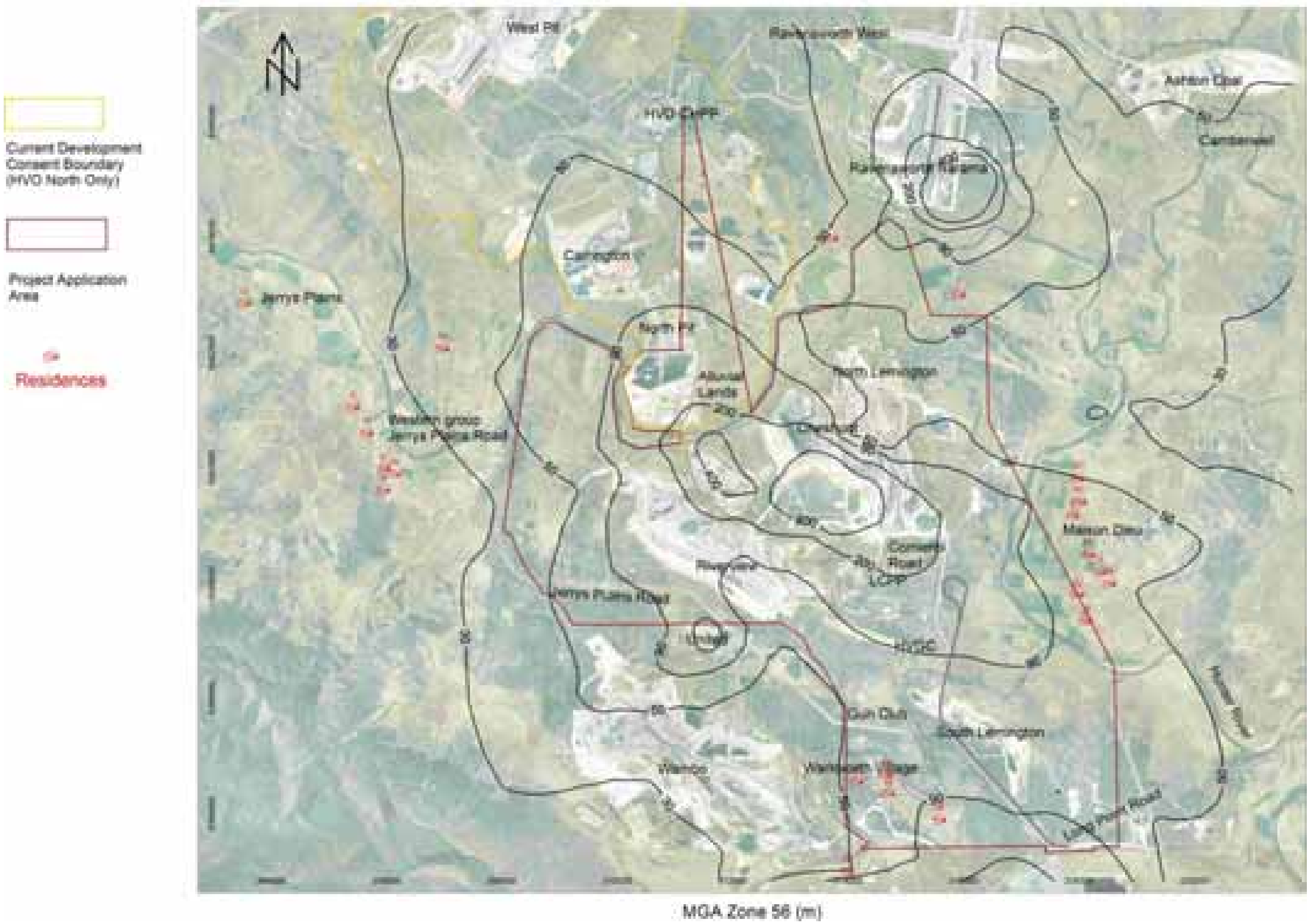
Predicted annual average TSP concentrations due to emissions from HVO South for 2019 - $\mu g/m^3$

Figure 36



Predicted annual average dust (insoluble solids) deposition level due to emissions from HVO South for 2019 - g/m^2/month

Figure 37



Predicted maximum 24-hour average PM_{10} concentrations due to emissions from HVO South and other mines for 2019 - $\mu g/m^3$

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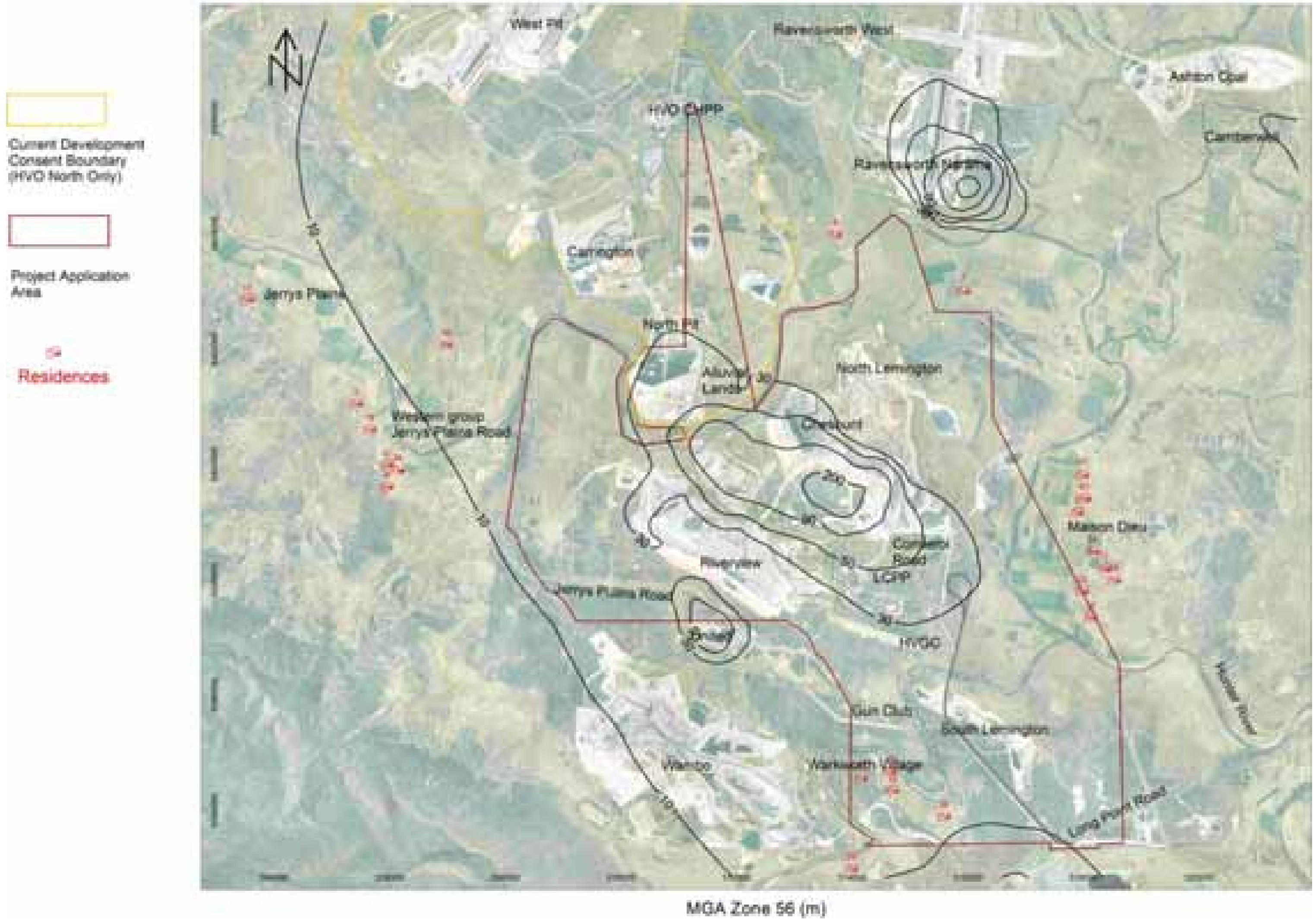
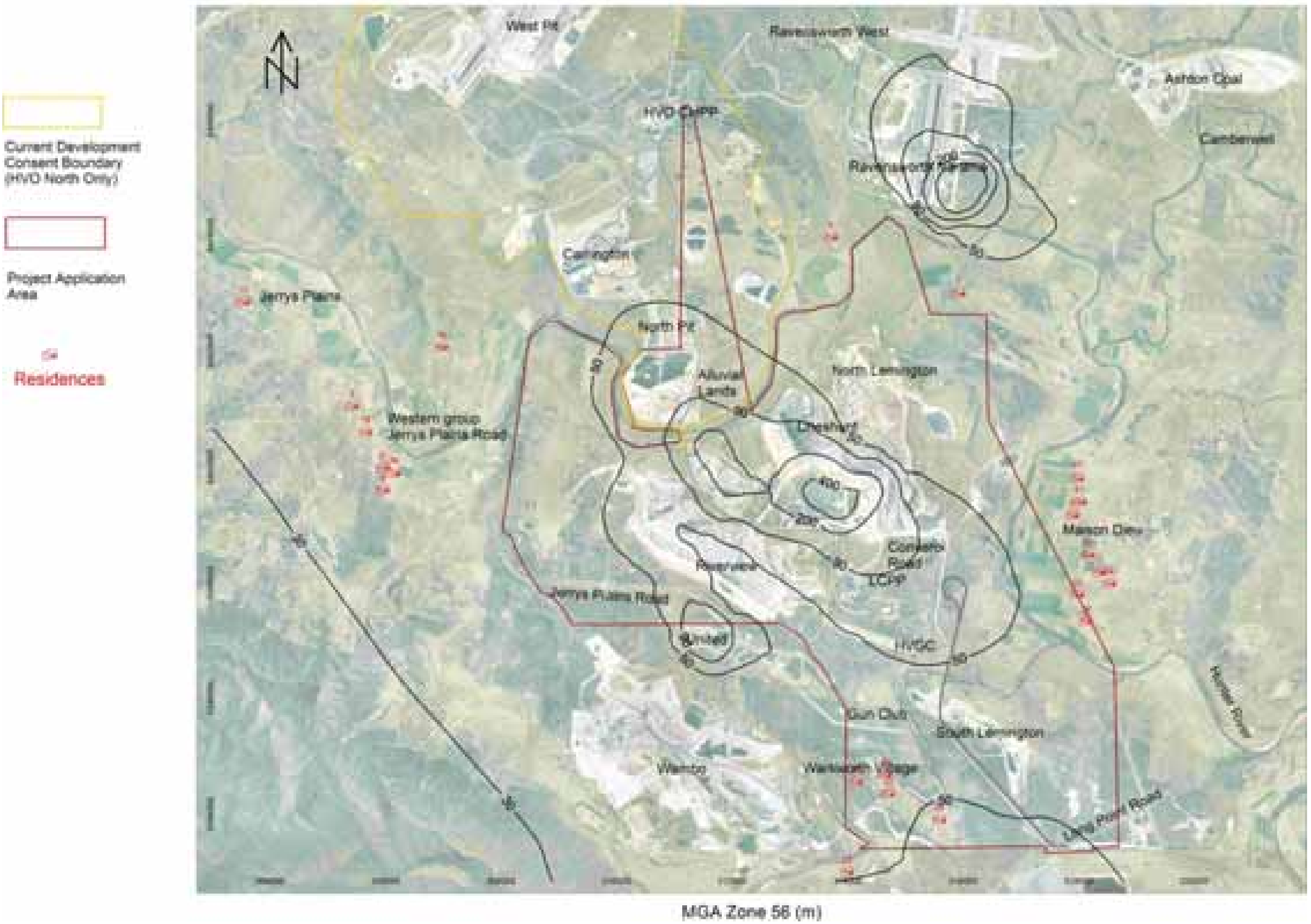


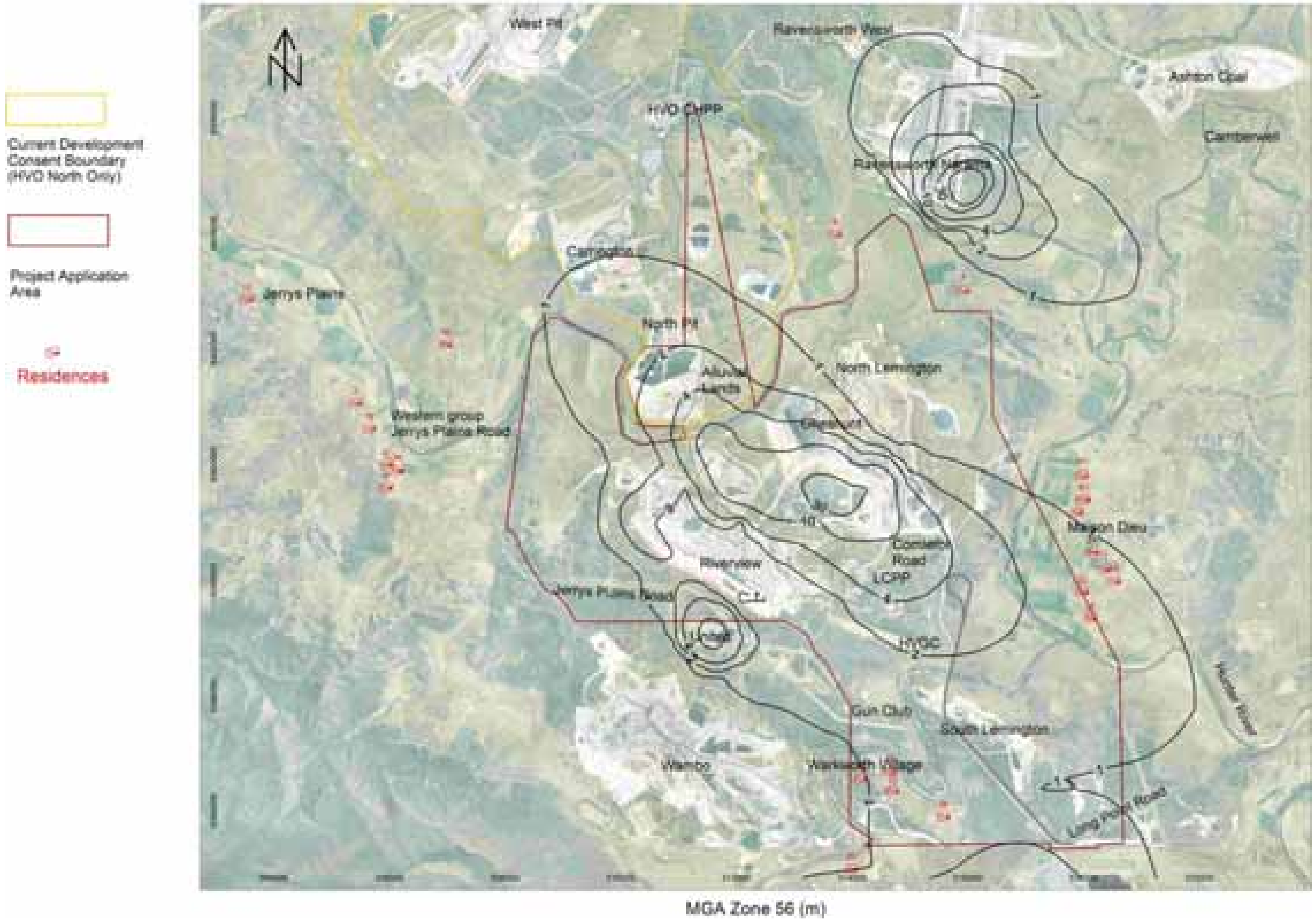
Predicted annual average PM_{10} concentrations due to emissions from HVO South and other mines and other dust sources for 2019 - $\mu g/m^3$

Figure 39



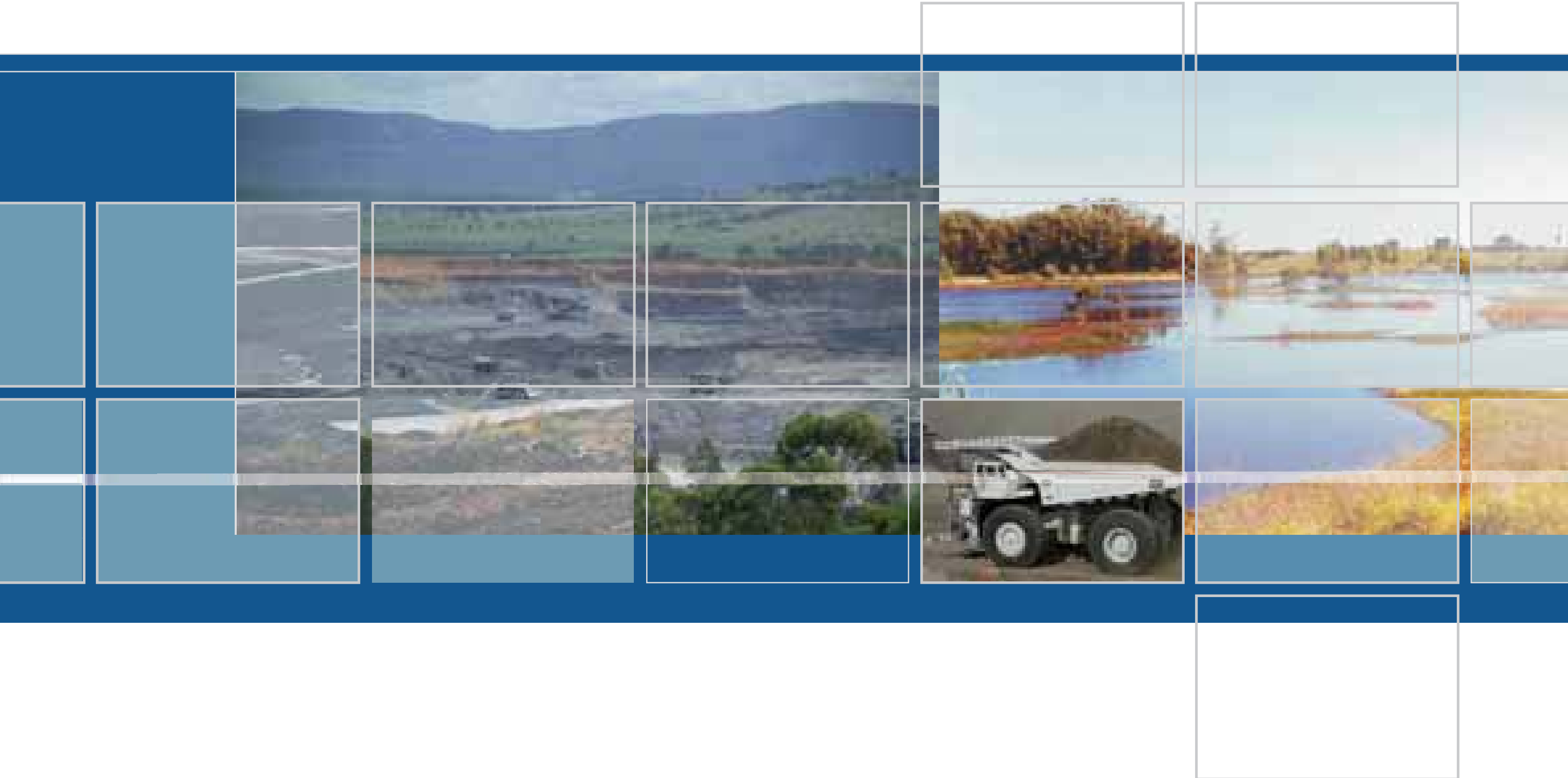
Predicted annual average TSP concentrations due to emissions from HVO South and other mines and other dust sources for 2019 - $\mu g/m^3$

Figure 40



Predicted annual average dust (insoluble solids) deposition level due to emissions from HVO South and other mines and other dust sources for 2019 - g/m^2/month

Figure 41



Annex J

HVO South Coal Project, Groundwater Assessment Report, ERM 2008

FINAL REPORT

Coal & Allied Operations Pty Limited

Groundwater Assessment
Hunter Valley Operations South Coal Project

January 2008

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EXECUTIVE SUMMARY

Environmental Resources Management Australia Ltd (ERM) was engaged by Coal & Allied Operations Pty Limited (CNA) to complete a hydrogeological and modelling investigation to assess the potential environmental impacts on surface water and groundwater resources of currently approved and proposed additional mining at the Hunter Valley Operations South of the Hunter River (HVO South).

Objectives and Approach

The main objectives of the investigation were to:

- assess the potential for groundwater flows in the Hunter River and Wollombi Brook to be impacted by the proposal;
- assess the potential impacts of deepening of the Cheshunt Pit with regards to deeper hard rock groundwater resources;
- assess the regional extent of depressurisation and recovery of groundwater resources over time associated with the proposed operations and post-closure,
- assess the potential for water quality impacts on surrounding surface and groundwater resources due to saline water generated within pit voids;
- assess the potential impact of reducing the recommended 150 m buffer zone between the pit highwall and alluvial zones;
- identify any potential resultant impacts on local water users and sensitive environmental receptors (eg, Hunter River and Wollombi Brook); and
- provide a groundwater model that can be refined and re-calibrated as mining progresses and as further pit seepage/dewatering and groundwater elevation data become available.

The investigation followed a three stage approach that included:

- conceptual model development and proposed model design;
- final model design and calibration; and
- model simulation results and sensitivity analysis.

The primary reasons for this staged process were to:

- allow for client and/or regulatory input prior to model development and production of modelling results; and
- to meet best practice requirements outlined in the Murray-Darling Basin Commission's groundwater modelling guidelines.

Model Development

The FEFLOW finite element groundwater modelling software was selected to simulate the potential impacts of mining.

Two models were developed to represent the mining within the Project Application Area. The main reasons for adopting this approach were:

- available data are generally clustered into two areas including Cheshunt/Riverview (represented in Model 1) and South Lemington (represented in Model 2);
- data processing times and model run times became more manageable; and
- there is a natural geological separation between mining in the Cheshunt/Riverview area and mining in the South Lemington area.

Calibration

Steady state models were developed and calibrated against available groundwater observation data and estimated flow budgets. The degree of calibration that was achievable was influenced by the following factors:

- groundwater elevations throughout the HVO area are impacted significantly by mine pit voids, however the precise locations of pits at the times of water level measurements was not available;
- to keep the computer model manageable, the complex geology containing more than 40 individual stratigraphic layers was simplified into six combined layers. This resulted in greater drawdown being predicted near pit voids than is historically observed on-site; and
- river elevations in metres above Australian height datum (m AHD) could only be approximated from an airborne survey. The Hunter River exerts a significant control on groundwater elevations in alluvium.

To adequately account for these factors an extensive sensitivity analysis was undertaken to examine the impact on predictions of changes in river elevations, constant head boundaries, rainfall recharge, hydraulic conductivity and storage coefficients.

Modelling Results

A series of steady state models were used to simulate mine progression through time. However, during sensitivity analysis it became apparent that steady state simulations will always over-estimate seepage from a river to a nearby pit. Due to the significant changes proposed for mining in the Cheshunt Pit it was decided to simulate mine progression in Model 1 under both transient and steady state conditions. Proposed modifications to mining activities in the South Lemington Pit area are minimal therefore Model 2 was simulated under steady state conditions only.

The results of the modelling are summarised as follows:

Model 1 - Cheshunt and Riverview Areas

- net groundwater flow is predicted to be towards the Hunter River during and after the proposed mining. The net groundwater flow towards the Hunter River is predicted to drop by 188 m^3/day. This reduction in flow approximates 5% of the minimum flows in the Hunter River recorded between 1969 and 2006 and is therefore considered to represent a negligible impact;
- groundwater flows into the Cheshunt and Riverview Pits are predicted to be primarily from the release of groundwater stored within geological strata surrounding these pits. Groundwater is also removed through the process of mining, ie removing saturated overburden and coal from the pit. A maximum seepage rate of approximately 7,320 m^3/day is predicted to occur at the time of fastest mining rates;
- the primary drawdown impacts are likely to be localised around the pit voids where release of water from storage occurs. In particular, simulated impacts to shallow groundwater in alluvium are minimal suggesting that there is unlikely to be adverse impacts to surrounding groundwater users, who primarily abstract from alluvium in this area;
- the modelling results suggest that impacts on flows to or from the Hunter River will primarily be associated with areas currently consented to be mined rather than the proposed areas. Seepage into the Cheshunt and Riverview Pits out to 2040 will comprise roughly of one third from storage in the ground, one third leakage from shallow alluvials and underlying coal seams below the Hunter River, (Layers 1 to 3 in the model) and one third from deep bedrock aquifers;
- a 50 m reduction of the 150 m buffer zone measured from the highwall to the edge of the alluvium will result in only minimal reduction of net seepage towards the Hunter River by 57m^3/day;
- the Deep Cheshunt Pit final void will act as a sink for leachate emanating from mine spoil and will prevent the migration of leachate to other surface water bodies. Therefore, the potential for the leachate to adversely impact Hunter River water quality is considered to be negligible;
- mine spoil leachate is estimated to be similar in chemical composition to current coal seam groundwater. Therefore, it is considered unlikely that leachate will have an adverse impact on groundwater quality if it migrates into coal measures after mine closure;
- salt loading will occur in the Deep Cheshunt Pit final void over time. Simulations suggest it will take in excess of 200 years for salt concentrations in the mine pit lake to increase to concentrations similar to that present in surrounding groundwater;
- the final void water elevation is expected to oscillate around an average elevation of approximately 0 metres above Australian Height Datum (mAHD), which is approximately 50 m to 60 m below current ground surface in this area;
- sensitivity analysis suggests that net seepage to the Hunter River is relatively insensitive to changes in input parameters when compared to fluctuations in the flow regime in the Hunter River. This affords greater certainty to the modelling outcomes in regard to the predicted impacts to the Hunter River; and
- sensitivity analysis suggests that seepage to pits could vary (eg, by more than 100%) due to variations in storage characteristics and hydraulic conductivity of the coal seams.

Model 2 - South Lemington Area

- the simulated worst case change in net seepage rates for Wollombi Brook approximate 580 m^3/day and could change the average groundwater flow regime from towards to away from Wollombi Brook. This could result in a potential increase in the number of dry days in Wollombi Brook by up to 6%;

- groundwater drawdown at the locations of neighbouring groundwater users is predicted to be less than 1 m. This predicted drawdown is conservative as the simulation was undertaken under steady state conditions and therefore the actual impact is likely to be significantly less than 1 m;

- seepage into South Lemington Pits 1 and 2 is primarily through alluvial deposits that are intersected by the pit void. The maximum seepages rates into South Lemington Pits 1 and 2 approximate 805 m^3/day and 62 m^3/day respectively and are considered to represent manageable volumes of water;

- seepage towards South Lemington Pit 1 is sensitive to parameters such as river elevations, alluvium hydraulic conductivity and pit spoil conductivity that create an additional flow through the alluvium connecting Wollombi Brook and the pit voids;

- the proposed additional mining in South Lemington Pit 1 will not increase the worst case leakage from Wollombi Brook or the worst case seepage to South Lemington Pit 1. This is because the proposed additional mining is located in areas further to the west and south away from Wollombi Brook and Wollombi Brook alluvium;

- a 50 m decrease in the buffer zone from the edge of the Wollombi Brook alluvium, could reduce groundwater flows to Wollombi Brook by 136 m^3/day. This will potentially increase the number of dry days within Wollombi Brook; and

- current mine plans include total infilling and rehabilitation of the land surface within the South Lemington mines. As such, groundwater will not migrate to a pit void evaporative sink as at the Deep Cheshunt Pit final void. Therefore, groundwater emanating from the mine spoil after mine closure is predicted to migrate into the surrounding regional groundwater system. The mine spoil leachate has previously been estimated to approximate the chemistry of the current coal measures groundwater. As such, it is not considered likely to result in adverse impacts to the surrounding groundwater system.

Recommendations

Groundwater management at HVO is detailed in a management plan that lists the key objectives and control measures.

The management plan outlines key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle.

The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for groundwater management are to:

- manage the operations in a way that minimises groundwater impacts to environment and neighbours, and limits interference to mining production;
- understand the site groundwater resources and minimise impacts on quality;
- understand the zone of influence of potential impacts of operations on groundwater and aquifer pressures including alluvium;
- monitor and manage seepage of groundwater from shallow aquifers and impacts on surface streams; and
- keep the local community and regulators informed of activities where required and to respond quickly and effectively to issues and concerns.

The recommended management measures have been considered in the context of the existing HVO activities and the CNA EMS. As a result a number of mitigation measures for groundwater will be implemented across HVO South to minimise the potential impacts resulting from the proposal.

Mitigation Measures

Regular controls for groundwater management include:

- selective backfill or construction to inhibit seepage into pits following mining;
- captured groundwater managed as mine affected water;
- levee construction to prevent flood water inflows to pits;
- monitoring of groundwater at sites as detailed in the Groundwater Monitoring Programme; and
- monitoring results for sites as listed in the Groundwater Monitoring Programme to be included in the AEMR.

Commitments Specific to the Proposal

In addition to the mitigation measures applied across HVO South the following controls will be implemented.

Groundwater Flow to and from Rivers:

- development of protocols for monitoring and reporting of stream gauge results to clearly record any reductions in groundwater flows that are attributed to mining. This will include monitoring Hunter River flows immediately up gradient and down gradient of the works area. In addition, consideration will be given to tying in specific CNA water level recordings with current DWE gauging locations;

- monitoring of groundwater elevations within alluvium between the Hunter River and the Cheshunt Pit;

- measured groundwater elevations and river flow will be assessed against predictions to determine whether application of additional management measures is required; and

- any reduction in river flow will be offset in accordance with legislative requirements.

Regional Groundwater Drawdown:

- the HVO *River Red Gum Rehabilitation and Restoration Strategy* and CNA EMS Procedure for Flora and Fauna will be updated to reflect changes resulting from the proposal. This will include monitoring the health of the River Red Gums located on the Hunter River and Wollombi Brook alluvium as identified in *Chapter 11* of Volume 1 (*Figure 11.2*). The monitoring programme will include details on frequency of monitoring, reporting and corrective actions; and

- up to three monitoring wells will be installed in the proximity of the cluster of registered DWE bores located to the east of the LCPP (*Figure 25*). Data will be used to compare actual versus predicted impacts. Deviations away from predicted impacts will be assessed, and if predictions are exceeded, management measures will be implemented.

Alluvial Buffer Zone:

- a buffer zone of 100 m will be retained from the Cheshunt Pit highwall to the edge of the Hunter River alluvium;

- a buffer zone of 150 m will be retained from the South Lemington Pit 2 highwall to the edge of the Wollombi Brook alluvium;

- bores will be installed to further delineate the saturated zone between the Hunter River and the Cheshunt Pit before mining commences within this area; and

- the groundwater component of the Water Management Manual will include procedures for monitoring potential impacts, including accurately measuring seepage to pits throughout mining and assessment of proximity to alluvials as mining approaches.

Pit Wall Stability:

Management measures relating to fracture development along pit walls are included in the Blast and Vibration Management Plan (refer to *Chapter 7* of Volume 1).

Deep Cheshunt Pit Final Void:

- the Deep Cheshunt final void will be designed to intercept leachate from overburden emplacements and minimise discharge of saline groundwater. Final void design will be reviewed at least three years prior to anticipated mine closure;

- the Final Void Management Plan will include future use options including investigation of feasibility to use the Deep Cheshunt Pit final void as a water storage that could be used as a buffer in times of flood flows in the Hunter River and as a supplementary water supply at times of scarce water supply. This would include additional investigations to refine predictions of final void water chemistry;

- a post closure monitoring programme will be developed for water quality monitoring of the final void; and

- the mine plan will be further reviewed with a view to minimise the area of the Deep Cheshunt final void as much as practicable.

Conclusions

A detailed assessment of the potential regional and local groundwater system impacts was undertaken for this environmental assessment. Two models were adopted for the assessment with Model 1 simulations being run under steady state and transient conditions and Model 2 simulations under steady state conditions only.

Flows in the Hunter River are not predicted to be significantly impacted by mining, with an approximate reduction of 5% of Hunter River minimum flows predicted. Of the maximum seepage predicted to occur into the Cheshunt and Riverview Pits, approximately 2.5% of flows are derived from the Hunter River. This includes mining up to within 100 m of the edge of the Hunter River alluvium.

Under worst case conditions, the number of days the Wollombi Brook is dry is predicted to increase by up to 6%. An assessment of the potential impacts to ecological values, specifically on the River Red Gums located on the Wollombi Brook alluvium, found that these species will not be significantly impacted by the proposal.

Seepage into the Cheshunt pit is predicted to range from 770 m^3/day to 7,320 m^3/day, dominated by water contained within the material disturbed by mining. This range does not include the potential 100% variability in initial stages of mining. All other impacts are considered minimal.

Currently consented mining within the Cheshunt, Riverview and South Lemington areas will comprise the major source of the identified impacts to the Hunter River and Wollombi Brook.

Existing CNA management system procedures and management plans currently govern the management of groundwater across HVO South. These documents will be updated to reflect changes to groundwater resulting from the proposal.

The Water Management Manual will be developed to replace the existing groundwater related management plans. The Manual will include management of pit seepage, a detailed monitoring programme and development of trigger values and corrective actions to manage changes to groundwater flows. This multilayered approach to groundwater management will minimise the potential for impacts to the regional and local groundwater systems.

1 INTRODUCTION

1.1 BACKGROUND

Coal & Allied Operations Pty Limited (CNA) own the Hunter Valley Operations (HVO) mining complex located 18 kilometres (km) west of Singleton.

HVO has expanded through a process of extension of existing mines and acquisition of additional mines. As a result there are a number of separate development approvals that apply to the operation.

The mining and processing activities at HVO are geographically divided by the Hunter River into HVO South and HVO North with movements of coal, overburden, equipment, water for operations, materials and personnel between the two areas. While HVO South and HVO North each have separate approvals, HVO is managed as an integrated operation. *Figure 1* of *Appendix A*[1] presents the location of the HVO areas.

HVO South, the focus of this investigation, comprises the Cheshunt, Riverview and Lemington Pits and the Lemington Coal Preparation Plant (LCPP).

There is now an opportunity to replace the current 25 separate consents and 11 associated modifications that apply to HVO South with a singular Project Approval. These consents have been issued by both the Singleton Shire Council (SSC) and the Department of Planning (DoP). The granting of a Project Approval for HVO South under the new Part 3A process (*EP&A Act*) will result in one approval for the operation and allow the surrender of the existing consents.

The potential for impacts to the groundwater resource associated with mining related activities has been recognised by CNA and the Department of Water and Energy (DWE) as an environmental issue of concern for HVO South. CNA has therefore commissioned ERM to produce an in depth regional hydrogeological assessment and groundwater model to examine:

- the potential influence of the proposed mining activities on surface and groundwater resources over the period of the proposed mining; and

- provide recommendations on how any potential effects may be minimised.

To facilitate acceptance of the modelling approach by DWE and to avoid unnecessary delays, it was agreed between ERM and CNA that a three stage approach should be adopted. The three stages of works are as follows:

- Stage 1: Conceptual and Proposed Model Design;

- Stage 2: Model Description and Preliminary Model Calibration and Results; and

- Stage 3: Final Model Simulations and Recommendations.

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[1] All figures referred to are included within Appendix A.

This report combines all stages of this process and includes documentation of available data, development of a conceptual hydrogeological model, model development, model calibration, model simulation results and management and monitoring commitments.

1.2 ASSESSMENT OBJECTIVES

The primary objective of this hydrogeological investigation is to assess the cumulative influence of HVO mining related activities south of the Hunter River on the local and regional surface and groundwater resources. To focus the assessment on the environmental issues of primary concern, the following specific objectives were developed in consultation with CNA and DWE:

- assess the potential for groundwater flows in the Hunter River and Wollombi Brook to be impacted by the proposal;
- assess the regional extent of depressurisation and recovery of groundwater resources over time associated with the proposed HVO South and post-closure, and the potential resultant impacts on local water users and sensitive environmental receptors (eg, Wollombi Brook and Hunter River);
- assess the potential impact of reducing the recommended 150 m buffer zone between pit highwall and alluvial zones;
- assess the potential impacts of the proposed deepening of the Cheshunt Pit with regards to deeper hard rock groundwater resources;
- assess the potential for water quality impacts on surrounding surface and groundwater resources due to saline water generated within pit voids; and
- provide a groundwater model that can be refined and re-calibrated as mining progresses and as further pit seepage/dewatering and groundwater elevation data become available.

1.3 SCOPE OF WORK

This hydrogeological investigation was initiated by consolidating the results of previous studies and monitoring carried out for the individual pit sites in the HVO South mining complex. These data were used to develop conceptual and numerical groundwater flow models designed to assess the specific project objectives outlined above. The following tasks were undertaken to achieve the objectives of this assessment:

- comprehensive review and consolidation of relevant historical data from the HVO South mining complex, including geological data (borehole logs, structural maps), historical surface water and groundwater monitoring results, previous Environmental Impact Assessments and meteorological data;
- development of a detailed Conceptual Site Model of the surface water and hydrogeological flow systems associated with the study area, including the alluvial deposits and underlying hard rock aquifers;

- development of two (separate) three-dimensional finite-element numerical groundwater flow models using the FEFLOW modelling package. The two models comprise the northern and southern mining areas, and were separated based on the distribution of available data and the distinction between specific coal seams targeted for mining in each of these areas;

- design and calibration of two steady state models based on historical hydraulic head data;

- initial predictive analysis of water flow between the Wollombi Brook alluvial aquifer and South Lemington Pits 1 and 2 using a steady state simulation to assess the potential for induced leakage as a result of highwall mining;

- predictive analysis of the regional extent of aquifer depressurisation and recovery through the active and post-mining phases near the Cheshunt and Riverview Pits using transient simulations;

- predictive analysis of saline groundwater migration pathways from pit voids;

- predictive analysis of the potential for aquifer depressurisation to adversely affect surface water systems (eg, the Hunter River and Wollombi Brook) within or near the HVO South mining complex; and

- on the basis of the hydrogeological assessment results, development of initial recommendations to address potential environmental impacts identified during the assessment.

1.4 MODELLING BEST PRACTICE APPROACH

Groundwater modelling best practice in NSW has been defined by the Murray Darling Basin Commission (MDBC) Groundwater Flow Modelling Guideline (2000). This document suggests that in order to achieve best modelling practice, the following key points should be incorporated into the modelling approach:

- *"clearly state, at the outset, the modelling objectives and the model complexity required;*

- *adopt a level of complexity that is high enough to meet the objectives, but low enough to allow conservatism where needed;*

- *develop a conceptual model that is consistent with available information and the project objectives. This will include documentation of any assumptions involved;*

- *if possible, a suitably experienced hydrogeologist/modeller should undertake a site visit at the conceptualisation stage;*

- *address the non-uniqueness problem by using measured hydraulic properties, and calibrating to data sets collected from multiple distinct hydrologic conditions;*

- *perform an assessment of the model uncertainty by undertaking application verification and sensitivity or uncertainty analysis of calibration and predictive simulations;*

- *provide adequate documentation of the model development and predictions;*

- *undertake peer review of the model at various stages throughout its development, and to a level of detail appropriate for the model study scope and objectives; and*

- *maintain effective communication between all parties involved in the modelling study through regular progress reporting and review."*

To achieve the above key points, the guidelines imply the following step by step modelling methodology:

1. *Conceptualisation:*

   i. *Define study objectives.*

   ii. *Complete initial hydrological and hydrogeological interpretation.*

   iii. *Prepare conceptual model.*

   iv. *Select modelling code.*

   v. *Prepare detailed model study plan (grid, layers, boundaries, timeframes, accuracy).*

   vi. *Report and review.*

2. *Calibration:*

   i. *Construct model by designing grid, setting boundary conditions and assigning parameters.*

   ii. *Calibrate model by adjusting parameters until simulation results closely match measured data.*

   iii. *Complete model verification, sensitivity and uncertainty analysis.*

   iv. *Report and review.*

3. *Prediction:*

   i. *Prediction scenarios.*

   ii. *Complete sensitivity and uncertainty analysis.*

   iii. *Report and review."*

The modelling investigation and reporting have been designed to be consistent with the key points listed above and are therefore considered to meet best modelling practice as documented in the guidance. To highlight the best modelling practice procedure adopted for this investigation, the report layout is also designed to consistently follow the guidance.

The methodology in the guidance document suggests the completion of staged updating, reporting and peer review at three key stages – conceptualisation, calibration and prediction. This process has been completed between ERM, CNA and the DWE.

1.5 LIMITATIONS

1.5.1 General Limitations

The findings of this report are based on the Scope of Work outlined above. ERM performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental consulting profession. No warranties, expressed or implied, are made.

Subject to the Scope of Work, ERM's assessment is limited strictly to identifying typical environmental conditions associated with the subject property.

This assessment is based on a review of historical assessments relevant to the study area, and information provided by the property owner or other people with knowledge of site conditions. All conclusions and recommendations made in the report are the professional opinions of the ERM personnel involved with the project and, while normal checking of the accuracy of data has been conducted, ERM assumes no responsibility or liability for errors in data obtained from regulatory agencies or any other external sources, nor from occurrences outside the scope of this project.

ERM is not engaged in environmental consulting and reporting for the purpose of advertising sales promoting, or endorsement of any client interests, including raising investment capital, recommending investment decisions, or other publicity purposes. The client acknowledges that this report is for the exclusive use of the client, its representatives and advisers and any investors, lenders, underwriters and financiers who agree to execute a reliance letter (a copy of which can be supplied upon request), and the client agrees that ERM's report or correspondences will not be, except as set forth herein, used or reproduced in full or in parts for such promotional purposes, and may not be used or relied upon in any prospectus or offering circular.

1.5.2 Modelling Specific Limitations

In addition to the general limitations, the following limitations also apply to this project:

- predictive analysis was undertaken using models calibrated in steady state because there was insufficient time-series data to calibrate under transient conditions. It is recommended that future validation of the modelling results is undertaken to assess the validity of steady state and transient predictions, and that the model parameters are refined in the future on the basis of transient calibration once a suitable time-series data set has been collected;

- due to a lack of operational and monitoring data, adjacent non-CNA mining operations were not included in the current model domains. The influence of external mining operations can be simulated in the future if sufficient information is provided to develop an accurate representation of these operations;

- when an area is modelled, the model creates a self-contained aquifer system within the model domain. In the real world, the groundwater regime outside of the model domain influences, or is influenced by, the modelled area. Subsequently, the perimeters of the model boundary must include the effects or implications of the groundwater regime outside of that boundary. These parameters, termed 'boundary conditions', are assumed conditions that are tested during calibration. There is always a risk that the chosen boundary conditions do not accurately reflect the real interaction between the model domain and surrounding aquifer system;

- model simulations aim to predict outcomes using the best available information at the time of the modelling. The results of these predictions are dependent on the assumptions made during the modelling process, which are outlined in the report. These assumptions may change as more data becomes available; and

- as with all modelling, there are often a number of possible approaches to creation and calibration of numerical simulation models. This model is based on one of several approaches possible. Other modellers may choose a different approach to the one adopted here, which may produce equally valid results.

2 ENVIRONMENTAL SETTING

2.1 EXISTING OPERATIONS

HVO South is comprised of Cheshunt, Riverview and Lemington Pits and Lemington Coal Preparation Plant (LCPP), which are presented in *Figures 1 and 2*.

Cheshunt and Riverview Pits are opencut operations with mining by both truck and shovel and dragline. The Riverview Pit is located in the north west section of the study area and Cheshunt Pit sits in the north east corner of the study area. At present, consent has been granted for mining down to the Vaux seam in the Cheshunt area and the Bowfield and Warkworth seams in the Riverview area. These seams and the approximate locations of the current pits are presented on *Figures 3 to 7*.

The mining process at HVO generally proceeds by mining the shallowest part of each seam first, ie closest to an area of outcrop, followed by subsequent mining of each seam down dip towards deeper elevations. This procedure maximises coal extraction while minimising overall land surface disturbance, which is less costly and more environmentally sound. At HVO South, the dip of the geology is generally to the south west resulting in a mine progression from the north east down dip to the south west. In the Cheshunt Pit the shallowest areas of the Warkworth and Mt Arthur coal seams have already been mined and in the Riverview Pit area the shallowest areas of the Bowfield coal seam have already been mined.

Lemington Mine is an opencut truck and shovel operation. It consists of northern and southern mining areas. Mining in the northern area is complete (with the exception of the south western corner) and the area is now being rehabilitated. Mining in the southern area has been approved to the north of Wollombi Brook (South Lemington Pit 2) and to the south of Wollombi Brook (South Lemington Pit 1). Mining has not yet commenced in South Lemington Pit 2 and has temporarily ceased in South Lemington Pit 1. At present, consent has been granted for the extraction of coal seams down to the Bowfield coal seam. The South Lemington Pit 1 is underlain by subsurface coal mines that have worked the Mt Arthur coal seam.

The LCPP, located to the south of the Cheshunt Pit, has approval to process run of mine (ROM) coal from the Lemington Pit and the Cheshunt and Riverview Pits.

Figure 2 presents the extent of current mining operations.

2.2 PROPOSED EXTENSIONS TO OPENCUT MINING

The mining will be a continuous process of excavation and backfilling with rehabilitation occurring when required backfilling heights are achieved.

Figure 2 presents the proposed future extensions to the pits over the proposal timeframe.

The proposed extensions to mining are summarised as follows:

- extraction of deeper coal measures from the Cheshunt Pit. This will entail excavating down to the base of the Bayswater coal seam, resulting in an excavation base approximating –130 mAHD. These seams and the associated pit extensions are discussed in more detail in *Section 2.7* and are presented on *Figures 3 to 7*;

- the Riverview Pit is to be excavated further to the west and will be excavated down to the base of the Vaux seam in central areas, which approximates depths of between -10 and -60 mAHD;

- the Riverview Pit will be extended to the south to intersect South Lemington Pit 2 with coal extraction down to the base of the Bowfield coal seam; and

- the South Lemington Pit 1 will be expanded to the west for recovery of coal down to the base of the Bowfield coal seam.

2.3 BUFFER ZONE

The DIPNR Draft stream/aquifer guidelines for *Management of Stream/Aquifer Systems in Coal Mining Developments* (DIPNR, April 2005) reference a notification zone of 150 m between the highwall of opencut mining and streams or associated alluvial zones. Specific merit based assessments are required for any proposed reduction of this protection zone.

The proposal includes the option of mining in the Hunter River and Wollombi Brook buffer zones, hence in accordance with the guidelines, an assessment has been undertaken to assess the potential impacts of a reduction in the buffer zone. Where results indicate negligible impact, a request to reduce the buffer zone has been made.

The defined edge of alluvium associated with the Hunter River and Wollombi Brook at HVO have been surveyed using resistivity measurements.

2.4 CLIMATE

The nearest long term rainfall gauging station is operated by the Bureau of Meteorology at Jerrys Plains. The average annual rainfall based on data collected between 1975 and 2006 is 657mm.

The nearest long term gauging station that records evaporation data is operated by the Bureau of Meteorology and is located at Cessnock. The average annual evaporation based on data collected between 1975 and 2006 is 1,338mm. Monthly variations in rainfall and evaporation are presented in *Figure 8*.

2.5 SURFACE DRAINAGE

HVO South is located in the Hunter River Catchment and is bounded to the north by the Hunter River. Under the *Water Management Act 2000*, the *Water Sharing Plan for the Hunter Regulated River Water Source* (WSP) (DIPNR, 2004) applies to the Hunter River from Glenbawn Dam to Maitland, and relates to the management of water access licences and allocations dependent upon available water determinations. The *Water Act 1912*, *Water Management Act 2000* and therefore the WSP, where they apply, regulate the licencing of water seepage into pit from hard rock aquifers and from alluvial aquifers associated with the Hunter River.

This proposal includes ongoing water allocation and extraction as currently licensed as well as seeking approval for changes to water infrastructure associated with the extraction of water.

Wollombi Brook meanders in a north easterly direction through the southern part of the area, separating South Lemington Pits 1 and 2. The confluence of the Wollombi Brook and the Hunter River is within the south east of the HVO South area.

Longford Creek and several other small tributaries drain the area to the south of Wollombi Brook. Within the HVO South boundaries these tributaries all flow to meet Wollombi Brook. Longford Creek flows in a northerly direction through the southern part of the HVO South area to meet Wollombi Brook approximately 1 km upstream from the confluence with the Hunter River.

To the north of Wollombi Brook, Redbank Creek and Comleroi Creek drain in a southerly direction to meet Wollombi Brook. The north western area of HVO South (in the vicinity of the Cheshunt and Riverview Pits) drains to Hobden Gully which flows in a northerly direction to meet the Hunter River.

The locations of the surface water drainage lines described above are presented in *Figure 1*.

The DWE PINNEENA database has stream flow and river gauging data for the Wollombi Brook and the Hunter River at the locations presented in *Figure 1*.

The gauging station on Wollombi Brook at Warkworth (station no. 210004) has recorded data since 1908. Average daily flows at this location are 468 ML/d, with a maximum daily flow of 322,576 ML/d recorded on 26 February 1955. The flow data suggest that Wollombi Brook is ephemeral being dry 11% of the time. Average water levels are 48.61 mAHD with a maximum water level recorded at 57.05 mAHD.

There are six gauging stations along the Hunter River in the vicinity of HVO South, with periods of record varying from 11 years to 37 years. The station with the longest record (station no. 210083) is located approximately 10 km upstream from HVO South and has recorded data since 1969. Average daily stream flows recorded at this location during this period are 1,088 ML/d and a maximum daily flow of 208,070 ML/d was recorded on 5 March 1977 and a minimum daily flow of 3.57 ML/d was recorded on 13 November 1982. Water elevations at sites along the Hunter River are currently not corrected to Australian Height Datum hence surface water elevations cannot currently be related to groundwater elevations in the alluvial deposits and/or the saturated thickness of alluvium.

The six gauging stations on the Hunter River each have different periods of record, however, they overlap for the period from April 1994 to November 2005. *Figure 9* illustrates the daily stream flow record for the six stations during this period. As expected due to tributaries joining the Hunter River, river flow increases downstream. Flow in the Hunter River during 1998 only was also plotted to allow a closer assessment of the variation in flow along the river (*Figure 10).* The data do not show evidence of consistent loss of water from the river to groundwater.

2.6 RAINFALL RUN-OFF AND RECHARGE

Previous groundwater modelling investigations (Mackie, 1992, 1998 and Rust PPK, 1997) within the HVO region have adopted a value approximating 1.0% annual rainfall as recharge to groundwater (0.02 mm/day) over weathered clay zones. Mackie (in ERM, 1998) also suggested an annual run-off ranging between 2% and 20% with an average of 7.2% of annual rainfall.

For the purpose of understanding variations in recharge to groundwater a revised estimate of the potential recharge to groundwater has been developed using the method outlined by Hulme *et al* (2001). This method uses pan evaporation data and rainfall data to estimate the quantities of run-off and recharge to groundwater for different types of vegetation and soils. It was assumed that:

- pasture/grasslands predominate in the area as listed on the DWE web atlas; and
- the study area is underlain by deep structured red clay loams but has alluvium around surface water features as indicated by bore log data in the area.

The run-off and recharge to groundwater using the method outlined by Hulme *et al* (2001) and using the rainfall and pan evaporation data for the period between 1975 and 2006 are presented in *Appendix B* and are summarised as follows:

- the daily run-off estimated using this method ranges from 0 mm/d to 66 mm/d with an average of 0.31 mm/d, which approximates 17% of average annual rainfall. This value is higher than that estimated in Mackie (1998);
- the recharge rate to groundwater for outcropping coal seams and alluvium ranges from 0 mm/d to 21 mm/d with an average of 0.05 mm/d or 2.8% of average annual rainfall. Groundwater recharge on weathered coal measure clays is likely to be negligible, due to the low permeability of these sediments. These values, which are applied to alluvium only, are likely to result in similar or slightly lower recharge to groundwater in comparison to the blanket 1% groundwater recharge applied to all surface geology for previous regional modelling (Mackie*, 1998*).

2.7 GEOLOGY

Figure 3 presents the regional geology for the area, which has been adapted from the Geological Survey 1:100,000 series map for the Hunter Coalfield Regional Geology and updated with relevant CNA data.

The geological structure beneath the study area is comprised of a series of synclines and anticlines. The Bayswater Syncline trends north-south, and is present to the east of the Cheshunt Pit and to the west of the South Lemington Pit 1. The geology is interpreted to slope upward toward the Camberwell Anticline located to the east of the study area, and toward the Muswellbrook Anticline located west of the study area.

The stratigraphy directly beneath the study area comprises recent alluvial outwash deposits and Permian aged Coal Measures (Singleton Coal Measures). Folding, faulting and igneous intrusions have affected these sediments after deposition. A summary of the area stratigraphy is outlined below.

2.7.1 Alluvial/Unconsolidated Deposits

Quaternary to recent alluvial deposits are present along the banks of the Hunter River, Wollombi Brook and their tributaries and comprise silts, clays, sands and gravels deposited as local flood plain and river related sediments. The extent and thickness of these deposits as determined by CNA borehole data is presented in *Figure 11.*

The thickness of the alluvium along the Hunter River is estimated to be between 2 m and 20 m depending on the proximity of the incised river channel. These thicknesses are generally similar to those reported in the vicinity of Wollombi Brook.

Three aspects relating to the stability of the Hunter River alluvium and the distance between the limit of alluvium and the highwall of the Cheshunt Pit are regional structural geology; site geotechnical investigations; and slope stability analyses.

Knowledge of the regional structural geology of HVO and specifically Cheshunt Pit is based on current mining operations directly north and east of the Cheshunt Pit and on the north side of the Hunter River from the North Pit and Alluvial Lands excavations. In addition, extensive exploration drilling and geological modelling have been used to identify any major structural characteristics.

The HVO coal deposit generally has a shallow bedding dip to the south or south west with some localised steepening of seams where thickness of interburden changes. Overprinted on this shallow grade to the south is a north-south trending anticline structure (a fold of rock layers with strata sloping downward on both sides from a common crest), oriented perpendicular to the Hunter River. The geometry of this structure has been identified by drilling at close spacing across the axis. The northern extent of this structure (north of the Hunter River) has already been mined and is isolated by the existing Alluvial Lands barrier wall. Mining in the Alluvial Lands opencut identified some minor thrust faulting on the limbs of the anticline. The southern extension of these minor thrust faults is currently exposed and being mined through in the upper benches of the Cheshunt Pit. The thrust fault as exposed has caused no structural weakness in the advancing highwall or northern endwall.

Non-cored and cored boreholes have been drilled throughout the Cheshunt Pit area, facilitating a series of geotechnical investigations. Cored boreholes have allowed sampling of all coal and interburden rock units for extensive laboratory strength testing. Cored and non-cored boreholes have been investigated with downhole acoustic scanning instruments to identify all bedding, jointing, shear and fault orientations. In the pattern of non-cored boreholes at 125 m spacing and at various seam levels, airlift water pump tests have been conducted to identify any localised high permeability areas that would indicate more open fracturing of rock units. Mapping of the Cheshunt Pit northern highwalls and endwalls has assisted understanding of localised joint set orientation and character. This localised face mapping has been combined with the borehole scanner mapping to identify the general joint set orientations and their spatial relationship to the northern endwall for geotechnical slope stability analysis.

All geotechnical data on Cheshunt Pit rock unit strengths, seam structure and joint orientation has been provided to a ground engineering and environmental services consultancy to conduct a geotechnical assessment and slope stability analyses of the proposed Deep Cheshunt Pit. This study will identify any highwall and endwall stability risks and will estimate the safety factors associated with the proposed highwall and endwall design. The safety factors are incorporated into the mining design to ensure acceptable safety and stability when mining the area.

2.7.2 *Singleton Coal Measures*

The Singleton Coal Measures comprise ten interbedded seams of coal, sandstone, mudstone, shale and conglomerate. The Coal Measures range in thickness between 360 m at the Bayswater Syncline and 75 m at the Camberwell Anticline. Cross-sections of stratigraphy based on CNA borehole data are presented in *Figures 4* to *7* and their locations are shown on *Figure 3*. There are more than 50 individual coal seams that have been grouped by CNA geologists into thirteen lithological units. These are described in *Table 2.1*.

Table 2.1 Lithological Sequence in the Singleton Coal Measures beneath the Study Area

Lithological Unit	Unit Description
Wambo Coal Seams	Not present in Study Area.
Whynot Coal Seams	Not present in Study Area.
Blakefield Coal Seams	Not present in Study Area.
Glen Munro Coal Seams	Present in South Lemington Area only (SKM, 1997).
Woodlands Hill Coal Seams	This unit is present primarily in the South Lemington area (SKM, 1997) and the combined seam thickness is approximately 3 m.
Arrowfield Coal Seams	This unit is present primarily in the South Lemington area (SKM, 1997) and is extensively mined in the Riverview area where it outcrops. The combined seam thickness approximates 3 m, but is sometimes separated by thicker layers of interburden.
Bowfield Coal Seams	This unit is present primarily in South Lemington area (SKM, 1997) and is extensively mined in the Riverview area where the seam outcrops. The combined seam thickness approximates 7 m and is rarely separated by thicker interburden layers.
Warkworth Coal Seams	The remaining seams are below those proposed for extraction in the South Lemington area. In the Cheshunt and Riverview areas the combined seam thickness approximates 10 m however this is often distributed over 7 individual coal seams separated by much thicker layers of interburden.
Mt Arthur Coal Seams	In the Cheshunt and Riverview areas this seam can approximate a thickness of 10 m and has only localised zones where individual seams are separated by thicker interburden layers.
Piercefield Coal Seams	In the Cheshunt and Riverview areas this seam can approximate a thickness of 6 m. It only has localised zones where individual seams are separated by thicker interburden layers. This unit is generally separated from the Mt Arthur Seams by thin interburden layers.
Vaux Coal Seams	In the Cheshunt and Riverview areas the combined seam thickness can approximate 6 m and only has localised zones where individual seams are separated by thicker interburden layers. This unit is generally only separated from the Piercefield Seam by thin interburden layers.
Broonie Coal Seams	In the Cheshunt and Riverview areas the combined seam thickness approximates 20 m however this is often distributed over 6 individual coal seams separated by thicker layers of interburden. The basal Broonie Seam is often in contact with the Bayswater or separated by thin interburden layers.
Bayswater Coal Seams	In the Cheshunt and Riverview areas the combined seam thickness approximates 7 m and only has localised zones where individual seams are separated by thicker interburden layers.

The general locations of the outcropping Bayswater, Vaux, Bowfield and Woodlands Hill coal seams are presented in *Figure 3*. The Bayswater seam outcrops approximately 2 to 3 km east and up to 8 km north of HVO South and forms the groundwater catchment/recharge boundary at these locations for this investigation.

Figures 4 to *7* suggest that the predominant coal seams subcropping beneath alluvial deposits in the Cheshunt and Riverview area are the Mt Arthur, Piercefield and Vaux coal seams.

Figures 12 to 14 show the elevation of the base of the Bayswater, Mt Arthur and Bowfield seams, which dip to the south in this area.

The Singleton Coal Measures are underlain by Permian-aged Maitland Group Mulbring Siltstone, which comprises siltstones and sandstones and approximate a thickness of 350 to 400 m beneath the study area.

2.7.3 Igneous Intrusions and Faulting

The locations of dykes and faults within the study area are presented on *Figure 10*. Displacement of up to 15 m is reported in faults dissecting the South Lemington Pit area and up to 20 m in faults to the west of the Carrington Pit to the north west of the HVO South consent boundary.

Extensive faulting, igneous intrusions and the Muswellbrook Anticline are likely to comprise a groundwater flow boundary/flow divide approximately 2 km west of HVO South.

2.8 HYDROGEOLOGY

Previous investigations undertaken for earlier environmental assessments support the following general observations:

- the alluvial sands and gravels around the Hunter River and Wollombi Brook form shallow unconfined aquifers of limited extent that are potentially in hydraulic connection with surface water bodies. These sediments intermittently intersect with sub-cropping coal measures resulting in potential hydraulic connection between these stratigraphical units;
- beneath the alluvial deposits, the inter-layered sandstones, siltstones, shale and coal measures form a series of sandstone/siltstone and shale aquitards with the more permeable coal seams forming aquifers. Mackie (in ERM, 1998) suggests that groundwater flow within the coal measures is primarily through cleats or within occasional jointing. Previous investigations of groundwater elevations (Rust PPK 1997 in SKM, 1997) suggest that the sandstone, siltstone and shale layers may act as a significant barrier to vertical flow. This is supported by sparse jointing and low seepage rates from interburden deposits in existing pit excavations (Mackie, in ERM, 1998). However, where additional fracturing is present associated with underground mining (ie, at South Lemington Pit 1) an enhanced vertical hydraulic connection could exist; and
- faulting, folding and dykes may affect the flow of groundwater within the study area. Previous groundwater investigations completed by Rust PPK (in SKM, 1997) suggest that complete hydraulic disconnection of coal seams has occurred due to faulting in the South Lemington region.

2.8.1 *Hydraulic Conductivities*

A number of investigations have been completed to estimate the hydraulic conductivity of the subsurface stratigraphy. *Figures 15 and 16* present the distribution of reported hydraulic conductivity data for alluvial deposits and coal seams where co-ordinate data are available. The hydraulic conductivities (K) for the entire data set are presented in *Table 2.2*.

Table 2.2 Hydraulic Conductivities of Stratigraphy within the Study Area

Strata	Number of Data points	Median	90th percentile	10th percentile
Alluvium (Hunter River Bed)	20	14.5	36.7	4.04
Alluvium	98	2.4	75.9	0.015
Interburden	56	0.007	0.36	0.000018
All Coal Seams	58	0.052	0.64	0.0057

1. Units are m/day.
2. The data presented are from hydraulic investigations and analysis completed by other consultants including: Golders (1981, 1986 and 1990); Mackie (1998 and 2005) and SKM (1997).

The data suggests the following:

- alluvial deposits are generally more permeable than the underlying Singleton Coal Measures;
- coal seams are generally more permeable than the sandstone and shale interburden;
- there is significant variation in the reported K values for each lithological unit;
- variability in coal seam hydraulic conductivities is due to variations in natural fracturing and cleating within and between seams. The median value reported in *Table 2.2* for the coal seams includes variations in hydraulic conductivity associated with natural fracturing and cleating; and
- the Hunter River bed alluvial deposits are unlikely to impede groundwater flow between the river and underlying Quaternary alluvial deposits.

Scarce data is available on the vertical hydraulic conductivities of the main geological units. An assessment of the bulk formation anisotropy ratio, which represents the relationship of the horizontal K (Kh) to the vertical K (Kv) hydraulic conductivity, was completed by Dr Lloyd Townley of Rio Tinto Technology and Innovation using detailed bore logs for the area. The results suggested that the anisotropy ratio is likely to range between four for interburden units through to 3,500 for the coal seam units such as the Vaux seam. The average bulk formation Kh/Kz anisotropy ratio from the Warkworth seam down to the Bayswater coal seam was calculated to be 44 for the interburden deposits and 2,700 for coal seams. Based on this, the bulk formation vertical hydraulic conductivities for interburden are estimated to approximate $1.6E^{-4}$ m/day.

The bulk formation vertical hydraulic conductivities for coal seams are estimated to approximate $2E^{-5}$m/day. These values are likely to significantly retard vertical flow of groundwater between lithological units and are responsible for the large differences in groundwater elevations with changes in depth in the lithological profile as discussed in *Section 2.9.5.*

A comparison of previously adopted bulk formation Ks (Mackie, 1998) and those estimated during this investigation are detailed as follows:

- values adopted previously for coal measures ranged between <0.001 and 3 m/day, with a median value approximating 0.026 m/day. The calculated coal seam median K for this investigation approximates 0.052 m/day, which is higher than that previously used but lies within the range of the previous investigation data;

- values adopted previously for alluvium ranged between 0.00077 and 173 m/day with a mean of 25 m/day adopted for modelling purposes. This data was likely to be skewed upward due to the presence of one high value (173 m/day) that was at least 2 orders of magnitude above other results. The calculated alluvium median K for this investigation approximates 2.4 m/day and is considered to more closely represent alluvium Ks;

- values reported previously for interburden ranged between $3.74E^{-6}$ and $7.21E^{-3}$ m/day with a median value of $4.1E^{-4}$, these being results from core laboratory permeability testing. These values were not incorporated into the previous modelling as the model adopted one layer and used bulk formation hydraulic conductivities to represent the coal measures (ie coals seams and interburden). The current investigation has a median calculated value of $7E^{-3}$ for interburden, which is at the higher end of that reported previously. The higher value is attributed to the presence of packer test data in the current data set, which is likely to increase calculated Ks due to the incorporation of flow within fractures within the interburden; and

- values reported previously for vertical anisotropy (Kh/Kz) were from core laboratory permeability testing data for interburden samples (mainly sandstones) and ranged between 0.66 and 11.61 with a median value of 1.54. These differ from those calculated for this investigation (4 to 3,500) primarily because previous data focused on micro-scale anisotropy (core data). The current investigation uses values which incorporate estimates of anisotropy on a holistic (bulk formation) basis.

Given that the current investigation data set includes the values from Mackie (1998) and additional values obtained from an in depth search of CNA's archive files, it is considered to be more representative of the hydraulic conductivity properties. *Table 2.2* estimates have been adopted for modelling purposes.

2.8.2 Effective Porosity (Specific Yield)

At present there appear to be few data reported in previous literature on porosity and specific yield. However, Mackie (1998) assigned a specific yield of 0.05 for coal measures and 0.3 for alluvium for regional groundwater modelling. *Table 2.3* presents the values adopted by Mackie (2005) for the most recent 2D modelling completed for Cheshunt Pit.

Table 2.3 ***Specific Yield Data***

Lithology	Specific Yield (dimensionless)
Alluvium	0.25
Coal Seams	0.02
Interburden	0.02
Data from Mackie (2005)	

The specific yield for the alluvium sediments calculated by Golder Associates Ltd, (1981, 1986 and 1990) from analysis of pumping test data are presented in *Table 2.4,* and range between 0.01 and 0.2 with an average value of 0.087. This data is considered to be most representative of the effective porosity of alluvium in the study area.

2.8.3 Storativity

Table 2.4 presents the available storativity data derived from constant discharge or constant head tests completed within the study area (Golders, 1981, 1986 and 1990).

Table 2.4 Reported Aquifer Storativity Data

Strata	Data Points	Average	Median	Min	Max
Alluvium	3	8.67E-02	5.00E-02	1.00E-02	2.00E-01
Interburden	2	-	-	2.25E-05	2.06E-01
Mt Arthur Coal Seam	6	1.06E-03	1.83E-04	7.49E-06	5.27E-03
Piercefield Coal Seam	7	2.37E-03	1.63E-04	7.02E-07	1.51E-02
Vaux Coal Seam	5	9.71E-04	2.10E-04	7.26E-06	3.20E-03
All Coal Seams	18	1.55E-03	1.83E-04	7.02E-07	1.51E-02

Note: The data presented have been derived by investigations conducted by other consultants including: Golders (1981, 1986 and 1990); Mackie (1998 and 2005) and SKM (1997).

A storativity value of $1.0E^{-4}$ was adopted for previous regional modelling to represent the coal measures (Mackie, 1998), which was reported to be based on regional knowledge and experience. This value was used to represent the bulk coal measure formation in a single layer model (ie both coal seams and interburden). The current coal seam storativity data analysed has a median value of $1.83E^{-4}$, which approximates the value used for previous modelling. The available data for the interburden ranges between $2.25E^{-5}$ and $2.06E^{-1}$.

2.9 GROUNDWATER ELEVATIONS

Available groundwater elevation data has been collated for the period 1996 to 2006 for the alluvial aquifer, the Bowfield coal seam, the Mt Arthur coal seam and the Bayswater coal seam. These seams correspond to the model development (refer *Section 3*). The data are discussed below.

2.9.1 Alluvium Groundwater Elevations

Figure 17 shows the spatial groundwater elevation variations within alluvial deposits in the study area.

The groundwater data can be summarised as follows:

- groundwater elevations are available for 32 wells screened within alluvial deposits. The groundwater elevation data are primarily located to the north of HVO South on the periphery of the Alluvial Lands and Carrington Pit areas and along the southern edge of Wollombi Brook in the vicinity of the South Lemington Pit area;

- groundwater elevations are available at three locations within Hunter Valley alluvium to the south of the Hunter River. A further five wells, which have been measured for groundwater elevations and located along the southern edge of the Hunter River and north of Cheshunt Pit, are dry. These wells are screened at/or about the base of the alluvium in these areas suggesting that the full thickness of alluvium is dewatered in these areas. This is most likely to be due to the elevation of the base of the alluvium being above river elevations in these wells. There is groundwater present in well BZ3-2, however, the base of the alluvium in this well is estimated at approximately 58 m AHD, which is above estimated Hunter River elevations in this area. This suggests that groundwater is perched within Hobden Gully alluvium and that Hobden Gully alluvium extraction is less likely to initiate seepage from Hunter River. Bore logs for wells HG1 and HG3 (*Figure 17*) were not available so the saturated alluvium thickness at these locations could not be determined. Due to scarce data, the saturated depth of alluvium in the Cheshunt Pit Extension to the northwest of Cheshunt Pit is not currently known;

- the flow direction from the Hunter River alluvium, based on groundwater data collected in September 2005, is interpreted to be eastward in a semi-parallel direction to the flow of the Hunter River, with a groundwater gradient of approximately $5.5E^{-4}$ (dimensionless). The flow direction for the Wollombi Brook alluvium, based on groundwater data collected on or about 4 February 2000, is interpreted to be toward Wollombi Brook, with an estimated groundwater gradient of $4.8\ E^{-3}$ (dimensionless); and

- comparison between the groundwater elevations in Wollombi Brook alluvium and the average water elevations in Wollombi Brook, suggests that the water elevations are similar, supporting the presence of a hydraulic connection at this location.

Figure 18 presents the groundwater elevation variations over time for wells screened within the alluvial deposits. Groundwater elevations appear to be affected by mining as indicated by the following observations:

- the groundwater elevations in the Hunter River alluvium, within the vicinity of the Alluvial Lands barrier wall (north of the Hunter River), increased by approximately 5 to 10 m for the period February 2000 to June 2000, which corresponds with the backfilling and termination of pit dewatering in this area;

- the groundwater elevations in the 'CGW' wells which are located closest to the Carrington Pit (north of the Hunter River) exhibit a general trend of decreasing groundwater elevations during the period December 2002 to April 2006; and

- a rise in groundwater elevations is apparent in the CGW wells between November and December 2005, which is unlikely to be attributable to rainfall events and/or Hunter River flows and is therefore attributed to pit activities.

A rise in groundwater elevations is apparent in wells within the Wollombi Brook alluvium between August 1998 and February 1999, which is attributed to a large streamflow event that occurred in Wollombi Brook between 8 and 24 August 1998.

2.9.2 Bowfield Coal Seam Groundwater Elevations

Figure 19 presents the spatial groundwater elevation variations within the Bowfield coal seam within the study area. The Bowfield coal seam generally outcrops to the south of the Hunter River (see *Figure 3* and *Figure 12*), so there is unlikely to be a significant hydraulic connection between this seam and the Hunter River alluvium other than in a localised area between Riverview Pit and the Hunter River. The Bowfield seam is absent within the Cheshunt Pit area. There is insufficient groundwater monitoring data to clearly define the depressurisation of the Bowfield seam aquifer that is associated with current and historic mining in the Riverview Pit. However, based on the information presented for the Mt Arthur seam (*Sections 2.9.3* and *2.9.5*) it is likely that the Bowfield seam is already extensively dewatered in areas between the Hunter River and Riverview Pit. The groundwater data are summarised as follows:

- groundwater elevations are available for 20 wells screened within the Bowfield coal seam. The groundwater elevation data are primarily located in the vicinity of the South Lemington Pits/Wollombi Brook area. Groundwater elevation data for the Bowfield coal seam to the north of Wollombi Brook/South Lemington Pits 1 and 2 are scarce. This is due to the coal seam outcropping to the south of the Hunter River and previous mining of the seam in the Cheshunt and Riverview Pits;

- groundwater elevations appear to be affected by faulting in this area, with differences in groundwater elevations of up to 15 m across some faults and within the southern most fault block (ie, at well B925 located on *Figure 19*);

- groundwater flow direction for 5 March 2001 appears to be toward a central sink located at or about the location of well B925. This suggests a zone of downward leakage into the underlying Mt Arthur seam, which is likely to be associated with dewatering of the underground mining of the Mt Arthur seam. This trend was still apparent on 23 December 2004 but has reduced which may reflect changes in groundwater dewatering; and

- groundwater flow gradient ranges from 0.025 in March 2001 to 0.017 in December 2004 for the southern fault block. Groundwater flow gradients are generally less steep in the northern and eastern fault blocks, ranging between 0.01 in March 2001 and 0.006 in December 2004.

Figure 20 presents the groundwater elevation variations over time for wells screened within the Bowfield coal seam. The data are summarised as follows:

- a groundwater elevation rise approximating 15 m in wells located in the south eastern fault block (South Lemington area) has occurred between February and May 2004. This is likely to be attributable to variations in dewatering rates of the underground mining of the Mt Arthur seam that occurred below the Bowfield coal seam in this area.

2.9.3 Mt Arthur Coal Seam Groundwater Elevations

Figure 21 presents the spatial groundwater elevation variations within the Mt Arthur coal seam within the study area. Groundwater elevations are available for six wells screened within the Mt Arthur coal seam. The monitoring wells are located along the southern edge of the Hunter River between the Cheshunt and Riverview Pits and where the Mt Arthur coal seam sub-crops beneath Hunter River alluvium. Given that the wells are located within in a relatively straight line, a general flow direction can not be determined at this time.

Figure 22 presents the groundwater elevation variations through time for wells screened within the Mt Arthur coal seam. The data are summarised as follows:

- the groundwater elevations within the Mt Arthur seam generally range between 30 and 46 mAHD. Comparison of these elevations with the Hunter River alluvium which generally approximate 55 mAHD in this area suggests that the Mt Arthur seam is significantly depressurised beneath the Hunter River. Therefore, induced seepage from the Hunter River due to depressurisation of the Mt Arthur coal seam is already likely to be approximating maximum rates; and

- groundwater elevations in the four wells located further to the west have increased gradually by approximately 12 to 15 m since records began in September 2004. Groundwater elevations in the two wells to the east have decreased gradually by approximately 4 m since records began. This is likely to be attributable to the cessation of opencut mining in the Alluvial Lands area and/or the underground mining of the Mt Arthur seam (which ceased in 1987, with access closed in 1991), again reflecting the potential impact of mining on groundwater elevations.

2.9.4 Bayswater Coal Seam Groundwater Elevations

Figure 23 presents the spatial groundwater elevation variations within the Bayswater coal seam within the study area. The groundwater data are summarised as follows:

- while there are likely to be a number of wells screened within the Bayswater coal seam with measured groundwater elevations, only two have sufficient data to accurately locate their screens within this coal seam. The monitoring wells are located within a localised area in the vicinity of the Carrington Pit; and

- the localised groundwater elevation data suggest that the groundwater flow direction is to the north east toward the Carrington Pit. However, it is likely that regional flow in this seam is toward the south in the direction of coal seam dip.

Figure 24 presents the groundwater elevation variations through time for wells screened within Bayswater coal seam. The groundwater elevations exhibit a slight decreasing trend between April 2003 and April 2006. No change in flow direction is apparent over this monitoring period.

2.9.5 Changes in Groundwater Elevations with Depth

Hunter River (Cheshunt and Riverview Area)

Groundwater elevations are available for nested well BZ1, which has piezometers screened within the Hunter River alluvium and the Mt Arthur coal seam. An additional piezometer is screened in the sandstone interburden between the two seams, but this has been dry since quarterly monitoring began in September 2004, suggesting a vertical hydraulic discontinuity between the alluvium and the Mt Arthur seam in this area. Groundwater elevations in the alluvium of 60 mAHD and in the Mt Arthur coal seam of approximately 39 mAHD suggest in excess of a 20 m head difference with a downward flow direction. This large variation is most likely due to dewatering of the Mt Arthur coal seam by underground mining. This is also likely to be the case within other coal seams mined out on the south side of the Hunter River such as the Warkworth and Bowfield seams in the Cheshunt and Riverview Pit areas.

A comparison of groundwater elevations between the Bayswater coal seam and alluvium in the Carrington Pit area suggests that groundwater elevations are relatively similar and that both upward and/or downward head gradients are minimal.

Wollombi Brook (South Lemington Area)

Groundwater elevations are available for the nested well C130, which has piezometers screened within the Wollombi Brook alluvium, the Arrowfield coal seam and the Bowfield coal seam. Comparison of this data suggests a strong downward head gradient in the southern most fault block. Comparison of groundwater elevations in monitoring wells PB01 screened in alluvium and FD612 screened in the Arrowfield and Bowfield seams suggest that at locations north west of the fault block, groundwater elevations in the Arrowfield coal seam approximate those in the alluvium. However, a significant decline in groundwater elevations between the Arrowfield and Bowfield coal seams is present. These groundwater elevations suggest a complete hydraulic disconnection between the alluvium/Arrowfield coal seam and the Bowfield coal seam, which supports the presence of very low bulk formation vertical hydraulic conductivities (*Section 2.8.1*).

2.10 DWE LISTED GROUNDWATER BORES

Figure 25 presents the locations of groundwater bores surrounding the study area (within 2 km), as registered on the DWE web atlas database. These bores represent potentially adversely impacted receptors.

Known details for these wells are provided in *Appendix C* and are summarised below:

- there are approximately 63 registered DWE groundwater bores within 2 km of the study area;

- 30 wells have been installed for abstraction, including water supply for domestic, irrigation, stock, industrial, mining and fire fighting purposes. These wells are identified as being potentially impacted by mining. Four wells have an unknown purpose and are identified as being potentially adversely affected by mining in the area. The remaining wells have been installed for geotechnical, geological and groundwater monitoring purposes and are considered not to represent potentially adversely impacted receptors;

- the location and depth of the wells presented in Figure 25 and Appendix C suggests that the wells in this area are predominantly screened within Hunter River and Wollombi Brook alluvial deposits; and

- it is likely that there is an absence of deeper water supply wells in the area due to poor yields and unsuitable water quality within the deeper coal seam aquifers.

2.11 WATER QUALITY

Groundwater monitoring is carried out on a quarterly basis at HVO. Surface water monitoring is undertaken at HVO on a monthly basis to assess both the quality of mine water in on-site dams and the possible impact of mining on the surrounding surface waters. Historic monitoring results are available with monthly monitoring data from 1997. The results of this monitoring are reported in the HVO Annual Environmental Management Reports. Data collected during monitoring is predominately pH and electrical conductivity (EC). A summary of the data obtained is provided below.

2.11.1 Surface Water Quality

Within the Hunter River water quality is monitored at seven sampling sites, located over an area upstream of the mine operations to a point downstream of the junction with Wollombi Brook. WL1 is the site located furthest downstream and is influenced by saline water from Wollombi Brook. Water quality is influenced by rainfall and flow conditions, with raised TSS and lowered pH and EC being associated with high river flow. CNA water quality monitoring data suggests that EC values within the Hunter River typically range from 195 to 2325 µS/cm, and pH values are generally between 7.2 and 8.6. Quality does not vary significantly between up and down gradient sites, which suggests that mining has had no significant impact on the Hunter River water quality.

Water is monitored at three locations on Wollombi Brook, which has historically had saline water. One of the monitoring sites has been dry during many of the monitoring events, with the other two sites being located where flow is typically present. EC values typically range from 230 µS/cm to 3,390 µS/cm. The pH readings for the Wollombi Brook are neutral to alkaline with values ranging from 7.4 to 9.2.

2.11.2 *Alluvium Water Quality*

Monitoring of groundwater within the alluvium indicates that EC ranges between 200 µS/cm and 13,030 µS/cm. The average value has been reported at 7,004 µS/cm. The pH has been reported within the range 6.1 to 8.4, with an average value of 7.1.

2.11.3 *Coal Seam Water Quality*

Monitoring of groundwater within the Broonie, Bayswater and Mt Arthur coal seams indicates that EC ranges between 820 µS/cm and 14,070 µS/cm, with an average value reported at 4,961 µS/cm. The pH has been reported within the range 6.2 to 8.1, with an average value of 7.2.

2.11.4 *Estimated Mine Spoil Water Quality*

Mackie (1998) estimated the water quality of groundwater in mine spoil to be 3,700 mg/L total dissolved solids (TDS) (≈ EC 5,780 µS/cm). This was based on laboratory leachate analysis of mine spoil. Mackie concluded that this compared favourably with the existing insitu coal seam water quality.

2.12 SEEPAGE INTO PITS

Dewatering occurs on a regular basis from the base of the mining pits in the HVO region. Current anecdotal evidence suggests that approximately 500 m^3/day of groundwater seeps into the Cheshunt Pit. Groundwater seepage into the Riverview Pit has been observed to be low and significantly less than that into Cheshunt Pit. There is currently no quantitative data for the potential groundwater seepage volumes into South Lemington Pit 1. Anecdotal evidence of groundwater elevations and water movements at South Lemington during and post mining in South Lemington Pit 1 since 1998 has indicated that seepage into South Lemington Pit 1 is negligible, as predicted in the 1997 EIS (SKM).

Due to the low vertical conductivities present in HVO South and higher permeabilities of the coal seams relative to interburden, seepage into the pits is likely to be primarily through the coal seams exposed by the pit walls. In the Cheshunt Pit these are the Warkworth and Mt Arthur seams, while in the Riverview Pit this is the Bowfield seam.

The seepage is primarily from the up dip (northwest) side of the pits where coal seams may extend in an upward gradient from the edge of the pit to ground surface, or may sub-crop beneath the Hunter River alluvium. Groundwater recharge from rainfall or Hunter River alluvium flows down gradient along the coal seams to discharge at the exposed pit faces.

The shallowest zones of the Bowfield, Warkworth and Mt Arthur coal seams have already been extracted to within 150 m of the limit of Hunter River alluvium at RL 66 m (as currently consented). These zones have the most potential for hydraulic connection with the Hunter River and have already been mined. Therefore, it is likely that the majority of potential seepage from the Hunter River into the Cheshunt and Riverview Pits along the Bowfield, Warkworth and Mt Arthur seams has already manifested. The estimated seepage rates through these seams are unlikely to increase significantly as the mine progresses. However, as deeper coal seams are exposed additional seepage may be induced from surrounding hardrock aquifers.

2.13 SUMMARY OF WATER INFLOWS AND OUTFLOWS

Regional flow fields for the coal seams are difficult to determine due to localised data and pit affected flow fields. However, the flows through the coal seams have been estimated using Darcy's Law and to alluvium using recharge estimates. These data have been summarised in *Table 2.5* to provide an initial basis for constraining and calibrating the modelling inflow and outflow budgets. There are likely to be additional inflows and outflows within the study area associated with interaction between groundwater and surface water features, which includes movement of water from the Hunter River and Wollombi Brook into coal seams sub-cropping beneath these features. These flows are estimated using groundwater modelling.

Table 2.5 Estimated Water Flows in the Study Area

Inflow Source	Input (m^3/d)	Assumptions
Recharge to Hunter River Alluvium	1,750	Assumes 35 km^2 of alluvium.
Inflow from Upgradient Bayswater seam	65	Estimated using Q = kia. 'i' estimated @ 0.012; 'a' = 15 m x 6.9 km, 'k = 0.052 m/d.
Cheshunt Dewatering	500	Site anecdotal evidence.

1. Estimates assume that recharge to exposed coal measures is negligible due to the presence of weathered red clays where these units outcrop (Section 2.6).

2.14 CONCEPTUAL MODEL

Figure 26 provides a conceptual summary of the data presented in this chapter. This has been developed to visualise the interactions/relationships between recharge, surface water bodies, alluvial aquifers and coal seam aquifers beneath the site.

3 MODEL DEVELOPMENT

3.1 INTRODUCTION

Based on the conceptual understanding presented in *Sections 1* and *2* of this report, independent proposed model development review and subsequent discussion with DWE on the proposed model, two numerical groundwater models have been developed. The models developed are detailed in the following sections.

3.2 MODELLING SOFTWARE

The modelling software preferred for this assessment was FEFLOW 5.2, developed by WASY software. This software is currently recognised as the preferred software for mining investigations in Australia. The software is a three-dimensional finite element modelling system that incorporates mass transport algorithms for the simulation of groundwater flow and contaminant transport. The primary reasons for choosing the software are as follows:

- finite element models such as FEFLOW are more flexible than finite difference models allowing for increased refinement at required locations while minimising refinement in other areas. This allows the development of much larger models with smaller processing times. It is particularly suitable to this study as a large area is required to be represented while having a high resolution of nodes in and around surface water bodies and the pit sites;

- the mathematical algorithms used by FEFLOW allow for quicker processing times than standard finite difference models;

- finite element models can represent complex geology and thin geological units more flexibly than finite difference models; and

- FEFLOW was the client's preferred software.

3.3 MODELLING PROCEDURE

The modelling procedure included a steady state calibration with a significant sensitivity analysis. This approach was initially adopted as it was more credible for dealing with scarce and uncertain data through space and time, which is generally the case within the current model domain.

However, during the sensitivity analysis it became apparent that steady state simulations were over-estimating seepage from a river to a nearby pit. Due to the significant changes proposed for mining in the Cheshunt Pit it was decided to simulate mine progression in Model 1 under both transient and steady state conditions. Proposed modifications to mining activities in the South Lemington Pit area are minimal therefore Model 2 was simulated under steady state conditions only.

3.4 *MODEL DOMAIN*

The region has been split into two separate areas for modelling. The model domains are presented in *Figure 27.* Justification for the model domains selected is provided below:

- the available site data are currently localised in two separate areas; near the South Lemington Pits, and near the Cheshunt and Riverview Pits. As a result, a single model incorporating the areas outside these zones could be less well calibrated and therefore unreliable and potentially misleading;

- the Bowfield coal seam, which is proposed to be the deepest coal seam excavated in the South Lemington area, generally outcrops before it reaches the alluvial deposits around the Hunter River and the Cheshunt Pit. In addition, mining of the coal seams down to, and including, the Bowfield seam in the Cheshunt and Riverview areas creates a no flow boundary for groundwater from the north. This creates a geological divide between the investigation area in the north and the investigation area in the south. The cross over in the numerical model domains is presented on *Figure 5*;

- the model domains have been chosen to be large enough to prevent boundary effects on model outcomes associated with constant head or flow boundaries. In addition, to incorporate any available data and potential receptors (ie, abstraction bores and surface water bodies) potentially adversely affected by the mining; and

- the model domains have been designed to be large enough to allow CNA to incorporate additional hydrogeological and groundwater elevation data in the future, to produce a calibrated transient regional groundwater model.

3.5 *MODEL LAYERING*

Based on the geological information presented in the previous section, the stratigraphical layering incorporated into each model is detailed in *Tables 3.1* and *3.2* below.

Table 3.1 Cheshunt and Riverview Model Layering (Model 1)

Layer no.	Lithological Unit	Justification
1	Alluvium and Coal Measures (where outcropping)	The alluvium thickness includes mine spoil. A 3 m default thickness for outcropping coal measures has been adopted to represent unconsolidated outcropping coal seams.
2	Interburden	This layer has been included to represent hydraulic retardation of flow between the alluvium and underlying coal measures. The layer has been represented by the thickness from the base of alluvium to 13 m above the base of the Vaux seam.
3	Coal Seam	This layer has been represented by the thickness from 13 m above the base of the Vaux seam to the base of the Vaux seam, which is equivalent to the combined thickness of the Mt Arthur, Piercefield and Vaux seams. These units are also the primary seams in contact with the Hunter Valley alluvium in the Cheshunt and Riverview areas.
4	Interburden	This layer has been represented by the thickness from the base of the Vaux seam to 15 m above the base of the Bayswater seam.
5	Coal Seam	This layer has been represented by the thickness from the base of the Bayswater seam to 15 m above the base of the Bayswater seam, which is equivalent to the combined thickness of the Broonie and Bayswater seams. This layer has primarily been included to simulate seepage from the Broonie and Bayswater seams and mining to the base of the Bayswater seam.
6	Interburden	This is a default layer representing interburden beneath the Bayswater seam which affords greater flexibility in simulating mining to the base of layer 5.

Table 3.2 South Lemington Model Layering (Model 2)

Layer no.	Lithological Unit	Justification
1	Alluvium	The alluvium thickness includes mine spoil. A 3 m default thickness for outcropping coal measures has been adopted to represent unconsolidated outcrop.
2	Interburden	This layer has been represented by the thickness from the base of the alluvium to the top of the Bowfield seam. This layer has primarily been included to simulate the retardation of seepage from the alluvials into underlying coal seam aquifers.
3	Coal Seam	This layer has been represented by the thickness from the top to the bottom of the Bowfield seam. It has been included as this coal seam represents the main coal seam aquifer in this region that is potentially in contact with Wollombi Brook alluvium. It also represents the base seam to be mined at this location.
4	Interburden	This layer has been represented by the thickness from the base of the Bowfield seam to the top of the Mt Arthur seam. This unit has been included to represent the leakage through the interburden between the Bowfield and Mt Arthur seams.
5	Coal Seam	This layer has been represented by the thickness from the top to the bottom of the Mt Arthur seam. This unit has been included to simulate dewatering of the Mt Arthur seam, associated with underground workings, resulting in induced downward leakage of groundwater from the Bowfield seam.

These layer definitions were agreed with CNA and are considered the most suitable for meeting the modelling objectives of estimating surface water impacts and groundwater inflow associated with mining in this area, while maintaining a realistic model size to minimise the overall model running time and changing of input parameters.

3.6 MODEL RESOLUTION

Table 3.3 presents the dimensions of Models 1 and 2:

Table 3.3 Model Dimensions

Feature	Model 1	Model 2
Easting	307000 to 319000[1] (12 km)	311000 to 319000[1] (8 km)
Northing	6395000 to 6405000[1] (10 km)	6392000 to 6398000[1] (6 km)
Elements per layer	37 422	13 857
Layers	6 (a total of 224 532 elements)	5 (a total of 69 375 elements).

1. Map Grid Australia Coordinates

Figures 28 and *29* show the node resolution and cell size adopted in the two models. The model cell sizes have been designed primarily to meet the following criteria:

- to achieve at least a 50 m cell size around the Cheshunt, Riverview and South Lemington Pits in order to simulate progression of open pit development over time if required;

- to achieve at least a 25 m cell size at the location of alluvial deposits where these are located between pit sites and the surface water bodies. This allows for the effective simulation of dewatering in these areas and simulation of buffer zone reduction; and

- to increase cell size in areas where resolution is not required for simulation outcomes, and thus reduce model processing time.

3.7 BOUNDARY CONDITIONS

The boundary conditions and locations are summarised in *Table 3.4* below.

Table 3.4 Model Boundary Conditions

Boundary Location	Value	Boundary Type and Rationale
Surface	-	Rainfall recharge to alluvium and outcropping coal seams only (set at 18 mm/yr).
Northern Boundary	**Model 1:**	Constant heads where coal seams extend beyond the model boundary. Head values have been iteratively set to align groundwater elevations and gradients with site data. No flow boundaries specified elsewhere.
	Model 2:	Constant heads where coal seams extend beyond the model boundary. Head values have been estimated using the up gradient groundwater elevations in the Mt Arthur seam and in the Bowfield seam where it outcrops into Riverview Pit. No flow boundaries specified elsewhere.
Western Boundary	**Model 1:**	No flow boundary. Flow impacted by faulting and igneous intrusions.
	Model 2:	No flow boundary specified where the model domain intersects with the Bowfield seam outcrop and where the southern limits of Cheshunt and Riverview mines have mined the Bowfield seam out. Constant heads are specified where coal seams extend beyond the model boundary. Head values have been iteratively set to maintain a groundwater gradient consistent with site data.
Southern Boundary	**Model 1:**	No flow boundaries are set as limited flow will occur into pits from southern areas due to the southerly dip in geology.
	Model 2:	Constant heads assigned to mimic groundwater heads within model.
Eastern Boundary	**Model 1:**	No flow boundary set as Bayswater seam outcrops inside eastern boundary.
	Model 2:	No flow boundary set as Mt Arthur seam (ie, model base) outcrops inside eastern model boundary.
River Boundaries		River Boundaries are represented as constant head cells. Cauchy or 'mixed' type boundaries have not been adopted as available data indicates that river bed hydraulic conductivities are generally higher than underlying alluvium hydraulic conductivities.
Pit Voids		Pit voids are represented as a zone of very high hydraulic conductivity and dewatered to the actual pit depth using a number of wells. The well pumping rates are constrained by a maximum head drawdown set equal to the base of the pit void at each time step.

3.8 MODEL INPUT PARAMETERS

Rationale for model input parameters are summarised below. The calibrated model input parameters are presented on *Table 4.1*.

3.8.1 Recharge

Recharge was initially set at an average rate (18 mm/yr) as estimated in *Section 1*, however this was adjusted during calibration to reach a calibrated value (*Table 4.1*). Recharge has been applied to outcropping coal measures and alluvial deposits only. This is because outcropping interburden has such low hydraulic conductivity that insignificant volumes of rainfall will recharge to groundwater.

3.8.2 Hydraulic Conductivity

Where data was considered to be abundant the median values for hydraulic conductivity, presented in *Section 2,* were used to represent K of the interburden, coal seams and alluvium in the model. Where data points are scarce the average has been adopted.

Vertical hydraulic conductivities have been adopted as presented in *Section 2*.

Hydraulic conductivity of pit voids is set at 15,000 m/day to promote seepage from the pit edges. These are drained using wells, which are constrained so that dewatering occurs only to the base of the mine pit void.

Hydraulic conductivity of the mine spoil has previously been estimated by Mackie (1998) as being 1 m/day. This value has been used for this modelling.

Hydraulic conductivity of the fault systems has been set to a value approximating the lower interburden conductivities. This is considered to be an acceptable approach given that lower K material either side of the fault is likely to control groundwater flow. In addition, groundwater elevation data suggest that faults currently act as barriers to groundwater flow.

3.8.3 Storage and Specific Yield

The median values obtained from site data as described in *Section 1,* have been adopted to represent storage and specific yield within the model.

A specific yield value of $1E^{-5}$ was adopted for pit voids to promote easy dewatering and hence better representation of an open void.

4 MODEL CALIBRATION

4.1.1 Calibration Procedure

Model calibration is a process by which model parameters are varied within acceptable boundaries, as indicated by the available data, in order to achieve a 'best-fit' to the available observations of heads and flows. The methods available to assess the fit of simulated to observation data are as follows:

- comparison of the difference between observed groundwater elevations in individual wells and simulated groundwater elevations. These data can be plotted as a scatter plot and regression equations and root mean square errors can be calculated;

- comparison of observed regional piezometry with simulated piezometry for each individual aquifer;

- comparison of estimated flow budgets with simulated flow budgets to establish the credibility of flow through the model; and

- comparison of groundwater flow budgets and groundwater elevations through time with transient observation data.

The calibration process mainly involved varying the constant head boundaries, recharge rates, river heads and hydraulic conductivity values for each model to produce a best fit.

Due to observation data being localised within the model domains, some areas of the model could not be calibrated against observed data. However, areas of particular concern such as the buffer zone around Cheshunt and Riverview Pits have data that has resulted in reasonable constraints on calibration.

Details of the specific calibration approach adopted for each model, the calibration results, and the best fit model input parameters, are discussed in more detail below.

4.1.2 Model 1 Calibration Results

Calibration Data

The groundwater monitoring data to December 2005 was used to calibrate the model under steady state conditions for the following reasons:

- it is most representative of the current mining infrastructure and hydrogeological conditions;

- it is considered that assessing the groundwater impacts associated with the existing operations along with the proposed extensions to mining is the primary objective of this investigation; and

- of all available data, this data set was the most complete.

Best Fit model input parameters

Table 4.1 details the input parameters that achieved the best fit results within the model.

Table 4.1 Best-Fit Model Input Parameters

Unit	Parameter	Value	Comment
Alluvium	K (x,y) (m/day)	2.3	-
	K (z) (m/day)	0.23	-
	Specific Yield (Sy)	0.09	-
	Aquifer Compressibility (1/m)	$1.83e^{-4}$	-
	Recharge (mm/yr)	18	Applied to layer 1 only
Interburden	K (x,y) (m/day)	0.007	-
	K (z) (m/day)	$1.6\ e^{-4}$	-
	Specific Yield (Sy)	0.02	-
	Aquifer Storativity (Dimensionless)	$1.83e^{-4}$	-
Coal Seams	K (x,y) (m/day)	0.052	Applied to layer 3 and 5 and outcropping zones in layers 2, 3 and 4.
	K (z) (m/day)	$2e^{-5}$	
	Specific Yield (Sy)	0.02	
	Aquifer Storativity (Dimensionless)	$1.83e^{-4}$	
Pit Spoil	K (x,y) (m/day)	1	Applied at various locations and times in all layers.
	K (z) (m/day)	0.16	
Faulting	K (x,y) m/day	0.007	Applied to layers 2 and 6.
	K (z) (m/day)	$1.6e^{-4}$	
River Boundaries Hunter River	Head (mAHD)	Varies 61.3 - 40.08	Applied to layer 1
River Boundaries Wollombi Brook	Head (mAHD)	Varies 48.6 - 41.3	Applied to layer 1
Pit Boundaries	Head (mAHD)	Cheshunt -20 Riverview 22	Applied to layers 1 and 2.
Northern Boundary	Head (m)	62	Layer 5
Southern Boundary	Head (m)	-8	Layer three
Eastern Boundary	Head (m)	NA	-
Western Boundary	Head (m)	NA	-

Observed versus Simulated Heads

Figure 30 presents a scatter diagram of observed versus simulated groundwater elevations for December 2005. The figure also presents the range in observed groundwater elevations at each monitoring well.

Alluvium

The data are summarised as follows:

- excluding the wells discussed below, the degree of fit in the alluvium can be illustrated by the absolute residual between observed and simulated groundwater elevations, which approximates 1.05 m. This absolute residual mean represents 3.2% of the total variation in groundwater elevations within the model and is, therefore, considered to be acceptable;

- the wells located in Hunter River alluvium within and around the Cheshunt and Riverview Pits have a good fit with monitoring data. The average absolute residual mean of 0.67m, suggests that groundwater elevations in alluvium are well calibrated around the mine voids;

- well CGW47a has a simulated elevation approximately 4.9 m higher than observed elevations. This is attributed to the proximity of this well to the Carrington Pit, which is not currently simulated in the model. This is not considered to be a significant issue as alluvium groundwater elevations in this area are unlikely to exert a significant impact on simulated results/outcomes;

- well CGW39 has a simulated elevation approximately 3.8 m greater than that observed. This is not considered to be a significant issue as groundwater elevations in this area are unlikely to have a significant impact on the overall effects of the mining areas under consideration; and

- well BZ3-2 has a simulated groundwater elevation approximately 6.4 m below observed groundwater elevations. This may be a perched water table associated with Hobden Gully alluvium, which appears to be significantly elevated compared with other wells screened to the base of the alluvium in this area. It is not considered to be representative of the overall water table elevation in the Hunter River alluvium.

Mt Arthur Coal Seam

The data are summarised as follows:

- excluding the wells discussed below, the results are considered to be acceptable given the range in groundwater elevations within these wells. The absolute residual mean between observed and simulated concentrations approximates 1.23 m; and

- simulated groundwater elevations in BZ2/3 and HG2a are 30 – 33 m lower than observed data. These wells are being impacted more by dewatering of Cheshunt Pit in the model due to the way the model is designed. Essentially the model has combined a number of layers into one, resulting in less capacity to represent the retardation of vertical flow through interburden layers. However, while this was a necessary requirement to avoid oversizing the model, it results in greater impact on groundwater elevations in the model. It is therefore considered to provide a conservative representation of potential environmental impacts.

Bayswater Coal Seam

The data are summarised as follows:

- the Bayswater seam currently has little calibration data. However, at present the simulated data has a reasonable degree of fit to the observed data, with an absolute residual mean of 0.96 m.

Observed versus Simulated Piezometry

Figures 32a, 32b and 32c present the simulated piezometry for the alluvium, Mt Arthur/Vaux seams, and the Broonie/Bayswater seam. The data are summarised as follows:

- the simulated flow field/piezometry for the alluvium is similar to that of the observed data presented in *Figure 17*;

- the simulated piezometry suggest active depressurisation of the geology surrounding pit voids;

- the simulated piezometry in the Wollombi Brook area is inaccurate. This is attributed to simplified geology (model layering) in this area and the approximate representation of the 2006 South Lemington Pit 1 void in this model, which is accounted for more accurately within Model 2; and

- the Broonie/Bayswater seam has a simulated flow direction to the south where as observed flow directions are the northeast toward Carrington Pit. The reason for this difference is likely due to the absence of Carrington Pit in the model.

Estimated versus Simulated Groundwater Flow Budgets

Table 4.2 presents the simulated flow budgets. The data presented are summarised as follows:

- the simulated flows are generally higher than those calculated in *Section 2*. This is attributed to the following:

    - river flow inputs from the modelling approximate 199 m^3/d; and

    - an additional groundwater flow in the model that is associated with dewatering of the Alluvial Lands mine backfill area and Hunter River interaction, which were not accounted for in the original budget estimates.

- the estimated seepage to the Cheshunt Pit approximates 333 m^3/day. This corresponds with anecdotal site evidence that indicates that seepage into the Cheshunt Pit approximates 500 m^3/day but is lower than the simulated seepage of between 500 and 2,000 m^3/day reported by Mackie (1998); and

- direct comparisons of the calibrated model budget against previous modelling completed by Mackie (1998) cannot currently be made as the calibrated flow budgets were not reported.

Table 4.2 Model 1 Flow Budget (m^3/day)

Layer	Parameter	Inflows			Outflows		
		Recharge	**Head Boundaries**	***Total Inflow***	**Head Boundaries**	**Well Boundaries**	***Total Outflow***
1	Hunter River	-	199	***199***	1 365	-	***1 365***
1	Hunter River Alluvium	1 431	-	***1 431***	-	-	***-***
1	Wollombi Brook Alluvium	358	-	***358***	-	-	***-***
1-3	Seepage to current Cheshunt Pit	-	-	***-***	-	333	***333***
1&2	Seepage to current Riverview Pit	-	-	***-***	-	87	***87***
1 & 3	Alluvial Lands	-	-	***-***	-	324	***324***
5	Broonie/Bayswater Seams	-	121	***121***	-	-	***-***
Total Model Budget		**1 789**	**320**	***2 109***	**1 365**	**744**	***2 109***

4.1.3 Model 2 Calibration Results

Calibration Data

Greater constraints on the Model 2 calibration process were achievable with the available observation data. This was due to the presence of dewatering within the Mt Arthur seam which had resulted in significant leakage at a localised point within the Bowfield seam. This essentially allowed calibration of the Bowfield seam and surface alluvium under stressed conditions when preferential flow paths and barriers to flows are more noticeable within the observed data. The groundwater elevation monitoring data used for the calibration were from 24 March 2000, when mining in the South Lemington area had had minimal impact on groundwater elevations. This allowed calibration against background groundwater conditions prior to mine development.

Best Fit Model Input Parameters

Table 4.3 details the input parameters that achieved the best-fit results within Model 2.

Table 4.3 Best-Fit Model Input Parameters

Unit	Parameter	Value	Comment
Alluvium	K (x,y) (m/day)	2.3	Applied to layer 1 only
	K (z) (m/day)	0.23	-
	Specific Yield (Sy)	0.09	-
	Aquifer Compressibility (1/m)	$1.83E^{-4}$	-
	Recharge (mm/yr)	18	-
Interburden	K (x,y) (m/day)	0.007	Layer 1, 2 and 4
	K (z) (m/day)	$2e^{-6}$	Layer 1 and 4 Layer 2
	Specific Yield (Sy)	0.02	-
	Aquifer Storativity (Dimensionless)	$1.83e^{-4}$	-
Coal Seams (Bowfield/ Arrowfield)	K (x,y) (m/day)	0.052	Layers 3 and 5. Outcropping zone in layer 2.
	K (z) (m/day)	$2e^{-6}$	Layer 3 Outcropping zone layer 2
	Specific Yield (Sy) Aquifer Storativity (Dimensionless) Recharge (m/yr)	0.02 $1.83e^{-4}$	Applied to layer 3 and outcropping zones in layers 1 and tw2o.
Faulting	K (x,y) m/day	0.007	Applied to layers 3 and 5
	K (z) (m/day)	$2e^{-6}$	
River Boundaries Wollombi Brook	Head (m)	Varies 52.2 – 45.2	Applied to layer 1
Northern Boundary	Head (m)	45.0 45.0	Applied to layer 3 Applied to layer 5
Southern Boundary	Head (m)	30 30	Applied to layer 3 Applied to layer 5
Eastern Boundary	Head (m)	-	No flow boundary specified
Western Boundary	Head (m)	-	No flow boundary specified.

There is a difference in the vertical hydraulic conductivities used for the same geological units in Models 1 and 2. The reasons for the differences between the models are presented as follows:

- both inputs used may represent normal regional geological and hydrogeological variations given the range in data specified in *Section 2*; and
- Model 2 had data available that provided an opportunity to calibrate the aquifer system while under stress, affording a greater understanding of vertical hydraulic conductivities in this area.

The procedure adopted for Model 2 (lowering vertical hydraulic conductivities) corresponds with the approach used by the SKM (1997) modelling to achieve the decoupling of shallow and deeper groundwater systems that was apparent in the observed data.

Observed versus Simulated Heads

Figure 32 presents a scatter plot of observed versus simulated groundwater elevations. The data are summarised as follows:

- the simulated groundwater elevations for wells screened in the alluvium have a good correlation with observed elevations. The absolute residual mean between the observed and simulated data approximates 0.8 m, which is considered to be acceptable given that the water elevations in Wollombi Brook (which are likely to impact the groundwater elevations in this area) are known at only one location up gradient of the area of concern; and

- the simulated groundwater elevations for wells screened within the Bowfield seam have a reasonable correlation with observed elevations. The absolute residual mean between the observed and simulated data approximates 3.5 m. Compared to the overall variation in groundwater elevations (approximately 61 m) in the Bowfield seam, this residual mean value is considered to be relatively small and therefore acceptable.

Observed versus Simulated Piezometry

Figure 34 presents the simulated piezometry for the alluvium and Bowfield coal seam. The simulated depressurised piezometry corresponds well with the observed groundwater piezometry reported in *Section 2*.

Estimated versus Simulated Groundwater Flow Budgets

Table 4.4 presents the simulated versus estimated flow budgets. The data presented are summarised as follows:

- the flow budgets generally approximate those calculated in *Section 2*;

- additional flow is attributed to induced leakage from the Bowfield seam down to the underlying Mt Arthur seam due to dewatering from underground mining; and

- SKM's (1997) calibrated model estimated flow to the underlying Mt Arthur workings of 370 m^3/day, which is relatively similar but higher than the current model calibration simulation of between 122 and 288 m^3/day[2]. SKM (1997) simulated seepage to Wollombi Brook of 70 m^3/day, which is significantly lower than this calibration simulation. However, this is primarily attributed to the differences in the recharge applied to Wollombi Brook alluvium. Due to differences in model domains other flow budget data cannot be used for comparing the previous SKM modelling to the current modelling.

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[2] The lower end of this range is estimated as the difference between inflow and outflow of groundwater from the Mt Arthur Seam. The upper end of the range is estimated as the maximum groundwater abstracted by wells from the Mt Arthur Seam.

Table 4.4 Model 2 Flow Budgets (m^3/day)

Layer	Parameter	Inflows			Outflows Total Budget		
		Recharge	Head Boundaries	***Total Inflow***	Head Boundaries	Well Boundaries	***Total Outflow***
1	Wollombi Brook	-	-		477	-	***477***
1	Wollombi Brook Alluvium	479	-	***479***	-	-	
1	Outcropping Coal Seams	96	-	***96***	-	-	
3	Arrowfield / Bowfield Coal Seam		33	***33***	9	-	***9***
5	Mt Arthur Coal Seam	-	166	***166***	-	288	***288***
	Total Model Budget			***774***			***774***

4.2 CALIBRATION CONCLUSIONS

The calibrated results show an acceptable correlation with the available data suggesting that the models are an acceptable steady state representation of the observed conditions present within the model domains. These models are considered to be suitable for use to simulate impacts from mining on the following:

- groundwater seepage into mine voids terminating at the base of the Bowfield, Vaux and Bayswater coal seams;
- variations in water flow from the Hunter River and Wollombi Brook under different mining conditions;
- changes in groundwater elevations within alluvial deposits surrounding the Hunter River and Wollombi Brook and within the Bowfield, Mt Arthur and Bayswater coal seams; and
- migration pathways and dispersion of saline water present within mine voids at the completion of mining.

The differences in some input parameters between Model 1 and Model 2 highlight the potential variability in the model inputs that can achieve a credible answer. While these calibrated models are considered to best represent the site conditions, given the current variability and knowledge of model input parameters, there is potentially a range of model set-ups that could achieve an equally credible calibration. Best modelling practice to deal with this uncertainty is to complete a sensitivity analysis which is discussed in *Section 7*.

5 *MODELLING SIMULATIONS*

To meet the modelling objectives the model simulations included using the calibrated model to simulate:

- flow between the Hunter River, Hunter River alluvium and the Cheshunt and Riverview Pits with the progression of mining;
- water flow between the Wollombi Brook alluvial aquifer and the South Lemington Pits to assess the potential for induced leakage;
- the regional extent of alluvial aquifer depressurisation and recovery at various times through the active and post-mining phases;
- the effects of the reducing the buffer zone in the Cheshunt Pit area on flows in the Hunter River;
- the effects of reducing the buffer zone around the South Lemington Pits on groundwater flows to Wollombi Brook; and
- saline groundwater migration pathways from final pit voids and tailings storage facilities (TSFs), to assess the potential impacts to surrounding surface water and groundwater quality.

To meet these criteria a number of simulations have been completed, which are detailed in *Table 5.1*.

The transient model (Model 1_1) explicitly represents the mine plan at 10 times including 2006, 2007, 2008, 2009, 2010, 2014, 2019, 2024, 2029, 2030, corresponding to changing mine plans provided by the CNA mine planners. The migration of pit voids across the landscape has been simulated to change through time at each time step by varying the K and Sy throughout the model as a function of time. Old pit void areas left behind each new pit location are considered to be backfilled with mine spoil, which has been represented with a K value of 1 m/day (as used previously by Mackie, 1998) and a storage value Sy of 0.09.

Well nodes have been used to represent the removal of water from pit voids through time. The pumping rates from the wells have been set to very high values to ensure that pits are totally dewatered. To ensure the right amount of dewatering and to prevent over-dewatering, a groundwater elevation constraint was placed on the pumping rates. The groundwater elevation constraint was set at the maximum depth of each pit void at each time step. FEFLOW allows a linear change in the groundwater elevation constraint over time. This allows a more realistic representation of a gradually deepening pit void between the times at which mine plans are specified, and is preferable over an abrupt change. The locations of the well nodes are also simulated to vary through time so that they are located in the approximate area of the maximum depth of each pit void at each time step.

Table 5.1 Modelling Simulations

Simulation Name	Run Number	Date (year)	Rationale for Simulation
Model 1_1	1	2006 – 2039	Transient simulation of drawdown, mine seepage and Hunter River flow changes over the proposed period of mining, including particle flow directions and groundwater recovery after mine closure.
Model 1_2	2	2029	Steady state simulation of seepage from the Hunter River associated with a reduction in buffer zone of 50 and 100 m under worst case mine void conditions.
Model 1_3	3	2029	
Model 2_1	4	2010	Steady state simulation of drawdown, mine seepage and Wollombi Brook flow changes at four times over the proposed period of mining, including mine closure. This includes the times at which the mine void has significantly changed.
Model 2_2	5	2014	
Model 2_3	6	2019	
Model 2_4	7	2024	
Model 2_5	8	2010	Steady state simulation of localised Wollombi Brook alluvium drawdown and Wollombi Brook flow changes given a 50 m and 100 m reduction in buffer zone for the South Lemington Pits. The mine voids for 2010 were selected for this simulation as the mine voids are closest to Wollombi Brook at this time.
Model 2_6	9	2010	
Model 2_7	10	2029	Steady state assessment of particle flow directions to assess saline water migration from the rehabilitated landform assuming that no dewatering of the mine waste material is taking place.

6 MODELLING RESULTS

The modelling results have been split into eight primary sections as follows:

- *Groundwater Flow to and from Rivers*: These results detail the potential impacts to rivers caused by reduced groundwater flows. They represent a significant part of the modelling objectives and aim to address environmental issues raised by the DWE;

- *Regional Groundwater Drawdown*: These results detail the overall impact of mine dewatering on regional groundwater elevations. This aspect also represents a significant part of the modelling objectives and considers the environmental issues raised by the DWE;

- *Seepage to Pits*: This section provides an estimate of the volume of water that will enter the pits within HVO South during the Project Approval period and determine where this water will come from;

- *Current and Proposed Impacts:* This section provides an understanding of the likely contribution from the current mining (as approved) compared to the proposal to allow an assessment of the additional impacts of the proposed mining;

- *Changes to Buffer Zone:* This section assess the predicted impact of variations in buffer zone between pit voids and surface water bodies. The model predicts the outcomes from:

    - a reduction in the current 150 m buffer zone between Cheshunt Pit highwall and the edge of alluvium of the Hunter River by 50 m and 100 m; and

    - a reduction in the recommended buffer zone between South Lemington Pits 1 and 2 highwall and the edge of alluvium of the Wollombi Brook, by 50 m and 100 m;

- *Estimation of Deep Cheshunt Pit Final Void Surface Water Elevations*: These results detail the estimated time it will take for the pit void to fill and estimated average water elevations;

- *Leachate Migration from Mine Spoil and Tailings Storage Facilities*: These results detail the impact of leachate liquids from pit spoils and TSFs on surface water bodies and the regional groundwater system after mine closure; and

- *Highwall Mining*: These results detail the potential impacts of mining into the exposed coal seams on the highwalls of some of the pits as proposed.

6.1 GROUNDWATER FLOW TO AND FROM RIVERS

The simulated net rates of groundwater flow towards the Hunter River over the duration of mining are presented in *Figure 35*. The net flow into the Hunter River is predicted to fall from approximately 1,156 m^3/day to approximately 968 m^3/day by 2024 (a 188 m^3/day change). This reduction is lower than but similar to that simulated in the previous regional modelling by Mackie (1998). Mackie 1998, predicted a gradual increase in seepage from the river over the 21-year mine lifetime to a maximum of 550 m^3/day.

The predicted reduction in groundwater flow towards the Hunter River represents a 5% reduction in the Hunter River minimum flows recorded between 1969 and 2006 at gauging station 210083. CNA will offset this potential reduction in flow in accordance with legislative requirements.

A similar situation exists near Wollombi Brook. The simulated seepage rates from Wollombi Brook at different stages of the proposed mining period are presented in *Table 6.1.*

Table 6.1 Simulated Net Groundwater Flow for Wollombi Brook

Simulation Name	Representative Year	Net Groundwater Flow for Wollombi Brook (m^3/day)	Change Relative to Base Case (m^3/day)
Base Case	2006	-485	0
Model 2_1	2010	-3	482
Model 2_2	2014	3	488
Model 2_3	2019	95	580
Model 2_4	2024	-291	194

A negative value represents a net flow into Wollombi Brook.

The data presented in *Table 6.1* are summarised as follows:

- under base case conditions there is a net groundwater flow towards Wollombi Brook using the average rainfall and evaporation conditions adopted for the model. However, in 2014 and 2019 groundwater flow is away from Wollombi Brook;
- the greatest change in net groundwater flow will occur in 2019, this being attributed to the South Lemington Pit 1 void intersecting the most alluvium at this time; and
- the simulated reduction in groundwater flow towards Wollombi Brook is significant relative to Wollombi Brook minimum flows of 0 m^3/day recorded at gauging station 210004 between 1908 and 2006. However, given that Wollombi Brook is already subject to periods of dry conditions, this is unlikely to significantly change the flow regime in Wollombi Brook. The number of dry days within Wollombi Brook is predicted to increase by up to 6%. This change will potentially impact the brook in areas that are owned by CNA.

As identified in *Chapter 11 – Ecology* of *Volume 1* and *Annex L* of *Volume 3*, there is a Hunter Floodplain Red Gum Woodland complex, a stand of River Red Gums and several isolated River Red Gum trees located on the Wollombi Brook alluvium. The predicted increase in the number of days the Brook is dry is not anticipated to significantly impact the complex, stand or isolated River Red Gums. The trees are unlikely to be affected as they rely on inundation by peak flow floods, which will not change as a result of the extension to mining. As the Brook is ephemeral, the changes to flow resulting from the proposed mining activities are not anticipated to significantly impact fish species. Potential impacts resulting from groundwater drawdown are discussed in *Section 6.2*.

6.2 *REGIONAL GROUNDWATER DRAWDOWN*

Figures 36 and *37* present the groundwater table drawdowns for Models 1 and Model 2 relative to the initial conditions at December 2005 for Model 1 and March 2000 for Model 2. The data presented are summarised as follows:

- *Figure 36* presents the groundwater elevation drawdown data for 2029, which is indicative of worst case drawdown conditions. The data presented are summarised as follows:

  - there is only a localised area of impact around the Cheshunt and Riverview Pit voids in shallow groundwater. These localised impacts do not extend to other groundwater users present in the area (as presented in *Figure 25*). As such, the impact on surrounding groundwater users is considered to be acceptable; and

  - groundwater drawdown within the coal seam aquifers extends to much greater distances from the pit voids, however, these aquifers are not used as potable water supplies primarily due to low yields and poor water quality. As such, the drawdowns simulated in the coal seams are considered to have a negligible adverse impact on the groundwater resource.

- *Figure 37* presents the groundwater elevation drawdown data for 2014 and 2019, which are indicative of worst case drawdown conditions. The data presented are summarised as follows:

  - model 2 drawdowns simulated in the South Lemington Pit 1 area are relative to pre-mining conditions. Given that the mine is already in place at this location, a percentage of simulated drawdown will have already occurred;
  - within the vicinity of alluvium and potential receptors (the groundwater users presented in *Figure 25*) the drawdowns simulated are estimated to be less than 1 m. While these drawdowns are considered to represent potentially adverse impacts, they are likely to be overstated due to modelling in this area (Model 2) being under steady state conditions. The actual impacts are likely to be less than this and are more likely to approximate the localised, negligible impacts presented for Model 1, which was completed under transient conditions; and
  - groundwater drawdown within the Bowfield coal seam is simulated, however the impact to surrounding groundwater resource is considered to be negligible given that these aquifers are not used as potable water supplies primarily due to low yields and poor water quality. There is a deep well (GW080963), that has been installed for fire fighting purposes, located to the north east near the LCPP plant. This well is located outside the zone of Bowfield seam outcrop and is likely to be screened in deeper seams that will not be impacted by the proposed mining. Therefore, the impacts to this well are considered to be negligible.

  As addressed in the preceding section there is a Hunter Floodplain Red Gum Woodland complex, a stand of River Red Gums and several isolated River Red Gum trees located on the Wollombi Brook alluvium. The location of this vegetation is illustrated in *Figure 11.2* of *Volume 1*. As depicted in *Figure 37*, as a worst case, a maximum groundwater drawdown of 1 m is predicted within the area where isolated River Red Gums are located with drawdown impacts not predicted below the River Red Gum stand or the majority of the Hunter Floodplain Red Gum Woodland complex. This has the potential to reduce the amount of groundwater currently available to the isolated River Red Gums. CNA are currently undertaking studies to investigate the preferred water source of River Red Gums and appropriate management measures will be developed and applied as appropriate.

6.3 *SEEPAGE TO PITS*

The locations of the pits discussed in this section are presented in *Figure 1*.

Transient simulations of seepage into Cheshunt and Riverview Pits are presented in *Figures 38* and *39* and represent the cumulative seepage over the times between each mine void time period (presented in *Section 5*). These results do not include any reduction in buffer zone. The results are summarised as follows:

- the majority of seepage into the pits is associated with the release of water from storage within the mined coal and interburden and the surrounding geology rather than seepage from nearby surface water bodies;

- the average simulated seepage into Cheshunt Pit ranges between 770 m^3/day in initial stages of the proposed mining and approximately 7,320 m^3/day over the period 2009 to 2010 when mine progression and pit deepening are greatest (as reflected by the falling groundwater elevation). As mining rates decrease toward the end of the proposed mining period the seepage rates are simulated to decrease to approximately 2,240 m^3/day. This rate is likely to approximate the rate of initial groundwater seepage into the pit post mining, which will gradually fall over time as the pit void fills with water. The highest seepage rates will require significant revision of the current water management infrastructure to effectively handle these simulated seepage volumes;

- previously reported seepage to Cheshunt Pit (Mackie, 1998) ranged between approximately 500 m^3/day and 3,000 m^3/day over the proposed mining period. This is lower than the seepage rates presented in *Figure 35*, however, the seepage rates towards the end of the proposed mining period are similar in comparison with the previous modelling;

- the average simulated seepage into Riverview Pit ranges between approximately 120 m^3/day in initial stages of mining and 850 m^3/day over the period 2009 to 2014 when mine progression is at its greatest; and

- the predicted maximum flow rates to Riverview Pit are considered to represent manageable water volumes that are unlikely to require significant review of the current water management strategy for this pit.

Due to the high simulated seepage rates into Cheshunt Pit, a calculation was performed to check the estimated volume of water available in storage that could potentially seep into the pit. The calculation adopted the following assumptions:

- a specific yield of 0.02, which was adopted for the modelling (*see Section 2.8.2*) and is consistent with previous modelling;

- a pit surface area approximating 3.8 km^2 and a total area impacted by drawdown of 14 km^2, as estimated from the modelled drawdown plots;

- that drawdown approximates 170 m in the pit and zero 1 km from the pit edge. This generally corresponds with the modelled drawdown plots; and

- that the mining occurs over a proposed period of 21 years.

The calculated seepage into the pit is estimated at 3,500 m^3/day, which generally corresponds with an approximate average seepage of 3,200 m^3/day predicted by the model.

In addition to the above, a reality check on the appearance of seepage on pit walls was performed to help the client visualise how this would look on the edges of pit walls.

Given the surface area of the pit in 2010 and a conservative pit depth of 65 m, the surface area of the pit is estimated to approximate 330,000 m^2. Given this value and a range in predicted seepage of 1,400 m^3/day to 7,320 m^3/day, the total seepage per square metre of exposed pit wall is estimated to range between 4.2 L/d (equivalent to 4.2 mm of water column or $4.8E^{-5}$ L/s) and 21 L/d (equivalent to 21 mm of water column or $2.4E^{-4}$ L/s). This is very low and is likely to be represented as surface seeps rather than surface flows. Once exposed at the surface, this seepage will be subject to evaporation losses. Given that evaporation ranges between 5.9 mm/day in summer and 1.5 mm/day in winter (*Figure 8*) it can be expected that at times evaporation will exceed seepage and therefore that seepage accumulation in the pit void will be negligible. With evaporation losses, the highest seepage rates of 7,320 m^3/day into the pit void can be expected to reduce to 6,510 m^3/day in winter months and 5,040 m^3/day in summer months.

The exposed surface area of the Deep Cheshunt Pit final void is expected to approximate 990,000 m^2 and pit seepage is predicted to range between the 3,340 m^3/day and 2,240 m^3/day at this time. Therefore, at this stage of mining seepage will range between 3.4 L/day/m^2 (or 3.4 mm of water column) and 2.2 L/d/m^2 (or 2.2 mm of water column). With evaporative losses incorporated it is likely that seepage accumulation in the pit will range from negligible in summer to approximately 1,870 m^3/day in winter.

Simulated seepage to South Lemington Pits 1 and 2 is presented in *Table 6.2*. These results do not include any reduction in buffer zone.

Table 6.2 Total Pit Void Seepage

Simulation Name	Indicative Year	Seepage to South Lemington Pit 2 (m^3/day)	Seepage to South Lemington Pit 1 (m^3/day)
Base Case	2006	0[2]	0[2]
Model 2_1	2010	40	472
Model 2_2	2014	62	463
Model 2_3	2019	0[1]	805
Model 2_4	2024	0[1]	389

1. South Lemington Pit 1 mining has been completed at this point in time in this model scenario.
2. Base case is calibrated against data obtained prior to mining in this region. Therefore, no seepage to pit voids is simulated for the base case simulation.

The data presented in *Table 6.2* are summarised as follows:

- seepage into South Lemington Pit 2 will range from 40 to 62 m^3/day;
- seepage into South Lemington Pit 1 will range from 389 m^3/day towards the final stages of mining to 805 m^3/day at the time of fastest mining rates (approximately 2010). Water flow into the pit is most likely sourced from the further intersection of Wollombi Brook alluvial deposits (in addition to the existing intersection with alluvial deposits in the northern section of the pit);

- the predicted flow volumes to South Lemington Pit 2 void are less than the values previously reported by SKM (1997) of 220 m^3/day;

- the predicted flow volumes to South Lemington Pit 1 void approximate the value previously reported by SKM (1997) of 750 m^3/day;

- the seepage into the pit voids is predominantly associated with flow through alluvium intersecting the mines with Wollombi Brook; and

- the predicted flow rates to South Lemington Pits 1 and 2 voids are considered to represent manageable water volumes that are unlikely to require significant revision of the current South Lemington Pits water management strategy.

Any reduction in river flow will be offset in accordance with legislative requirements.

6.4 CURRENT AND PROPOSED IMPACTS

6.4.1 Current Approved Mining

Cheshunt and Riverview Pits

The currently consented conditions allow for mining to the base of the Vaux seam in the Cheshunt and Riverview Pits. Modelling results for the additional mining to the base of the Bayswater seam are considered to represent the proposed additional mining. This represents a simplified approach to delineating impacts associated with consented versus proposed mining. This is considered to be appropriate given that the Deep Cheshunt Pit void (eg, the coal deeper seams) is the primary factor in the proposal generating potential impacts.

South Lemington

South Lemington Pit 1 is currently consented to the base of the Bowfield seam. A further two strips are consented to be mined in the existing pit. The proposed mining extension to South Lemington Pit 1 includes two additional strips to the west of the consented mining, which will be mined between 2019 and 2024, and does not include any mining to greater depths. A comparison of seepage results for consented and proposed mining activity is provided in *Section 6.4.2*.

South Lemington Pit 2 is currently consented and there is no additional mining proposed, therefore no comparison of consented and proposed impacts has been performed for this pit.

6.4.2 Changes to Groundwater Flows to and from Rivers

Figure 35 presents the changes in groundwater flows to the Hunter River alluvium within the areas contacted by seams that are currently consented to be mined. These include all seams down to the Vaux seam. The results show that the currently consented mining is most likely responsible for the majority of impacts on the Hunter River. These impacts have generally already occurred.

A comparison of the results for groundwater flow from Wollombi Brook between 2019 and 2024 as presented in *Table 6.1,* suggest that the proposed additional strips to be mined are unlikely to result in an increase in the worst case leakage from to South Lemington Pit 1. The results suggest a fall in leakage from Wollombi Brook, which is attributed to mining within proposed zones that are located greater distances away from Wollombi Brook than those currently consented.

6.4.3 *Changes to Pit Seepage*

Cheshunt and Riverview Pits

The modelling results suggest that seepage into Cheshunt and Riverview Pits will initially comprise leakage from shallow alluvials and underlying coal seams below the Hunter River and seepage from water stored within the rock matrix from zones currently consented. However, as the mining progresses into the Deep Cheshunt Pit void, seepage from the rock matrix within the proposed mining areas will increase. After the completion of the proposed mining, seepage into the Cheshunt and Riverview Pits will comprise roughly of one third from storage in the ground, one third leakage from shallow alluvials and underlying coal seams below the Hunter River, (Layers 1 to 3 in the model) and one third from deep bedrock aquifers.

South Lemington Pit 1

A comparison of the results for seepage to South Lemington Pit 1 between 2019 and 2024, as presented in *Table 6.2*, suggest that the proposed additional strips to be mined are unlikely to result in an increase in the worst case seepage to South Lemington Pit 1. The results suggest a fall in seepage to South Lemington Pit 1, which is attributed to mining within proposed zones that are located greater distances away from Wollombi Brook and Wollombi Brook alluvium than those currently consented. This decreases the potential for leakage from Wollombi Brook to South Lemington Pit 1.

6.5 *CHANGES TO BUFFER ZONE*

This assessment provides evidence on the applicability of the existing 150 m buffer zone between the edge of alluvium and pit highwalls.

The Project Application seeks approval to reduce the 150 m buffer zone to 100 m for Cheshunt Pit.

All potential buffer zone assessment results are presented in this report to provide an understanding of the assessment undertaken and the reasons behind applying for a 50 m buffer zone reduction in the Hunter River area only. This is reflected in *Chapter 9* of Volume 1 of the Environmental Assessment Report and in the mitigation and recommendations presented in *Section 9*.

6.5.1 Changes to Groundwater Flow To and From Rivers

Table 6.3 and *Figure 40* present the simulated changes in groundwater flow associated with a reduction of the width of the buffer zone. The results can be summarised as follows:

- a 50 m reduction in buffer zone width would cause groundwater flow to the Hunter River to decrease by 57 m^3/day, which is considered to be negligible relative to Hunter River minimum flows of 3,600 m^3/day recorded at gauging station 210083 between 1969 and 2006. The reduction in Hunter River flow is due to reduction in flows contributed from groundwater in hard rock aquifers and coal seam measures, with this groundwater preferentially seeping into the pits;

- a 100 m reduction in buffer zone width would cause groundwater flow to the Hunter River to decrease by 1,203 m^3/day, approximately one third of the minimum flow (3,600 m^3/day) but less than 2% of the 5^{th} percentile low flow (76,220 m^3/day) in the Hunter River. This non-linear increase in seepage is due to a greater connection of the pit faces with Hunter River alluvium; and

- a 50 m reduction in buffer zone width for South Lemington Pit 2 would cause the flow in Wollombi Brook to reduce by 136 m^3/day . This would be considered to be significant relative to Wollombi Brook minimum flows of 0 m^3/day recorded at gauging station 210004 between 1908 and 2006. However, given that Wollombi Brook is already subject to periods of dry conditions, this increase in seepage is considered unlikely to significantly change the flow regime in Wollombi Brook. Flood flows will not be significantly impacted by the simulated seepage loss provided that the pit faces is above the elevation of maximum flood in Wollombi Brook.

If the reduction in buffer zone is approved, any reduction to river flows will be offset in accordance with legislative requirements.

Table 6.3 Changes in Groundwater Flow to Rivers with Changes in Buffer Zone (m^3/day)

Change in Groundwater Flows to Hunter River		Change in Groundwater Flows to Wollombi Brook	
50 m reduction	**100 m reduction**	**50 m reduction**	**100 m reduction**
57	1 203	136	450

1. The 2029 mine plan conditions were adopted for Model 1 as this represented the worst case Hunter River leakage conditions.
2. Baseline flow from Hunter River Alluvium into the Hunter River approximates 990 m^3/day in 2029 (refer to *Figure 35*).
3. The 2010 mine plan conditions were adopted for Model 2 as this represented the time at which South Lemington Pit 2 was closest to Wollombi Brook.
4. The model runs used to obtain this data include Models 1_2, 1_3, 2_5, 2_6.

6.5.2 Groundwater Drawdown

Figures 41 and *42* present the simulated drawdown changes associated with changes in the buffer zone near the Hunter River and Wollombi Brook.

Predicted groundwater elevation drawdowns are generally confined to the areas where buffer zone reduction is simulated. However, in Model 1, the drawdown extends into the backfilled Alluvial Lands Pit (within HVO North) area.

Along the Hunter River, the simulations predict that variations in width of buffer zones result in a localised impact on alluvium.

The additional drawdown from buffer zone reduction around Cheshunt and South Lemington Pits does not extend to areas where other known groundwater users are located (*Figure 25*). Therefore, the additional drawdown created is considered to have a negligible impact on surrounding groundwater users.

6.5.3 Seepage to Pits

Table 6.4 and *Figure 40* present the simulated seepage changes associated with reduction of the width of the buffer zone.

Table 6.4 Simulated Changes to Pit Void Seepage (Inflow) with Changes in Buffer Zone (m3/day)

Change in Cheshunt Pit Seepage		Change in South Lemington Pit 2 Seepage	
50 m reduction	**100 m reduction**	**50 m reduction**	**100 m reduction**
50	1187	118	395

1. The 2029 mine plan conditions were adopted for Model 1 as this represented the worst case Hunter River seepage conditions.
2. The 2010 mine plan conditions were adopted for Model 2 as this represented the time at which South Lemington Pits 1 and 2 were closest to Wollombi Brook.
3. The model runs used to obtain this data include Models 1_2, 1_3, 2_5, 2_6.

The data presented in *Table 6.4* are summarised as follows:

- a 50 m reduction in buffer zone results in minor increases in seepage to both pits; and
- a 100 m reduction in buffer zone results in greater changes to seepage to the pits.

6.6 *Estimation of Deep Cheshunt Pit Final Void Surface Water Elevations*

A spreadsheet assessment of the water balance for the final pit void was used to assess potential final elevations within the pit void.

The model adopted the following input parameters:

- a decreasing groundwater inflow starting at the final simulated pit seepage of 2,500 m^3/day and approximating 333 m^3/day at an elevation of the current pit depth;
- surface run-off in the final void catchment approximating 80% of the average rainfall;
- a linear increase in lake area from 114,577 m^2 at an elevation of -140 mAHD to 11,903,036 m^2 at an elevation of 70 mAHD;

- a total run-off catchment area of 11,903,036 m^2; and
- average rainfall of 0.66 m/yr and average evaporation of 1.34 m/yr.

The spreadsheet model predicts that, given average climatic conditions and an absence of input from other surface water bodies, surface water is likely to oscillate around an elevation of 0 mAHD, which is approximately 50 to 60 m below current ground surface in this area. The spreadsheet model also suggests it could potentially take 250 years for this elevation to be reached.

The results also suggest that the Deep Cheshunt Pit final void surface water elevations will on average be significantly below other surface water body elevations within the area. Therefore, it is likely to act as a sink to groundwater flow in the area. This will result in a constant flow of groundwater from the coal seams and pit spoil into the final void.

As the water elevation in the void increases, the predicted impacts to Hunter River (reduced groundwater flows) will subside and tend toward original conditions (as presented in *Figure 35* and *Table 6.3*).

6.7 LEACHATE MIGRATION FROM MINE SPOIL AND TAILINGS STORAGE FACILITIES

Mine spoil leachate migration has only been assessed post mine closure, as prior to this, dewatering resulted in groundwater flow towards the remaining voids (ie, there is no leachate flow outwards into the regional groundwater system).

Figure 43 presents the particle flow directions simulated 100 years after mine closure in Model 1 and Model 2. The data presented are summarised as follows:

- Model 1 simulates migration of all pit spoil groundwater toward the final void indicating that the pit void will act as a groundwater sink and capture point for spoil leachate;

- Model 2 shows that flow within the South Lemington Pit 1 spoil will migrate away from Wollombi Brook. Some migration into coal seams down hydraulic gradient of the site is simulated. However, this is not considered to represent a potentially significant impact given that the spoil water quality was reported in Mackie (1998) to be similar to coal seam water quality and that coal seam aquifers are unlikely to be used as a water supply in this area due to low yields and poor water quality;

- Model 2 simulations suggest that groundwater within South Lemington Pit 2 spoil generally migrates northward through Riverview Pit spoil; and

- there is negligible groundwater leachate migration predicted from South Lemington Pit 1 void toward Wollombi Brook. This suggests that Wollombi Brook water quality is unlikely to be impacted by pit spoil leachate from the South Lemington Pits.

The Deep Cheshunt Pit final void will act as an evaporative sink for coal seam groundwater and mine spoil leachate, resulting in a gradual net loading of salt content to the lake over time. However, this is likely to be a slow process given that in excess of the 85% of the water contributed to the lake will be surface water run-off. Assuming that surface run-off has a total salinity approximating 300 mg/l and that groundwater and leachate have a total salinity approximating 3,700 mg/l, it is likely to take in excess of 200 years for total salinity within the Deep Cheshunt Pit final void to approximate that of the groundwater flowing into the void.

Further investigation of the potential salt sinks and potential Hunter River flood inflow is required to determine the likely equilibrium salinity value within the void. The potential for impacts resulting from migration of leachate from existing and potential TSFs including those proposed for Riverview and South Lemington Pit 1, was considered in this assessment. Fines present in TSFs within the HVO mining area generally settle out from solution over time and seal the base of the TSFs. This prevents the migration of potentially contaminated seepage out of the base of the TSFs. In addition, modelling predicts that the Deep Cheshunt Pit final void exerts such a control on the groundwater flow regime in the area, with groundwater primarily flowing into the pits that any TSF seepage potentially escaping from the facility into surrounding groundwater will migrate directly into the Deep Cheshunt Pit final void.

6.8 HIGHWALL MINING

The assessment completed for the proposed highwall mining was specifically based upon extraction designed to result in subsidence of less than 20 mm. The areas north east of the Deep Cheshunt Pit and to the south west of South Lemington Pit 1 are located within the footprint of active mining and will be subject to active management and rehabilitation. The area south of Riverview Pit extends under Jerrys Plains Road. The current timing for highwall mining is expected to be beyond approximately 2020. More detailed designs will be undertaken utilising best practice methodologies available at that time to ensure subsidence is limited to less than 20 mm. A Subsidence Management Plan may be developed if identified as being required.

An objective of this investigation was to assess the potential impacts resulting from highwall mining, in isolation. Proposed highwall mining areas are presented in *Figure 5.3* of Volume 1. A qualitative assessment of the potential groundwater impacts resulting from proposed highwall mining was completed using the outputs from the modelling and is detailed below.

Riverview Pit

Highwall mining was proposed on the northern and southern sides of the Riverview Pit.

On the northern side of the Riverview Pit, highwall mining of the Bowfield seam between the pit and the Hunter River was initially proposed. This is an area of coal seam identified as having a hydraulic connection with the Hunter River alluvium, which represents a potential risk of increasing seepage from the Hunter River. As the coal reserves are limited in this area it was decided not to undertake further detailed modelling at this time. Until specific modelling is completed to understand the risks posed to Hunter River by highwall mining in this area, approval will not be sought to highwall mine in this area.

A qualitative assessment was undertaken for the Riverview Pit southern highwall mining and identified that it is unlikely to adversely impact the surrounding environment for the following reasons:

- the Bowfield seam dips to the south west from the Riverview Pit and has been mined out to the north within the pit and up gradient towards the Hunter River. Therefore, there is no hydraulic connection between the Bowfield seam on the southern and western sides of Riverview Pit and the Hunter River. Consequently, no additional impact to the Hunter River will result from highwall mining in this area; and
- there are currently no other surface water features or water wells located in the vicinity of the proposed highwall mining in this area.

Cheshunt Pit

The current modelling for this area conservatively simulates mining in a larger zone to the base of the Broonie and Bayswater seams. This in combination with the simulated impact of the open pit creates a drawdown cone that extends beyond the zone of proposed highwall mining to the northeast of the Cheshunt Pit highwall. Therefore, the potential highwall mining in this area will have no additional impact on the Hunter River or surrounding groundwater users.

South Lemington Pit 1

At this location the available groundwater elevation data indicates complete decoupling of the groundwater within the Bowfield seam and shallower groundwater within the Arrowfield seam and alluvial deposits. This is despite the presence of extensive underground mining within the Mt Arthur seam located below the Bowfield seam and beneath the Wollombi Brook. While the current modelling is not capable of simulating surface subsidence, the background groundwater data and anecdotal evidence indicates that surface subsidence or seepage impacts have not occurred as a result of the underground workings. It is recognised that highwall mining uses less invasive techniques than underground mining. Therefore it is considered unlikely that the proposed highwall mining of the Bowfield seam will adversely impact surface water features.

In addition, the Bowfield seam dips to the south west from the pit edge and has been mined out to the north, up gradient towards any intersection with Wollombi Brook alluvium. The potential impacts associated with seepage from Wollombi Brook as a result of consented opencut mining in South Lemington Pit 1 have already been addressed as part of the groundwater modelling assessment prepared for the initial opencut proposal.

There is likely to be some minor drawdown to the groundwater elevations with dewatering of the Bowfield coal seam during highwall mining. This is not currently simulated by the modelling. However, this is likely to be localised around the area of the highwall mining and only within the deeper coals seams being worked, and is not within the vicinity of any potentially significant groundwater resources. Therefore, potential impacts are not considered significant.

While the assessment of highwall mining at South Lemington Pit 1 is based on key field data that suggests the potential impacts are negligible, it is recognised that this assessment is qualitative. Therefore, it is recommended that monitoring of groundwater elevations within the Wollombi Brook alluvium and in shallower coal seams such as the Arrowfield seam is continued. Any changes in groundwater elevations identified will be reviewed and if necessary, management measures implemented to minimise impacts.

7 SENSITIVITY ANALYSIS

In order to assess the potential variability in model outputs due to uncertainty in input parameters, a sensitivity analysis of a selected number of model input parameters has been undertaken.

7.1 SENSITIVITY ANALYSIS PROCEDURE

Model input parameters have been varied within reasonable limits as outlined below. The changes in model outputs have then been compared against selected simulations and base case outputs. This enabled an understanding of the potential variation in model outcomes. Models 1_3 and 2_3 (See *Table 5.1*) were selected to complete the sensitivity analysis as these model runs exhibit the greatest simulated impacts to groundwater elevations and seepage rates in and around the Hunter River and Wollombi Brook.

7.2 PARAMETER SELECTION

Parameters that were identified in the conceptual site model and model development to provide the greatest uncertainty were selected for the sensitivity analysis. The parameters, rationale for selection and parameter range selected are detailed as follows.

1. Recharge - recharge volumes are likely to vary significantly from periods of high rainfall to extended dry conditions. This will impact flow through the model, change groundwater elevations and change discharge to rivers. A range of 9 to 36 mm/yr was used to estimate changes associated with recharge variations.

2. River Elevations – at present, the river elevations within the model are uncertain due to data scarcity. In reality, the average river elevations could be up to two metres higher or lower at any given location within the model. To assess the potential impact that this may have on model outputs, a data range of +/-2 m from the base case was adopted.

3. Vertical Hydraulic Conductivity of the Interburden – the vertical hydraulic conductivity of the interburden may impact the rates of seepage from alluvium to underlying coal seam aquifers and into pit voids. As such, it is considered to be a primary factor potentially impacting modelling outcomes. Values of $3.5E^{-3}$ m/day to $1.4E^{-2}$ m/day have been adopted for estimation of potential changes associated with the ranges reported in *Section 2*. The conductivity ranges tested are smaller than the ranges specified in *Section 2* as these parameters have a direct impact on model calibration. Changing these significantly would result in uncertain changes in groundwater outputs and therefore unrealistic estimates of changes to model outputs. This also applies to the following conductivity sensitivity testing.

4. Horizontal Hydraulic Conductivity of the Coal Seams – the horizontal hydraulic conductivity of the coal seams varies due to factors such as changes in the interstitial geology, cleating and microfracturing. These changes may impact the volume of flow from alluvium to sub-cropping coal measures and the rates of seepage into pit voids. Values of 0.026 m/day and 0.104 m/day, representing respectively, a 0.5 and 2 times change in the best case value, have been adopted for sensitivity analysis.

5. Alluvium Hydraulic Conductivity – This parameter may significantly impact the volume of flow from alluvium to sub-cropping coal measures and the rates of seepage into pit voids. Values of 1.2 and 4.8 m/day have been adopted for sensitivity analysis.

6. Pit Spoil Hydraulic Conductivity – Field data for the hydraulic conductivity of the mine spoil is currently absent creating greater uncertainty in the value adopted for the modelling. As such a range of 0.5 m/day to 2 m/day has been adopted for sensitivity analysis.

7. Constant Head Boundaries – At present few data are available to constrain the head conditions at the model boundaries within each model. As such, it is necessary to test the model sensitivity to variations in this parameter. Constant head boundaries at the model edges have been varied by +/- 5 m to estimate changes to the model outcomes.

8. Specific Yield - Model 1 simulations were completed under transient conditions and had results suggesting that storage release is a significant proportion of the overall seepage to pits. As such, an assessment of the impact of variation of specific yield (equivalent to the volume of water held in storage per volume of lithology) parameters has been completed. Interburden and coal seam drainable/fillable water storage was varied within the model by 0.5 times and 2 times the base conditions.

A summary of the sensitivity analysis parameter variations is provided in *Table 7.1* below.

Table 7.1 Schedule of Sensitivity Simulations

Parameter	Recharge	Run Number
Recharge	18 mm/yr, 0.5 worst case simulation. 36 mm/yr, 2 times worst case simulation.	S_1 S_2
River Elevations	2 m rise in river elevation from worst case simulation. 2 m fall in river elevation from worst case simulation.	S_3 S_4
Horizontal Hydraulic Conductivity of Coal Seams (Kx, Ky)	0.5 times worst case simulation. 2 times worst case simulation.	S_5 S_6
Vertical Hydraulic Conductivity of Interburden (kKz)	0.5 times worst case simulation. 2 times worst case simulation.	S_7 S_8
Alluvium Hydraulic Conductivity (Kx, Ky, Kz)	0.5 times worst case simulation. 2 times worst case simulation.	S_9 S_10
Pit Spoil Conductivity (Kx, Ky, Kz)	0.5 times worst case simulation. 2 times worst case simulation.	S_11 S_12
Constant Head Boundaries (mAHD)	5 m fall in worst case simulation. 5 m increase in worst case simulation.	S_13 S_14
Specific Yield	0.5 times transient simulation. 2 times transient simulation.	S_15 S_16

7.3 SENSITIVITY ANALYSIS RESULTS

Table 7.2 presents the changes in river and pit void seepage from the sensitivity analysis.

Table 7.2 Sensitivity Analysis Results

Sensitivity Run	Hunter River Seepage (m^3/day)	Cheshunt Pit Seepage (m^3/day)	Wollombi Brook Seepage (m^3/day)	South Lemington Pit 2 Seepage (m^3/day)
Best Case	-515	-1380	95	-805
S_1	393	-1258	333	-794
S_2	-2191	-1420	-382	-825
S_3	-454	-1350	257	-963
S_4	-540	-1320	5	-716
S_5	-750	-1050	76	-761
S_6	-72	-1820	122	-878
S_7	-608	-1230	86	-800
S_8	-425	-1396	111	-813
S_9	-503	-1340	-110	-600
S_10	-378	-1440	517	-1230
S_11	-1045	-1250	54	-766
S_12	-453	-1384	156	-936
S_13	-503	-1278	101	-777
S_14	-486	-1400	89	-832

Notes:
1. A negative value represents a flow out of the model

The data presented in *Table 7.2* are summarised as follows:

- seepage from the Hunter River is most sensitive to variations in recharge and pit spoil conductivity. However, these changes are considered to be small relative to the impacts already simulated to Hunter River seepage and are unlikely to change the modelling outcomes;

- seepage to Cheshunt Pit is sensitive to changes in hydraulic conductivity of the coal seams. The changes represent a 30% variation in simulated pit flows and should be factored into water management planning. Smaller, but potentially significant changes are also apparent from changes in the constant head boundaries and rainfall recharge to alluvium within the model. Further characterisation of regional coal seam flow fields may help to reduce the uncertainty in the model associated with the variation in boundary conditions;

- seepage to/from Wollombi Brook is most sensitive to the hydraulic conductivity of the alluvium. It is most sensitive due to the inter-connection of Wollombi Brook alluvium with the South Lemington Pit 2 in this area, which is apparent in the large increase to seepage to the pit. While the potential changes are unlikely to impact base flows in Wollombi Brook, the longevity of flows within Wollombi Brook may be impacted. The seepage from Wollombi Brook is generally sensitive to all parameters tested in the model, however, given that Wollombi Brook under current conditions runs dry it becomes difficult to quantify the significance of the sensitivity relative to a base flow. However, relative to the average Wollombi Brook flows of 33,755 m^3/day, the sensitivity in simulated flow rates is considered to be minimal;

- seepage to South Lemington Pit 2 is most sensitive to the hydraulic conductivity of the alluvium as discussed in the previous bullet point. River elevation and pit spoil conductivity are also sensitive parameters, which is also attributed to the interconnection of Wollombi Brook alluvium with South Lemington Pit 2;

- conclusions from comparison of sensitivity runs 15 and 16 with the base case model are summarised as follows:

  - simulation S_16 which increases storage capacity by 2 times results in an approximate 100% increase in the worst base case seepage rate of 7,300 m^3/day to the Cheshunt Pit simulated in 2010 (ie, doubling of the specific yield results in doubling of the simulated seepage in Cheshunt Pit). This suggests that the model is sensitive to this parameter and potential pit seepage variations of this magnitude should be accounted for in water management planning. However, the variation in pit seepage between the base case, S_15 and S_16 model simulations reduces to approximately zero at and after the time of mine closure;

  - the maximum change in Hunter River flow occurs at the period 2010 and approximates 30 m^3/day. This approximates less than 3% of the simulated net seepage to the Hunter River. It is therefore considered that the Hunter River seepage is insensitive to changes in storativity in the model; and

- the remaining parameters presented in *Table 7.2* are considered to have a minimal impact on modelling outcomes.

8 SUMMARY OF SIMULATED IMPACTS

Two groundwater models have been developed to simulate the potential impacts of the HVO South on groundwater and surface water in the HVO region.

The potential impacts simulated from the modelling are detailed as follows:

Model 1 - Cheshunt and Riverview Areas

- net groundwater flow is predicted to be towards the Hunter River during and after the proposed mining. The net groundwater flow towards the Hunter River is predicted to drop by 188 m3/day. This reduction in flow approximates 5% of the minimum flows in the Hunter River recorded between 1969 and 2006 and is therefore considered to represent a negligible impact;
- groundwater flows into the Cheshunt and Riverview Pits are predicted to be primarily from the release of groundwater stored within geological strata surrounding these pits. Groundwater is also removed through the process of mining, i.e. removing saturated overburden and coal from the pit. A maximum seepage rate of approximately 7,320 m^3/day is predicted to occur at the time of fastest mining rates;
- the primary drawdown impacts are likely to be localised around the pit voids where release of water from storage occurs. In particular, simulated impacts to shallow groundwater in alluvium are minimal suggesting that there is unlikely to be adverse impacts to surrounding groundwater users, who primarily abstract from alluvium in this area;
- the modelling results suggest that impacts on flows to or from the Hunter River will primarily be associated with areas currently consented to be mined rather than the proposed areas. Seepage into the Cheshunt and Riverview Pits out to 2040 will comprise roughly of one third from storage in the ground, one third leakage from shallow alluvials and underlying coal seams below the Hunter River, (Layers 1 to 3 in the model) and one third from deep bedrock aquifers;
- a 50 m reduction of the 150 m buffer zone measured from the highwall to the edge of the alluvium will result in only minimal reduction of net seepage towards the Hunter River (57m^3/day);
- the Deep Cheshunt Pit final void will act as a sink for leachate emanating from mine spoil and will prevent the migration of leachate to other surface water bodies. Therefore, the potential for the leachate to adversely impact Hunter River water quality is considered to be negligible;
- mine spoil leachate is estimated to be similar in chemical composition to current coal seam groundwater. Therefore, it is considered unlikely that leachate will have an adverse impact on groundwater quality if it migrates into coal measures after mine closure;
- salt loading will occur in the Deep Cheshunt Pit final void over time. Simulations suggest it will take in excess of 200 years for salt concentrations in the mine pit lake to increase to concentrations similar to that present in surrounding groundwater; and
- the final void water elevation is expected to oscillate around an average elevation of approximately 0 metres above Australian Height Datum (mAHD), which is approximately 50 m to 60 m below current ground surface in this area;

- sensitivity analysis suggests that net seepage to the Hunter River is relatively insensitive to changes in input parameters when compared to fluctuations in the flow regime in the Hunter River. This affords greater certainty to the modelling outcomes in regard to the predicted impacts to the Hunter River; and
- sensitivity analysis suggests that seepage to pits could vary (eg, by the more than 100%) due to variations in storage characteristics and hydraulic conductivity of the coal seams.

Model 2 - South Lemington Area

- the simulated worst case change in net seepage rates for Wollombi Brook approximate 580 m^3/day and could change the average groundwater flow regime from towards to away from Wollombi Brook. This could result in a potential increase in the number of dry days in Wollombi Brook by up to 6%;

- groundwater drawdown at the locations of neighbouring groundwater users is predicted to be less than 1 m. This predicted drawdown is conservative as the simulation was undertaken under steady state conditions and therefore the actual impact is likely to be significantly less than 1 m.

- seepage into South Lemington Pits 1 and 2 is primarily through alluvial deposits that are intersected by the pit void. The maximum seepages rates into South Lemington Pits 1 and 2 approximate 62 m^3/day and 805 m^3/day respectively and are considered to represent manageable volumes of water;

- seepage towards South Lemington Pit 1 is sensitive to parameters such as river elevations, alluvium hydraulic conductivity and pit spoil conductivity that create an additional flow through the alluvium connecting Wollombi Brook and the pit voids;

- the proposed additional mining in the South Lemington Pit 1 are will not increase the worst case leakage from Wollombi Brook or the worst case seepage to South Lemington Pit 1. This is because the proposed additional mining is located in areas further to the west and south away from Wollombi Brook and Wollombi Brook alluvium;

- a 50 m decrease in the buffer zone from the edge of the Wollombi Brook alluvium, could reduce groundwater flows to Wollombi Brook by 136 m^3/day . This will potentially increase the number of dry days within Wollombi Brook; and

- current mine plans include total infilling and rehabilitation of the land surface within the South Lemington mines. As such, groundwater will not migrate to a pit void evaporative sink as at the Deep Cheshunt Pit final void. Therefore, groundwater emanating from the mine spoil after mine closure is predicted to migrate into the surrounding regional groundwater system. The mine spoil leachate has previously been estimated to approximate the chemistry of the current coal measures groundwater. As such, it is not considered likely to result in adverse impacts to the surrounding groundwater system.

9 MITIGATION MEASURES AND RECOMMENDATIONS

Management of groundwater at HVO is undertaken with reference to a management plan that details the key objectives and control measures.

The management plan outlines key environmental issues, performance criteria, recommended control measures, monitoring, inspection and incident management requirements, performance reporting and key related policies and procedures.

The relevant EMS procedures describe the implementation of these recommended controls. Monitoring is undertaken in accordance with the approved monitoring programme to determine the effectiveness of the control measures and promotes a continuous improvement cycle.

The CNA EMS will continue to be implemented across HVO and the relevant plans, procedures and monitoring programmes will be reviewed and modified to reflect the changes to HVO South resulting from the proposal.

The key objectives for groundwater management are to:

- manage the operations in a way that minimises groundwater impacts to environment and neighbours, and limits interference to mining production;
- understand the site groundwater resources and minimise impacts on quality;
- understand the zone of influence of potential impacts of operations on groundwater and aquifer pressures including alluvium;
- monitor and manage seepage of groundwater from shallow aquifers and impacts on surface streams; and
- keep the local community and regulators informed of activities where required and to respond quickly and effectively to issues and concerns.

The recommended management measures have been considered in the context of the existing HVO activities and the CNA EMS. As a result a number of mitigation measures for groundwater will be implemented across HVO South to minimise the potential impacts resulting from the proposal.

Mitigation Measures

Regular mitigation measures for groundwater management include:

- selective backfill or construction to inhibit seepage into pits following mining;
- captured groundwater managed as mine affected water;
- levee construction to prevent flood water inflows to pits;
- monitoring of groundwater at sites as detailed in the Groundwater Monitoring Programme; and
- monitoring results for sites as listed in the Groundwater Monitoring Programme to be included in the AEMR.

Commitments Specific to the Proposal

In addition to the mitigation measures applied across HVO South the following controls will be implemented.

Groundwater Flow to and from Rivers:

- development of protocols for monitoring and reporting of stream gauge results to clearly record any reductions in flows that are attributed to mining. This will include monitoring Hunter River flows immediately up gradient and down gradient of the works area. In addition, consideration will be given to tying in specific CNA water level recordings with current DWE gauging locations;

- monitoring of groundwater elevations within alluvium between the Hunter River and the Cheshunt Pit;

- measured groundwater elevations and river flow will be assessed against predictions to determine whether application of additional management measures is required; and

- any reduction in river flow will be offset in accordance with legislative requirements.

Regional Groundwater Drawdown:

- the HVO *River Red Gum Rehabilitation and Restoration Strategy* and CNA EMS Procedure for Flora and Fauna will be updated to reflect changes resulting from the proposal. This will include monitoring the health of the River Red Gums located on the Hunter River and Wollombi Brook alluvium as identified in *Chapter 11* of *Volume 1* (*Figure 11.2*) and *Annex L* of *Volume 3*. The monitoring programme will include details on frequency of monitoring, reporting and corrective actions; and

- up to three monitoring wells will be installed in the proximity of the cluster of registered DWE bores located to the east of the LCPP (*Figure 25*). Data will be used to compare actual versus predicted impacts. Deviations away from predicted impacts will be assessed, and if predictions are exceeded, management measures will be implemented.

Alluvial Buffer Zone:

- a buffer zone of 100 m will be retained from the Cheshunt Pit highwall to the edge of alluvium of the Hunter River;

- a buffer zone of 150 m will be retained from the South Lemington Pit 2 highwall to the edge of alluvium of the Wollombi Brook;

- bores will be installed to further delineate the saturated zone between the Hunter River and the Cheshunt Pit before mining commences within this area; and

- the groundwater component of the HVO Water Management Manual will include procedures for monitoring potential impacts, including accurately measuring seepage to pits throughout mining and assessment of proximity to alluvials as mining approaches.

Pit Wall Stability:

Management measures relating to fracture development along pit walls are included in the Blast and Vibration Management Plan (refer to *Chapter 7* of Volume 1).

Deep Cheshunt Pit Final Void:

- the Deep Cheshunt final void will be designed to intercept leachate from overburden emplacements and minimise discharge of saline groundwater. Final void design will be reviewed at least three years prior to anticipated mine closure;

- the Final Void Management Plan will include future use options including investigation of feasibility to use the Deep Cheshunt Pit final void as a water storage that could be used as a buffer in times of flood flows in the Hunter River and as a supplementary water supply at times of scarce water supply. This would include additional investigations to refine predictions of final void water chemistry;

- a post closure monitoring programme will be developed for water quality monitoring of the final void; and

- the mine plan will be further reviewed with a view to minimise the area of the Deep Cheshunt final void as much as practicable.

10 CONCLUSIONS

A detailed assessment of the potential regional and local groundwater system impacts was undertaken for this environmental assessment. Two models were adopted for the assessment with Model 1 simulations being run under steady state and transient conditions and Model 2 simulations under steady state conditions only.

Flows in the Hunter River are not predicted to be significantly impacted by mining, with an approximate reduction of 5% of Hunter River minimum flows predicted. Of the maximum seepage predicted to occur into the Cheshunt and Riverview Pits, approximately 2.5% of flows are derived from the Hunter River. This includes mining up to within 100 m of the edge of the Hunter River alluvium.

Under worst case conditions, the number of days the Wollombi Brook is dry is predicted to increase by up to 6%. An assessment of the potential impacts to ecological values, specifically on the River Red Gums located on the Wollombi Brook alluvium, found that these species will not be significantly impacted by the proposal.

Seepage into the Cheshunt pit is predicted to range from 770 m^3/day to 7,320 m^3/day, dominated by water contained within the material disturbed by mining. This range does not include the potential 100% variability in initial stages of mining. All other impacts are considered minimal.

Currently consented mining within the Cheshunt, Riverview and South Lemington areas will comprise the major source of the identified impacts to the Hunter River and Wollombi Brook.

Existing CNA management system procedures and management plans currently govern the management of groundwater across HVO South. These documents will be updated to reflect changes to groundwater resulting from the proposal.

The Water Management Manual will be developed to replace the existing groundwater related management plans. The Manual will include management of pit seepage, a detailed monitoring programme and development of trigger values and corrective actions to manage changes to groundwater flows. This multilayered approach to groundwater management will minimise the potential for impacts to the regional and local groundwater systems.

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Appendix A

Figures

Legend

Current Development Consent Boundary

Surface Water Gauging Station

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_019
Date:	18/10/2006 — Drawing size: A4
Drawn by:	ML — Reviewed by: SAC
Source:	Areal photograph from CNA Dec 2005
Scale:	Refer to Scale Bar

N

0 1 2 3km

Figure 1

HVO South in its Local Setting

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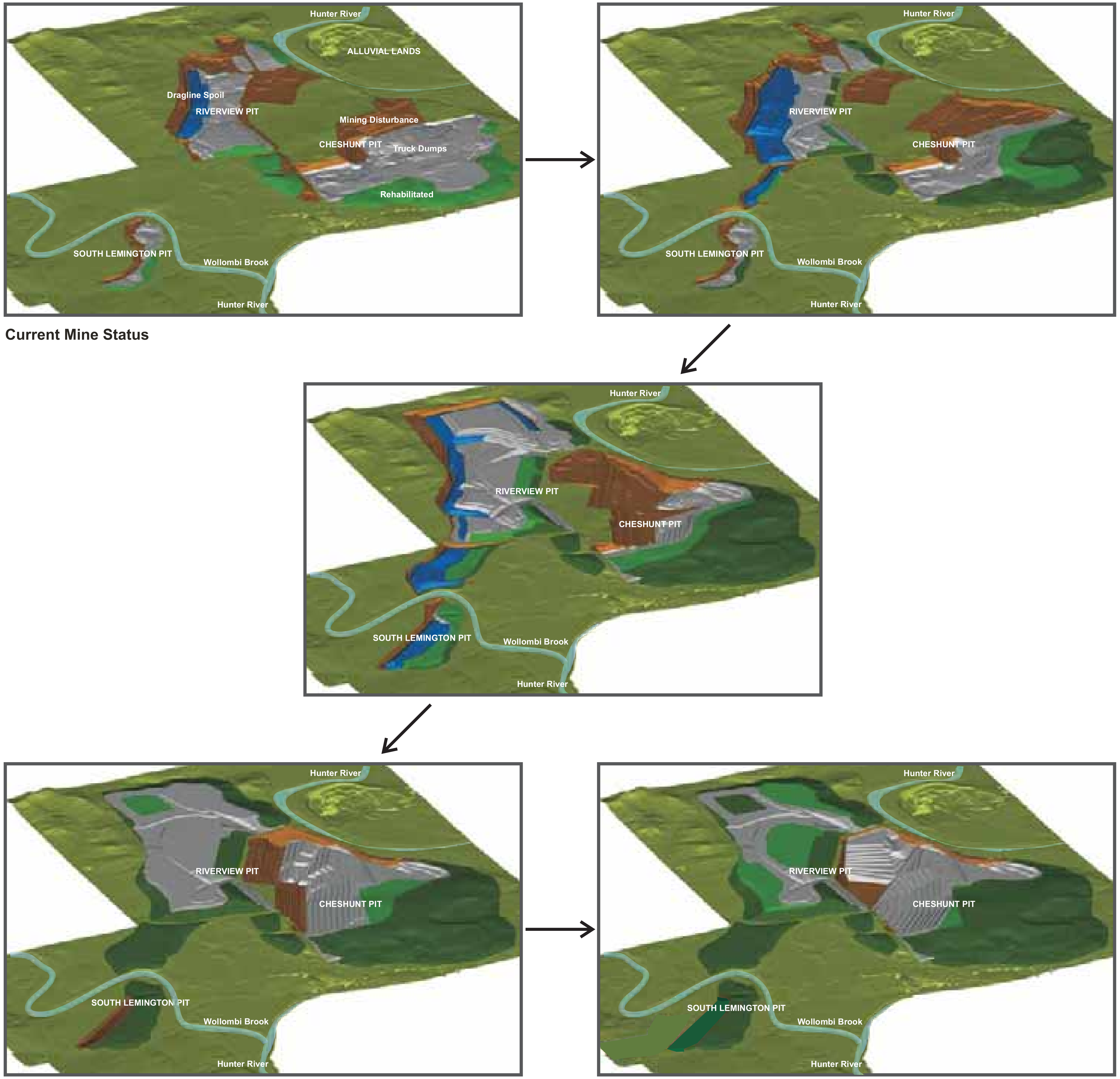
ERM



Legend
- Rehabilitated Zones
- Mining Disturbance
- Dragline Spoil
- Truck Dumps
- Approximate Mine Lease Boundary

Figure 2
Stages of the Proposed Mining

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_20_R1
Date:	18/09/2007 — Drawing size: A3
Drawn by:	GC — Reviewed by: SAC
Source:	RTCA Mine Planning Department
Scale:	N/A

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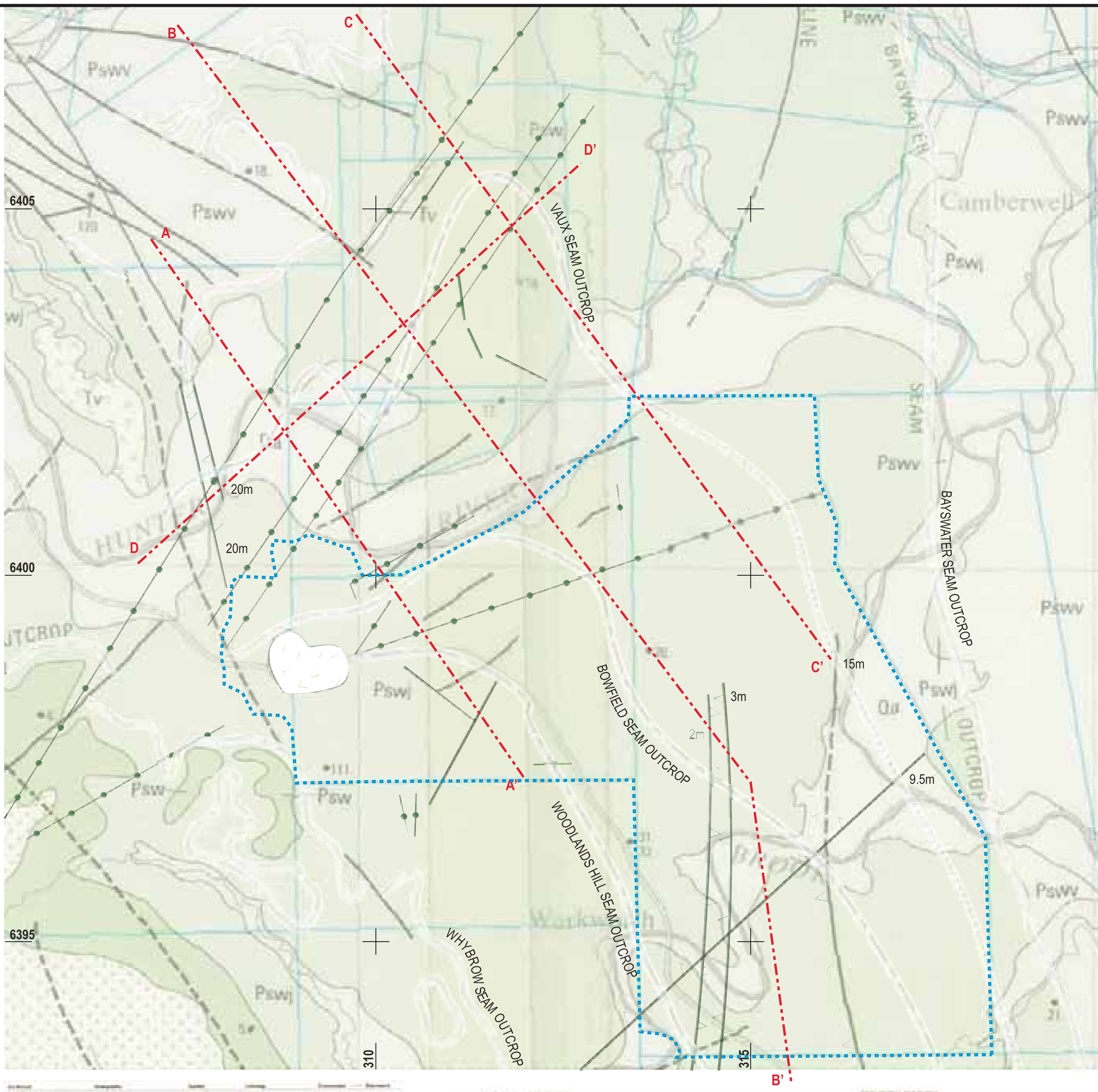

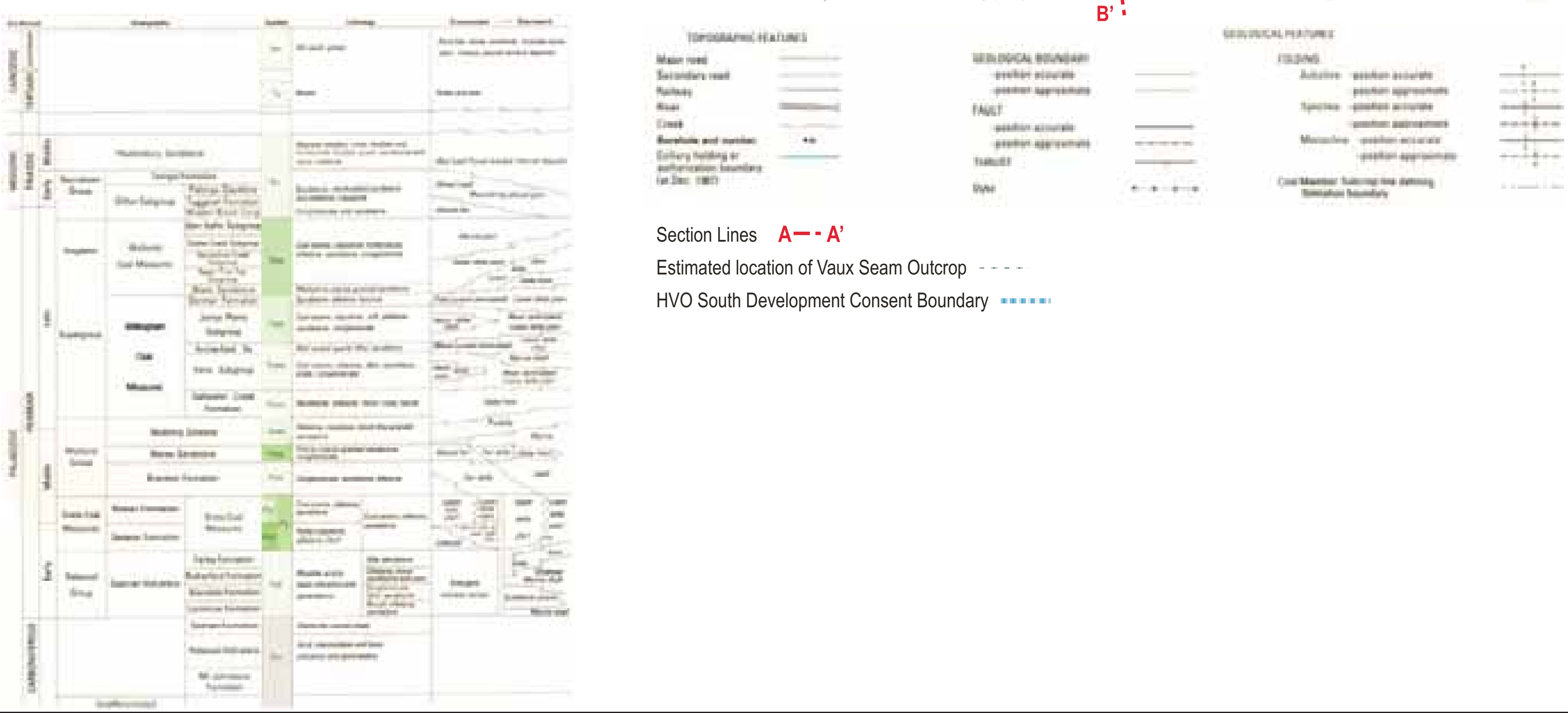

Section Lines A — - A'

Estimated location of Vaux Seam Outcrop - - - -

HVO South Development Consent Boundary

Notes:

Adapted from Hunter Coalfield Regional Geology, Geological Series Sheet 9033 & part of 9133, 9032, & 9132 (Edition 1) 1987.

Figure 3

HVO South Geology

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_01_R1
Date:	24/05/2007 — Drawing size: A3
Drawn by:	ML — Reviewed by: LR
Source:	-
Scale:	Refer to Scale Bar

0 0.5 1km

N

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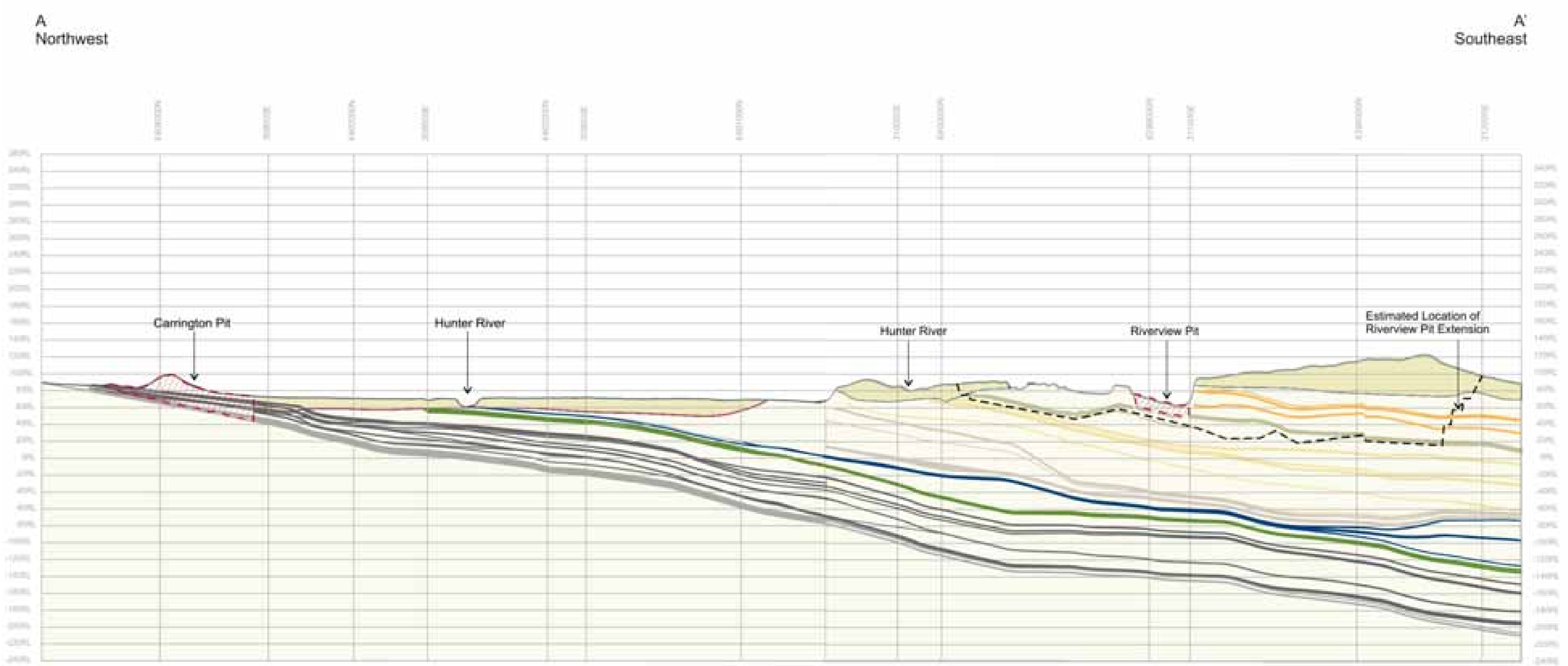

Legend

- Wambo Coal Seam
- Whynot Coal Seam
- Blakefield Coal Seam
- Glen Munro Coal Seam
- Woodlands Hill Coal Seam
- Arrowfield Coal Seam
- Bowfield Coal Seam
- Warkworth Coal Seam
- Mt Arthur Coal Seam
- Piercefield Coal Seam
- Vaux Coal Seam
- Broonie Coal Seam
- Bayswater Coal Seam
- Sandstone and Shale Interburden
- Unconsolidated Clays and Claybound Sands & Gravels
- RL Metres Relative to Australian Height Datum
- Estimated Surface Topography
- Estimated Mine Spoil Location

Figure 4

Geological Cross Section AA

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_21		
Date:	20/06/2007	Drawing size:	A3
Drawn by:	ML	Reviewed by:	SAC
Source:	CNA Geological Model		
Scale:	Refer to Scale Bar (Horizontal)		

0 250 500m

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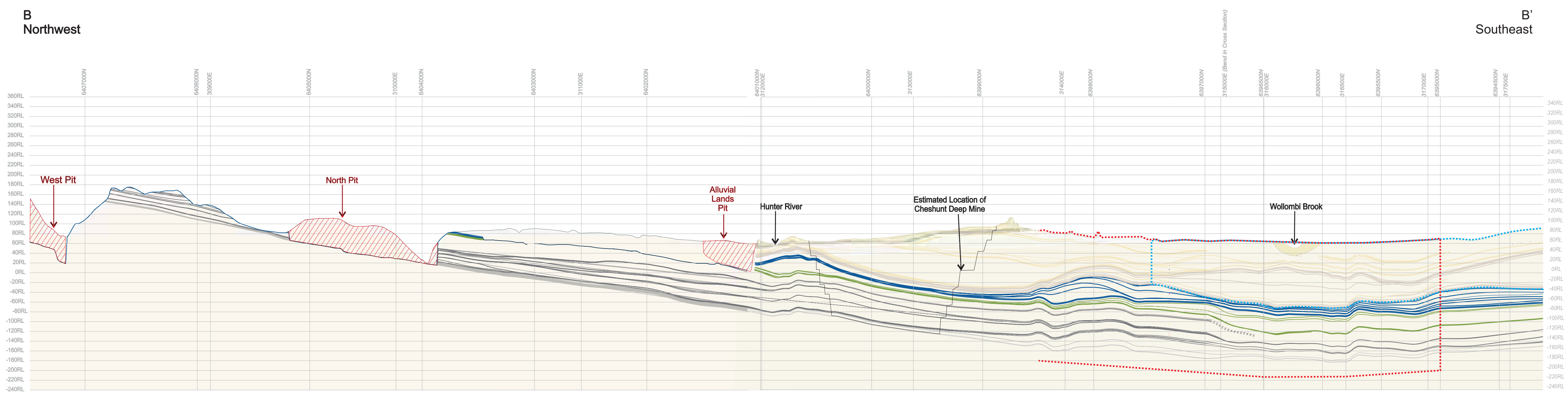

Legend

- Wambo Coal Seam
- Whynot Coal Seam
- Blakefield Coal Seam
- Glen Munro Coal Seam
- Woodlands Hill Coal Seam
- Arrowfield Coal Seam
- Bowfield Coal Seam
- Warkworth Coal Seam
- Mt Arthur Coal Seam
- Piercefield Coal Seam
- Vaux Coal Seam
- Broonie Coal Seam
- Bayswater Coal Seam
- Sandstone and Shale Interburden
- Unconsolidated Clays and Claybound Sands & Gravels
- RL Metres Relative to Australian Height Datum
- Estimated Surface Topography
- Estimated Mine Spoil Location
- Southern Edge of Model 1 Domain
- Northern Edge of Model 2 Domain

Figure 5

Geological Cross Section BB

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_45_R1
Date:	06/09/2007 Drawing size: A3
Drawn by:	SAC Reviewed by: SAC
Source:	CNA Geological Model
Scale:	Refer to Scale Bar (Horizontal)

0 500 1000m

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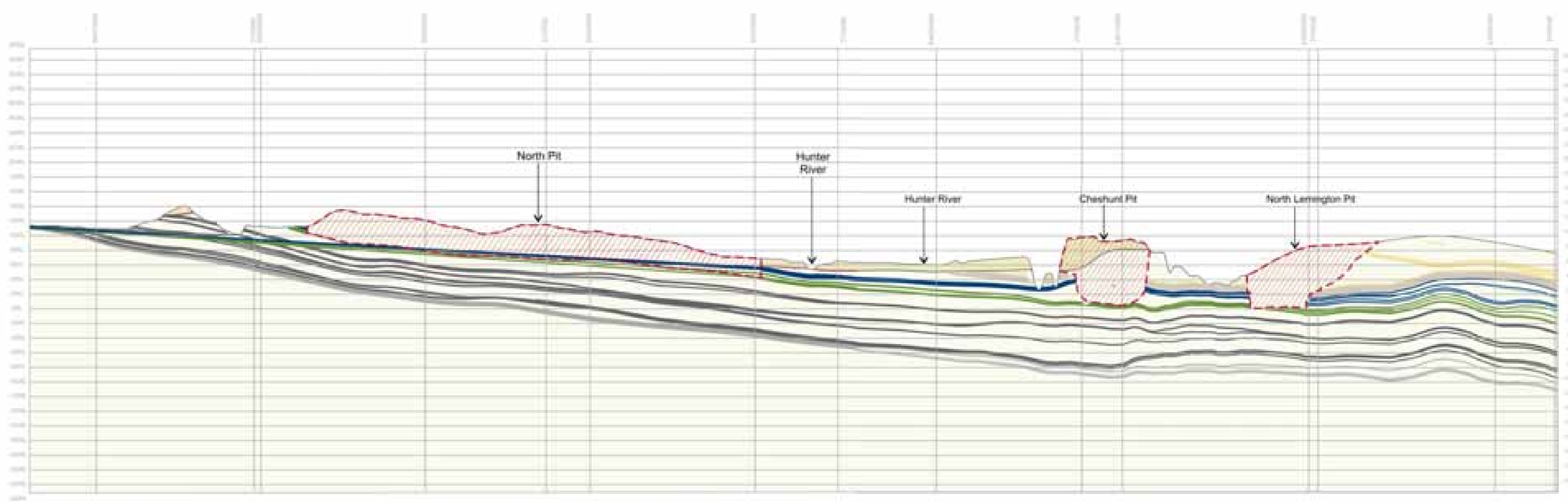

Figure 6

Geological Cross Section CC

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_23		
Date:	21/06/2007	Drawing size:	A3
Drawn by:	ML	Reviewed by:	SAC
Source:	CNA Geological Model		
Scale:	Refer to Scale Bar (Horizontal)		

0 250 500m

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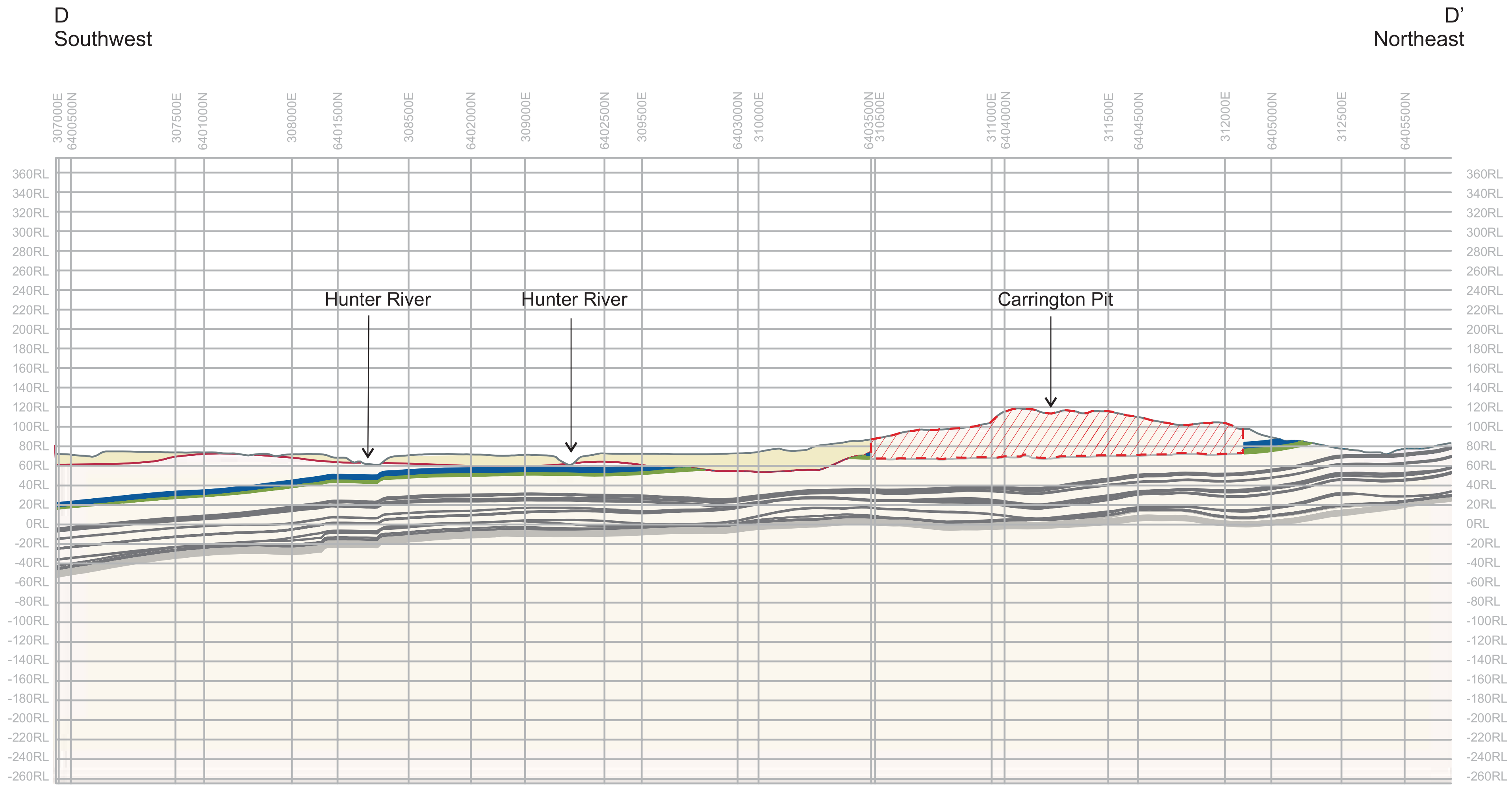

Legend

- Piercefield Coal Seam
- Vaux Coal Seam
- Broonie Coal Seam
- Bayswater Coal Seam
- Sandstone and Shale Interburden
- Unconsolidated Clays and Claybound Sands & Gravels
- RL Metres Relative to Australian Height Datum
- Estimated Surface Topography
- Estimated Mine Spoil Location

Figure 7

Geological Cross Section DD

Client: Coal & Allied Operations Pty Limited

Project: Hunter Valley Operations South Coal Project

Drawing No: 0064832s_24

Date: 21/06/2007 Drawing size: A3

Drawn by: ML Reviewed by: SAC

Source: CNA Geological Model

Scale: Refer to Scale Bar (Horizontal)

0 250 500m

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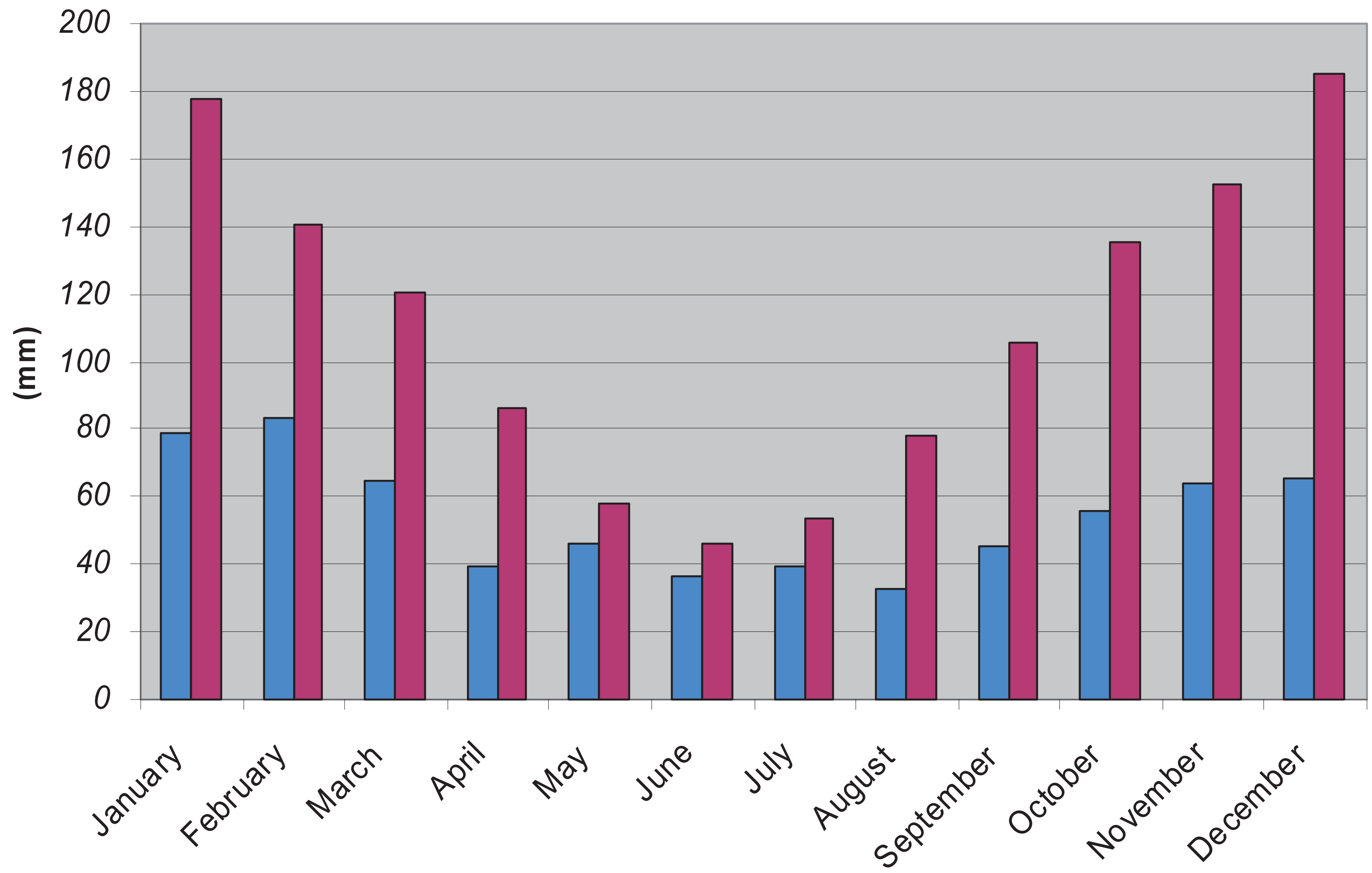

Legend

Rainfall - Jerrys Plain (BOM Station No.61086)

Evaporation - Cessnock (BOM Station No.61242)

Figure 8

Average Monthly Rainfall and Evaporation (1975-2006)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_25		
Date:	21/06/2007	Drawing size:	A4
Drawn by:	ML	Reviewed by:	SAC
Source:	-		
Scale:	N/A		

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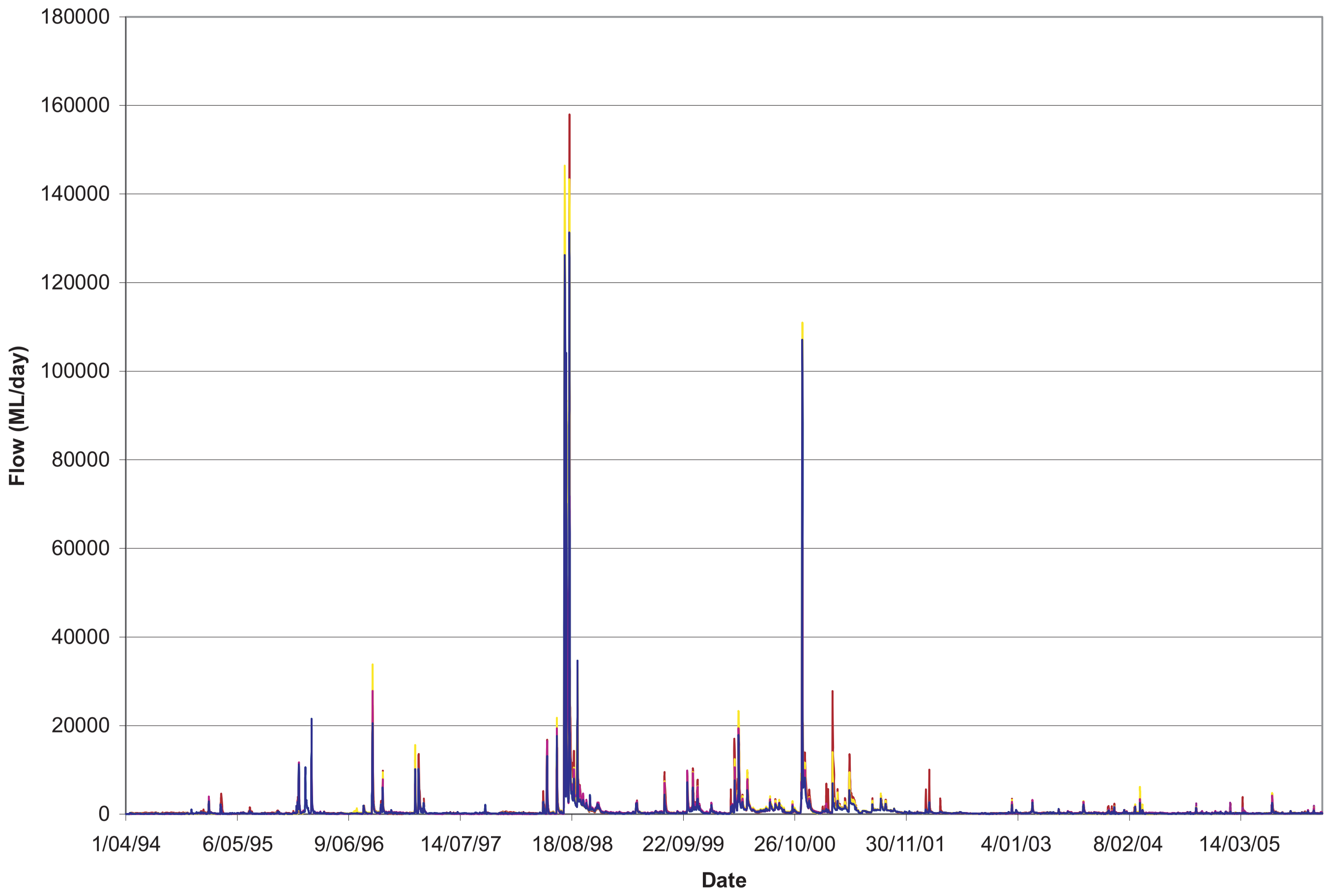

Legend

- Water Level Gauge 210134
- Water Level Gauge 210128
- Water Level Gauge 210127
- Water Level Gauge 210126
- Water Level Gauge 210125
- Water Level Gauge 210083

Figure 9

Hunter River Stream Flow Record 1995-2005

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_26		
Date:	21/06/2007	Drawing size:	A4
Drawn by:	ML	Reviewed by:	SAC
Source:	DNR PINEENA database		
Scale:	N/A		

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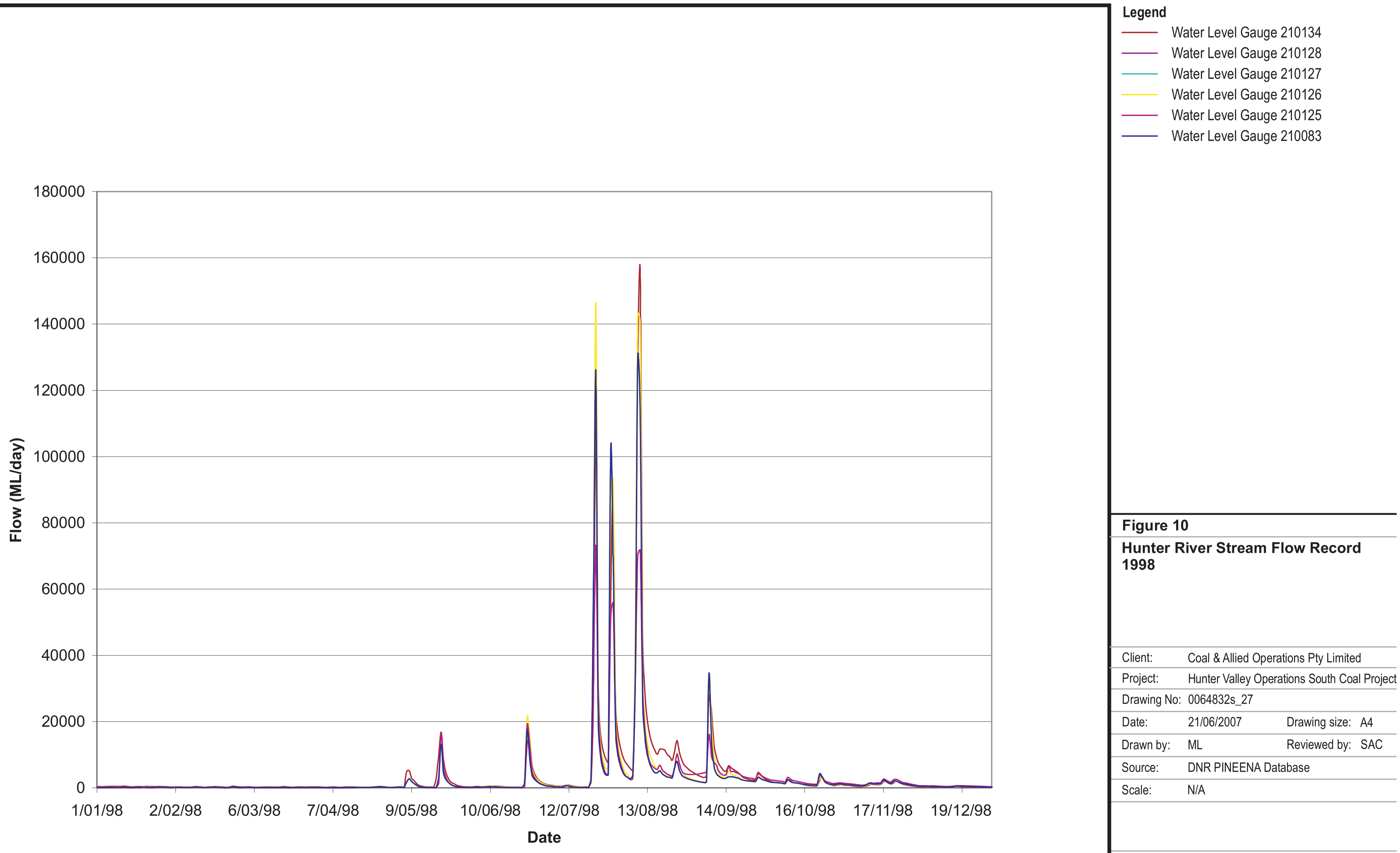

Figure 10

Hunter River Stream Flow Record 1998

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_27		
Date:	21/06/2007	Drawing size:	A4
Drawn by:	ML	Reviewed by:	SAC
Source:	DNR PINEENA Database		
Scale:	N/A		

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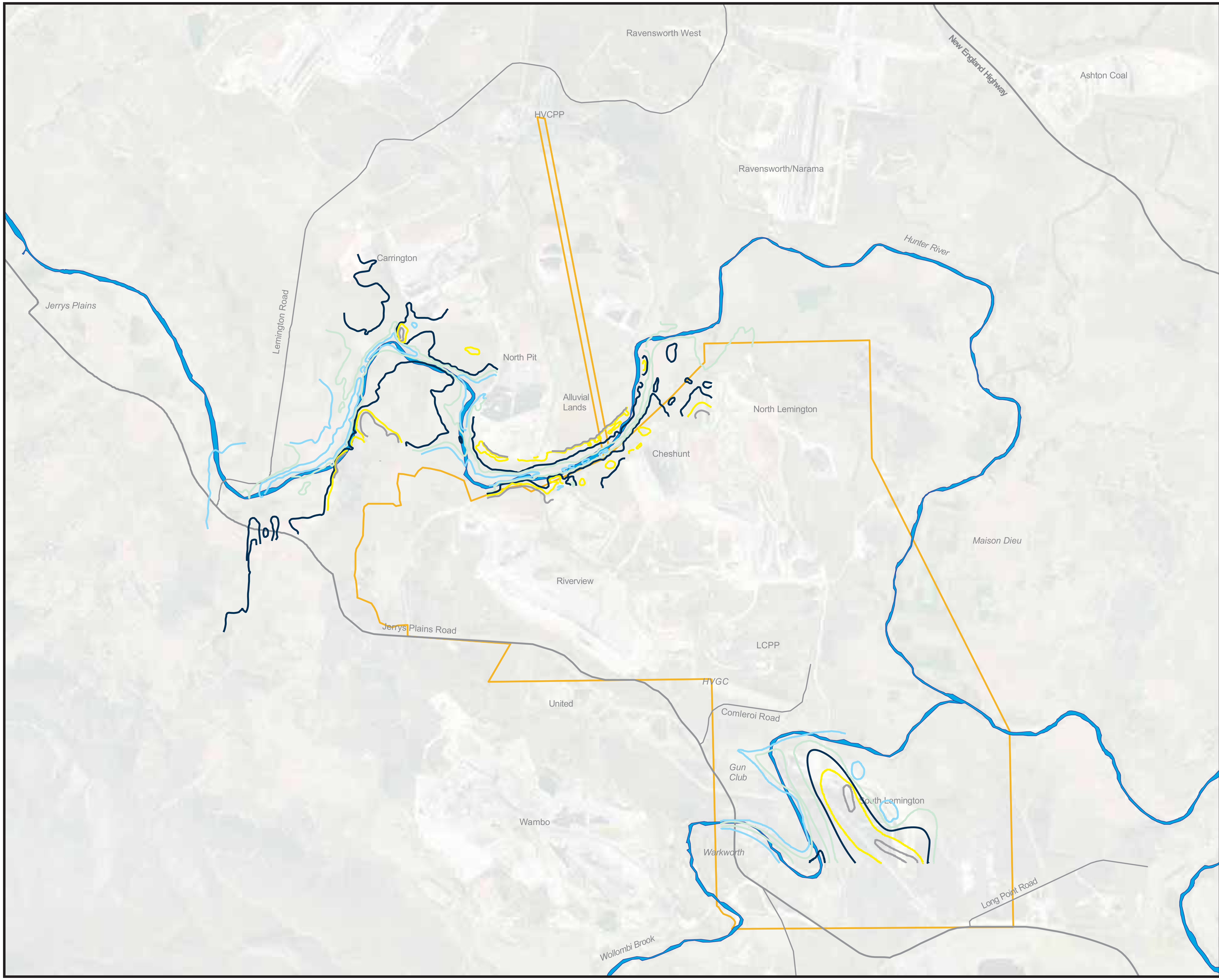

Figure 11

Alluvium Isopachs

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_28
Date:	24/10/2006 Drawing size: A3
Drawn by:	ML Reviewed by: SAC
Source:	CNA Bore Data
Scale:	Refer to Scale Bar

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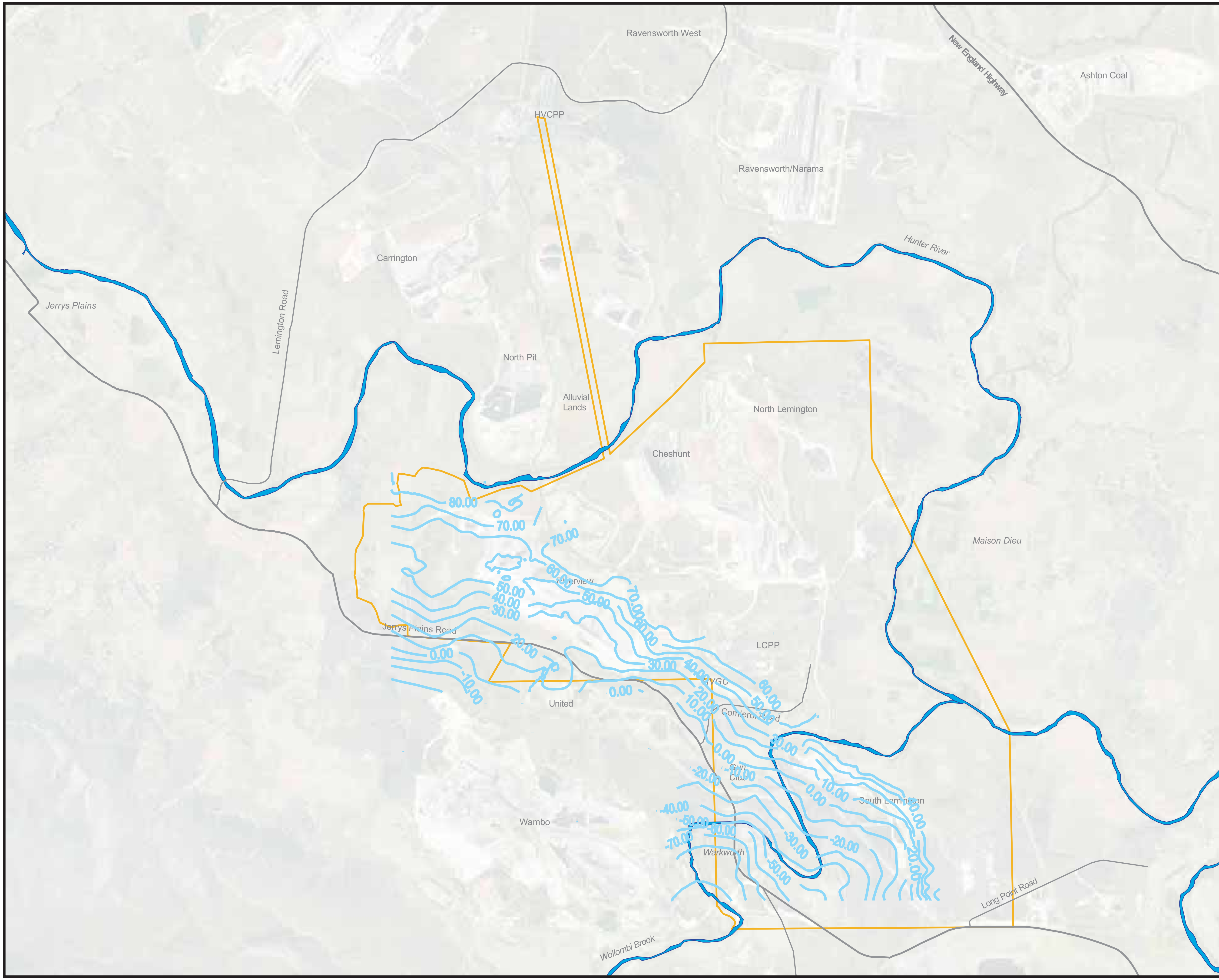

Legend

Current Development Consent Boundary

Contour (mAHD)

Figure 12

Elevation contous of the base of Bowfield Coal Seam

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_29
Date:	21/06/2007 — Drawing size: A3
Drawn by:	ML — Reviewed by: SAC
Source:	CNA Bore Data
Scale:	Refer to Scale Bar

N

0 1 2km

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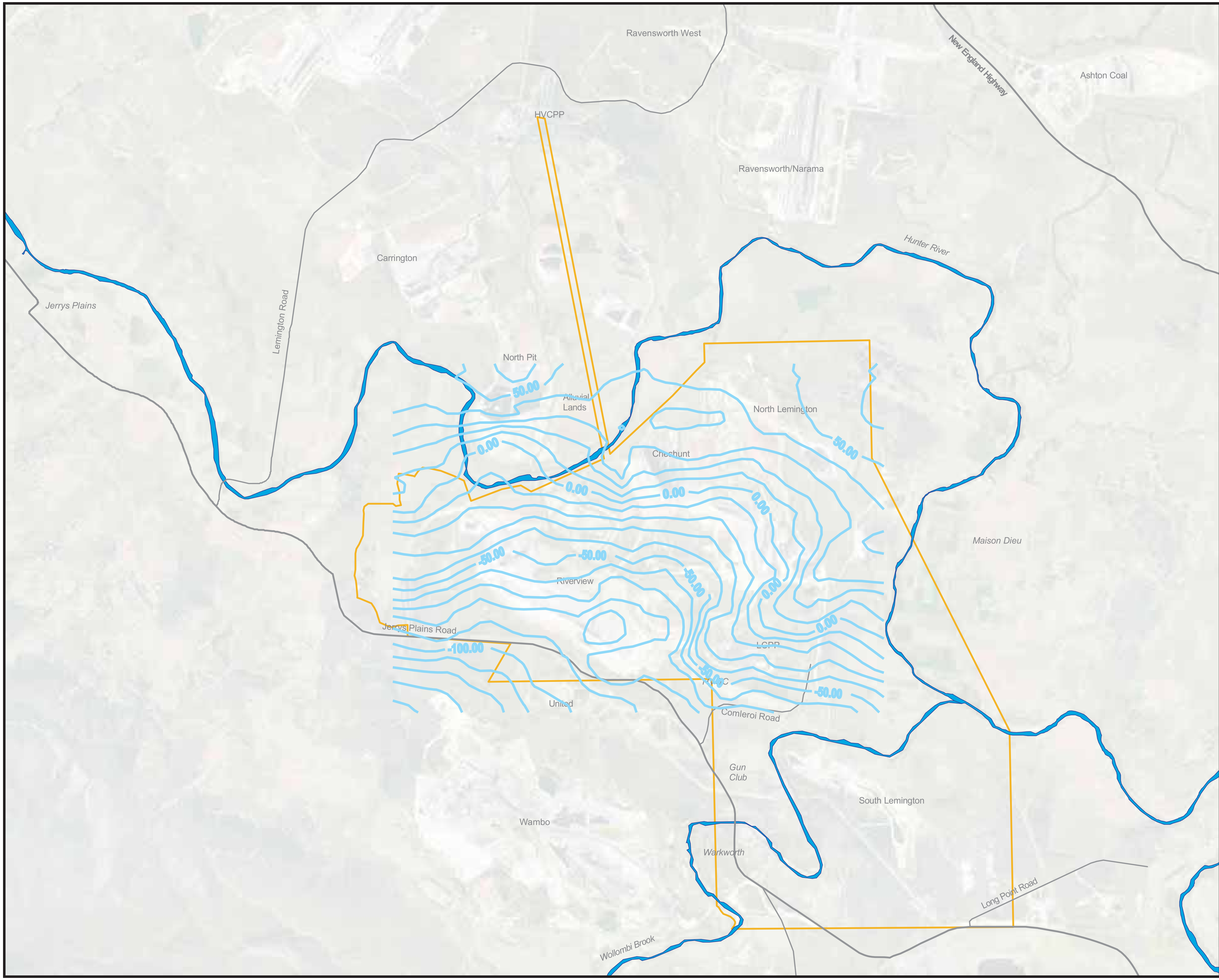

Legend

Current Development Consent Boundary

Contour (mAHD)

Figure 13

Elevation Contours of the base of Mt Arthur Coal Seam

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_30
Date:	21/06/2007 — Drawing size: A3
Drawn by:	ML — Reviewed by: SAC
Source:	CNA Bore Data
Scale:	Refer to Scale Bar

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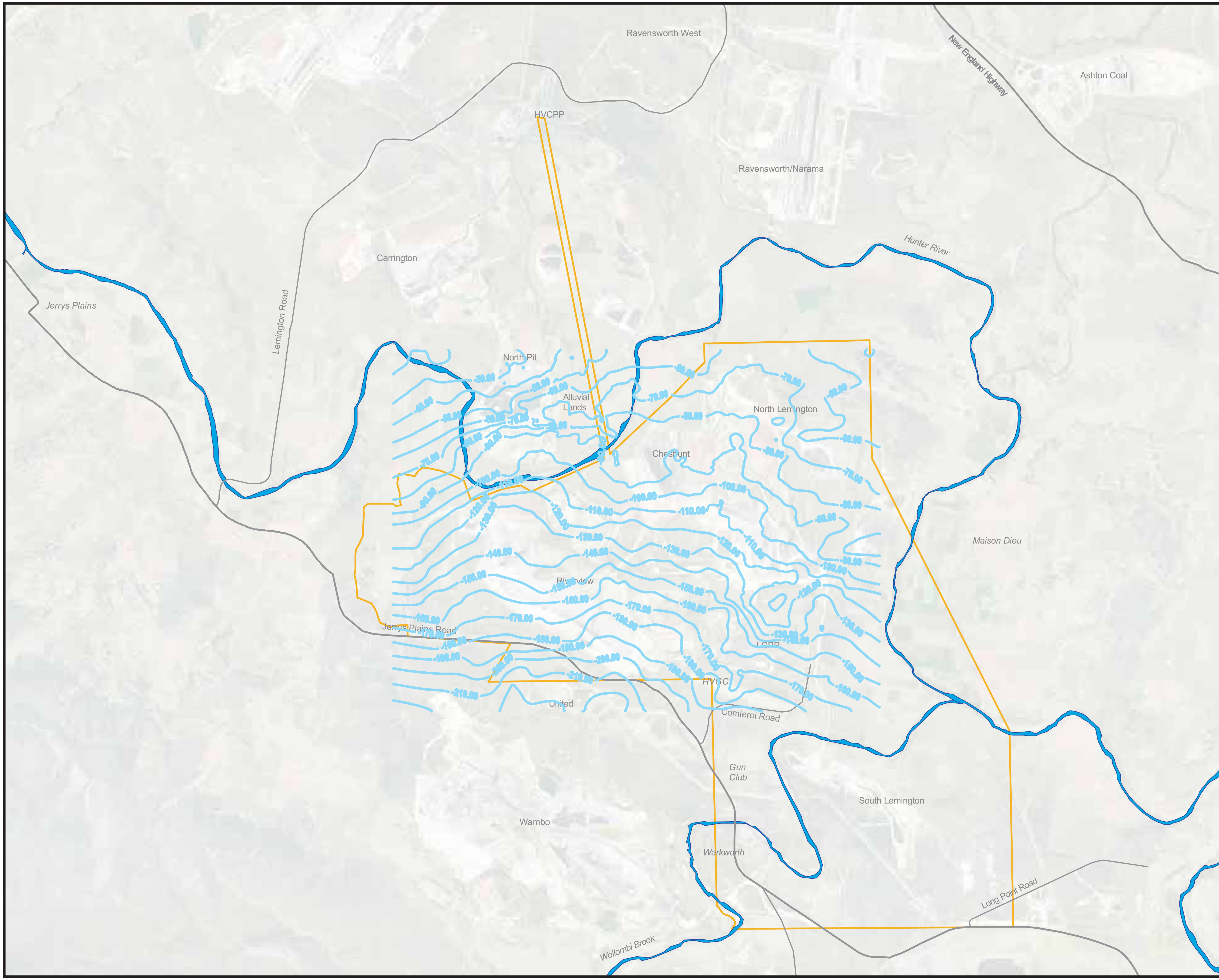

Legend

Current Development Consent Boundary

50.00 Contour (mAHD)

Figure 14

Elevation Contours of the base of Bayswater Coal Seam

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_31
Date:	21/06/2007 — Drawing size: A3
Drawn by:	ML — Reviewed by: SAC
Source:	CNA Bore Data
Scale:	Refer to Scale Bar

N — 0 1 2km

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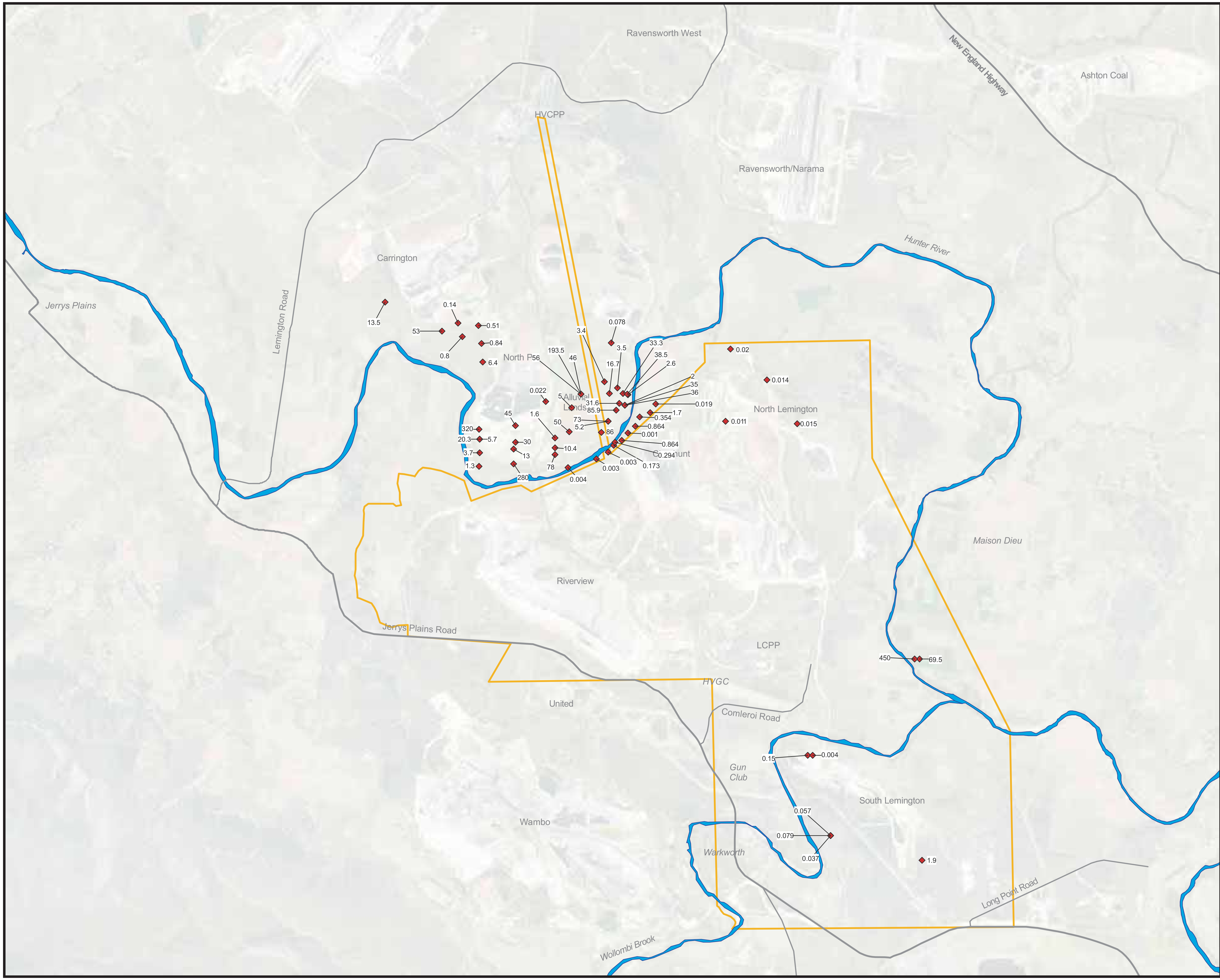

Legend

- Current Development Consent Boundary
- Borehole Location
- 0.014 Conductivity (m/day)

Figure 15

Reported Hydraulic Conductivities for Alluvial Deposits in the Study Area

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_32
Date:	25/10/2006 — Drawing size: A3
Drawn by:	ML — Reviewed by: SAC
Source:	CNA Bore Testing Data
Scale:	Refer to Scale Bar

N 0 1 2km

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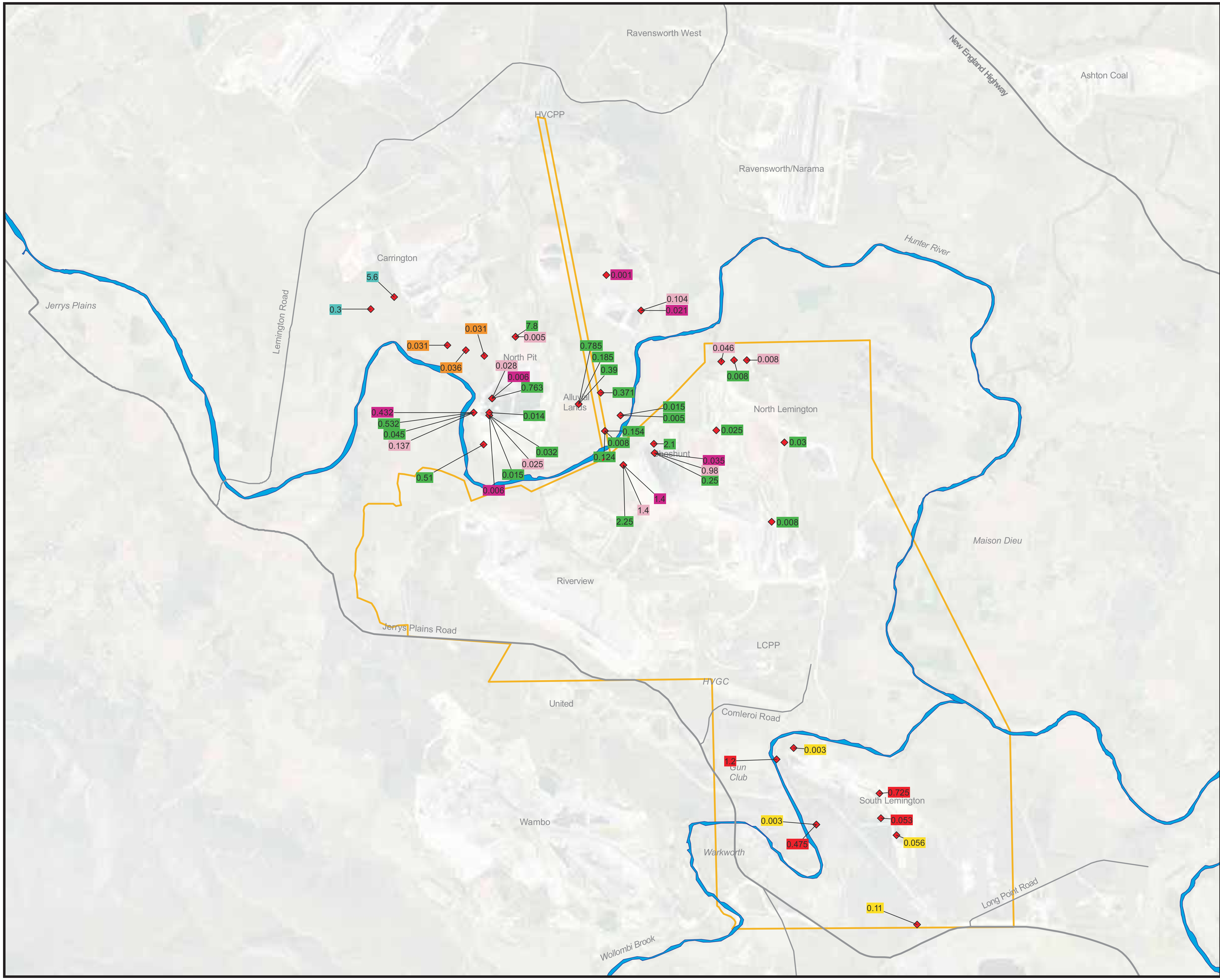

Legend

- Current Development Consent Boundary
- Borehole Location
- Woodlands Hill Seam
- Bowfield Seam
- Mt Arthur Seam
- Piercefield Seam
- Vaux Seam
- Broonie 1 Seam
- Bayswater Seam
- 0.725 Conductivity (m/day)

Figure 16

Reported Hydraulic Conductivities for the Coal Seams in the Study Area

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_33
Date:	21/06/2007 — Drawing size: A3
Drawn by:	ML — Reviewed by: SAC
Source:	CNA Bore Testing Data
Scale:	Refer to Scale Bar

N 0 1 2km

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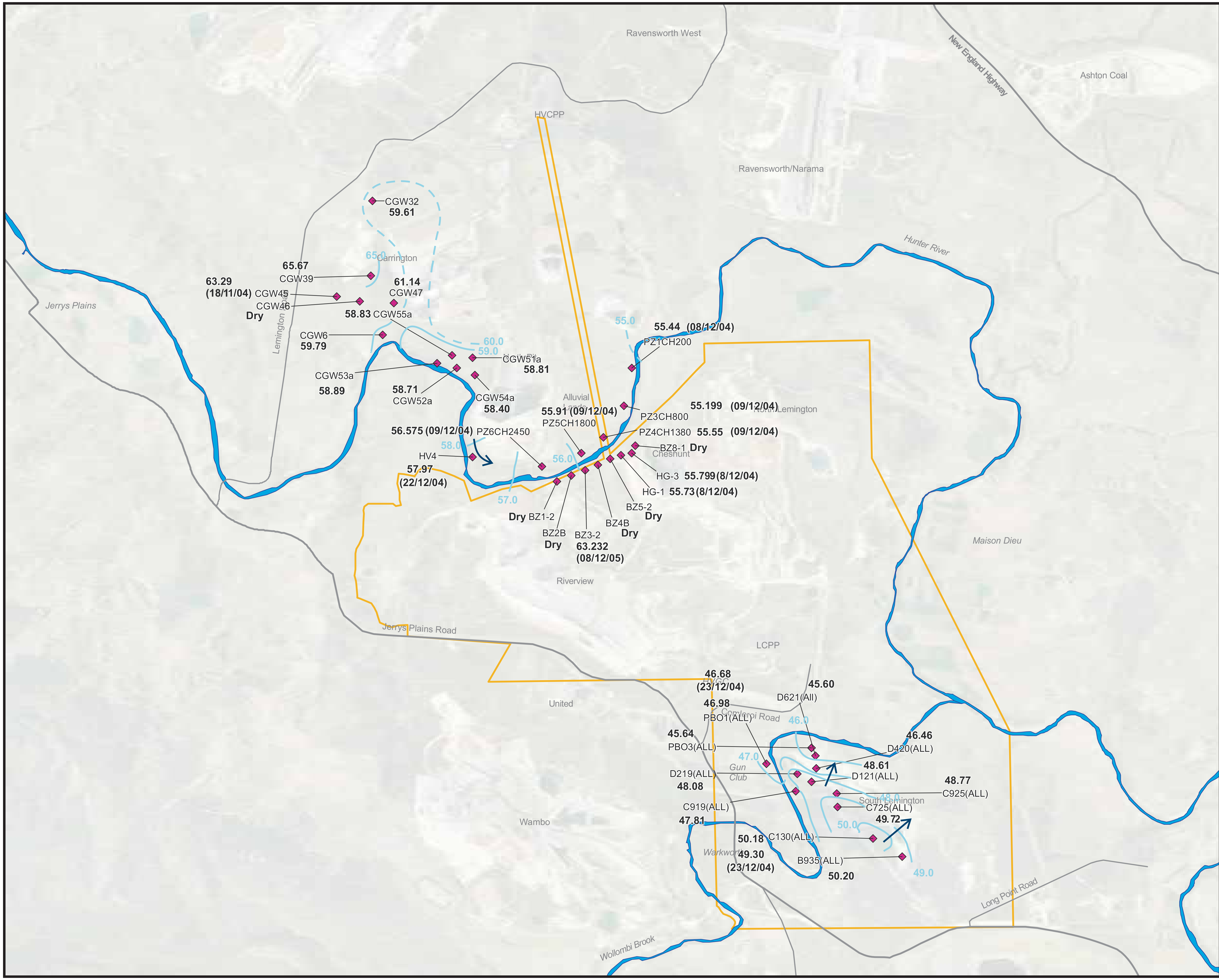

Legend

- Current Development Consent Boundary
- Well Locations
- **61.14** Groundwater Elevation (mAHD)
- Groundwater Elevation Contour (mAHD)
- Estimated Groundwater Flow Direction

Notes:

Groundwater elevations in northern areas are for the time period 20/01/05 unless otherwise stated.

Groundwater elevations in southern areas are for the time period 04/02/00 unless otherwise stated.

Figure 17

Groundwater Elevations and Piezometry in Alluvium and Unconsolidated Deposits

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_34		
Date:	18/09/2007	Drawing size:	A3
Drawn by:	GC	Reviewed by:	SAC
Source:	CNA Groundwater Monitoring Data		
Scale:	Refer to Scale Bar		

N

0 1 2km

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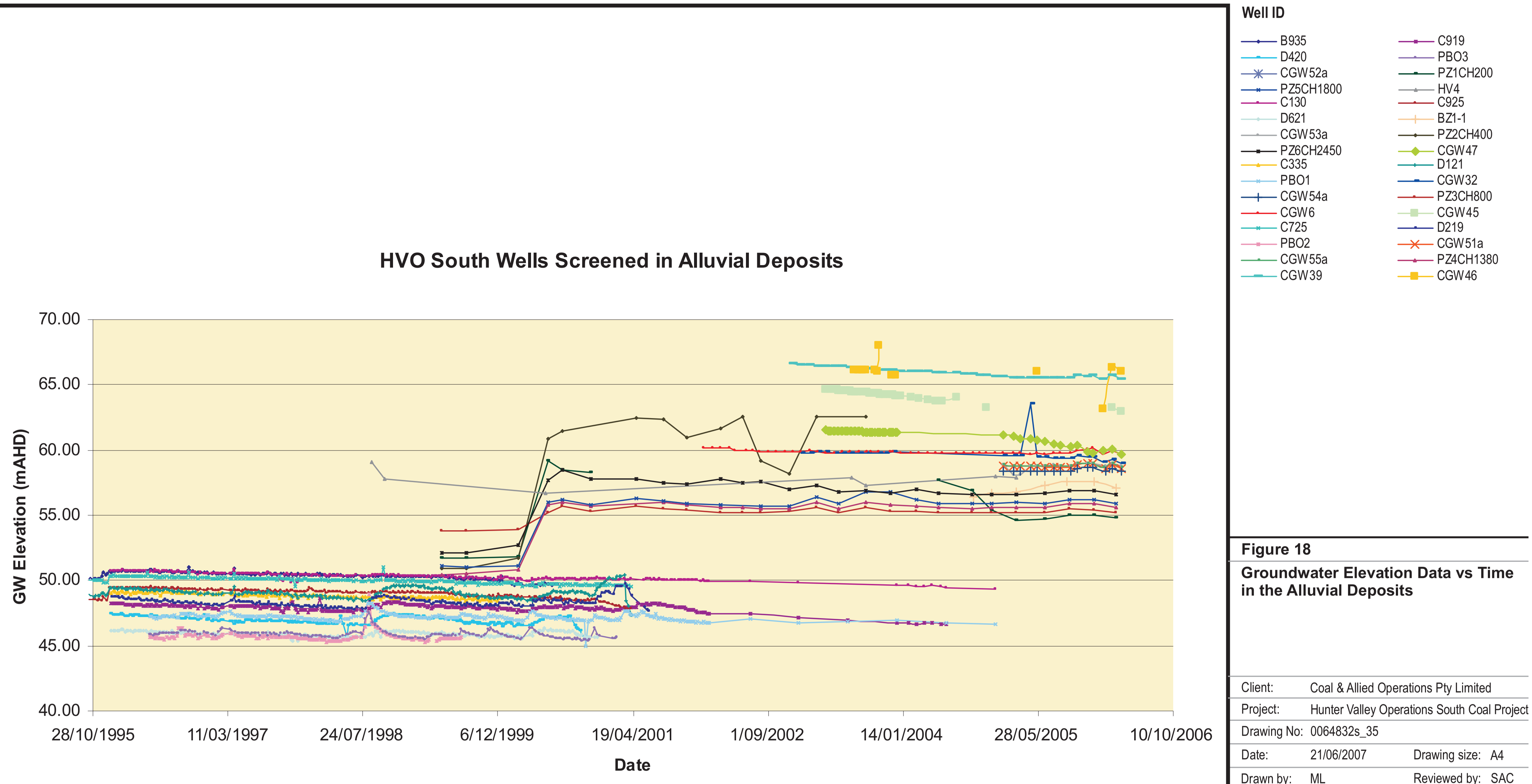

Figure 18

Groundwater Elevation Data vs Time in the Alluvial Deposits

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_35		
Date:	21/06/2007	Drawing size:	A4
Drawn by:	ML	Reviewed by:	SAC
Source:	CNA Bore hole monitoring network		
Scale:	N/A		

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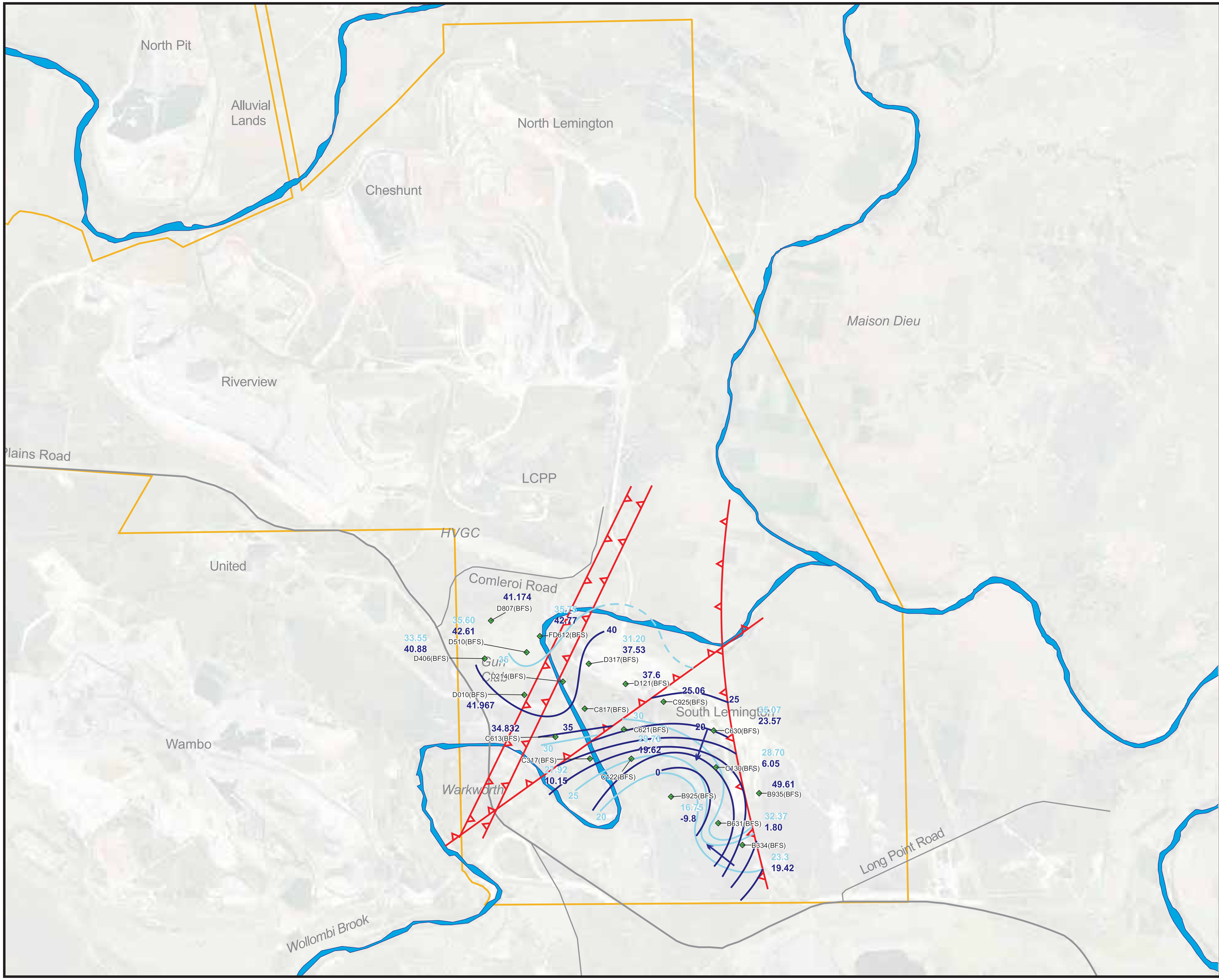

Legend

- Current Development Consent Boundary
- GWL Contours 05/03/01 (mAHD)
- GWL Contours 23/12/04 (mAHD)
- GW Flow Direction
- Fault

Figure 19

Groundwater Elevations and Piezometry in Bowfield Coal Seam

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_36
Date:	18/09/2007 — Drawing size: A3
Drawn by:	GC — Reviewed by: SAC
Source:	CNA Groundwater Monitoring Data
Scale:	Refer to Scale Bar

N

0 0.5 1km

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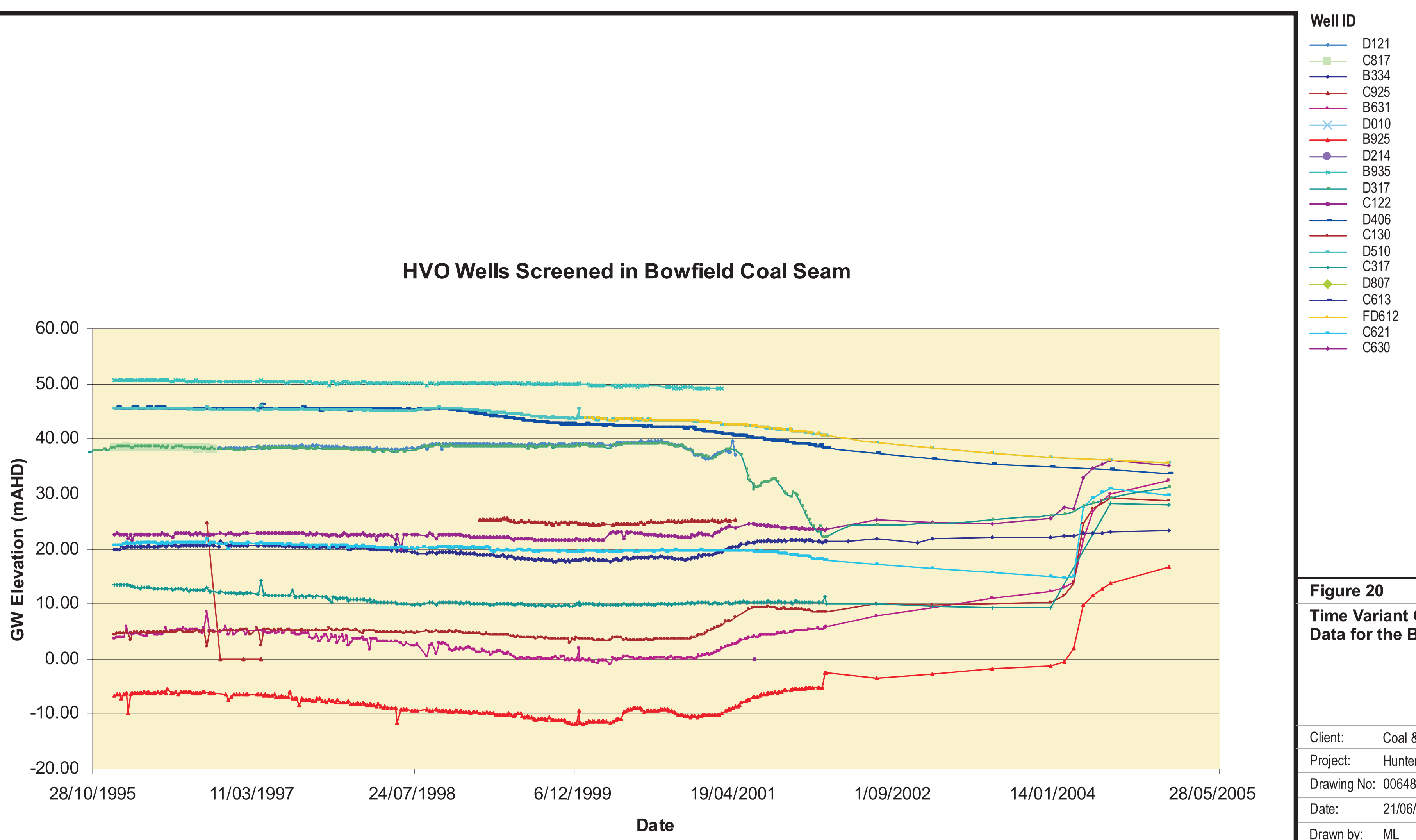

Figure 20

Time Variant Groundwater Elevation Data for the Bowfield Coal Seam

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_37
Date:	21/06/2007 Drawing size: A4
Drawn by:	ML Reviewed by: SAC
Source:	CNA Groundwater Monitoring Data
Scale:	N/A

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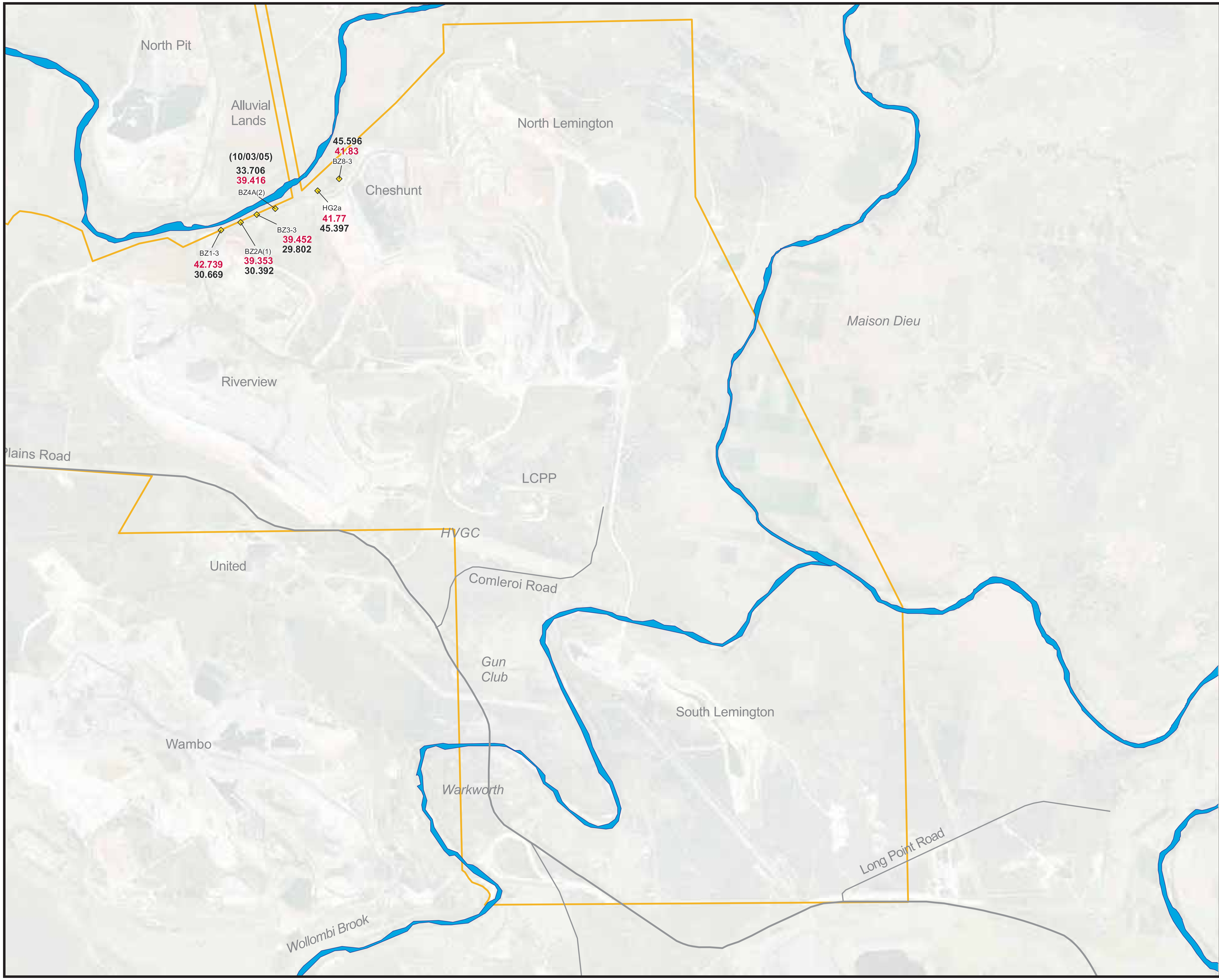

Legend

Current Development Consent Boundary

61.14 Groundwater Elevations on 08/12/04 (mAHD)

61.14 Groundwater Elevations on 14/03/06 (mAHD)

Figure 21

Groundwater Elevations and Piezometry in Mt Arthur Coal Seam

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_38
Date:	21/06/2007 Drawing size: A3
Drawn by:	ML Reviewed by: SAC
Source:	CNA Groundwater Monitoring Data
Scale:	Refer to Scale Bar

N

0 0.5 1km

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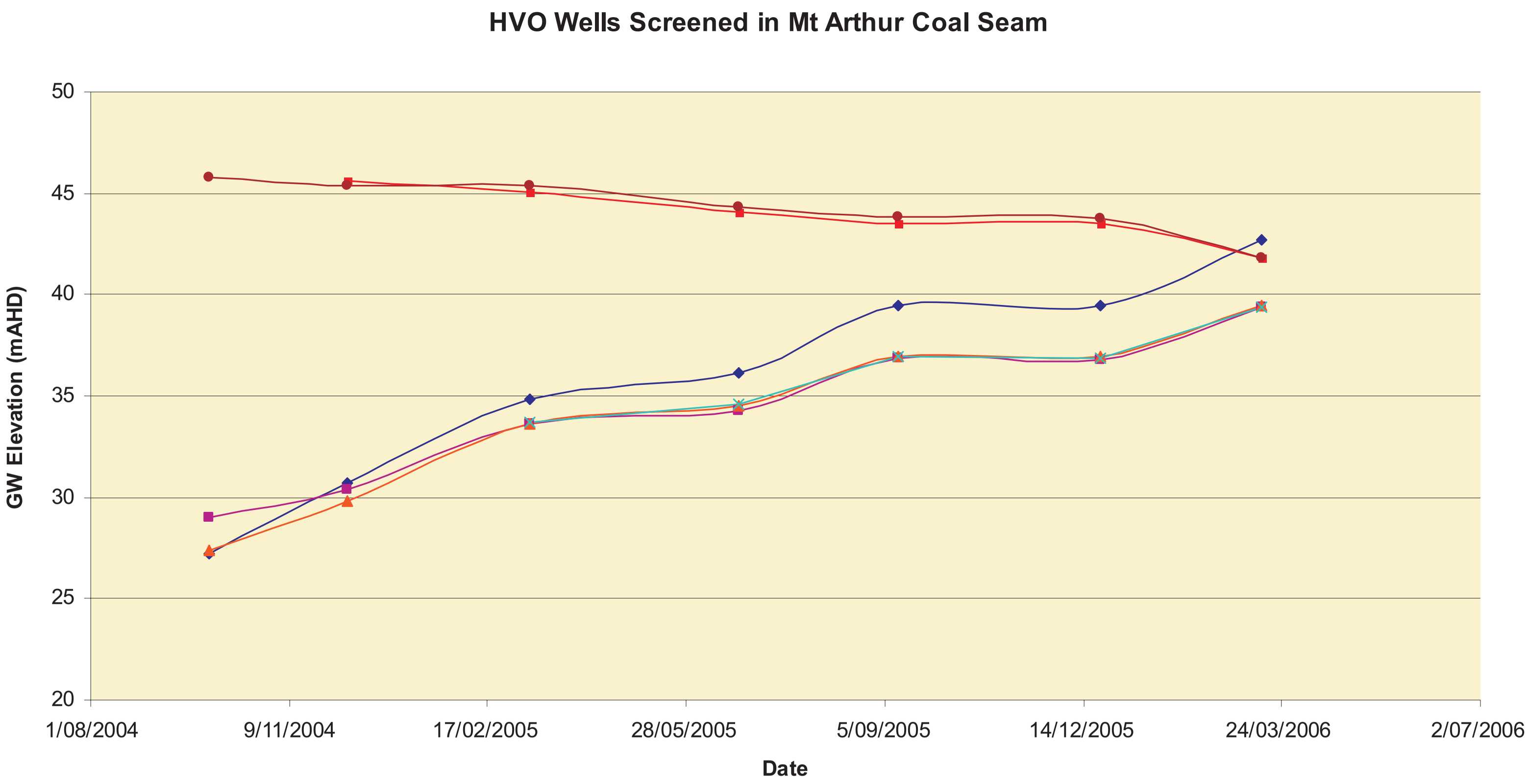

Well ID

- BZ1-3
- BZ2A(1)
- BZ3-3
- BZ4A(2)
- BZ8-3
- HG2A

Figure 22

Time Variant Groundwater Elevation Data for the Mt Arthur Coal Seam

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_39		
Date:	21/06/2007	Drawing size:	A4
Drawn by:	ML	Reviewed by:	SAC
Source:	CNA Groundwater Monitoring Data		
Scale:	N/A		

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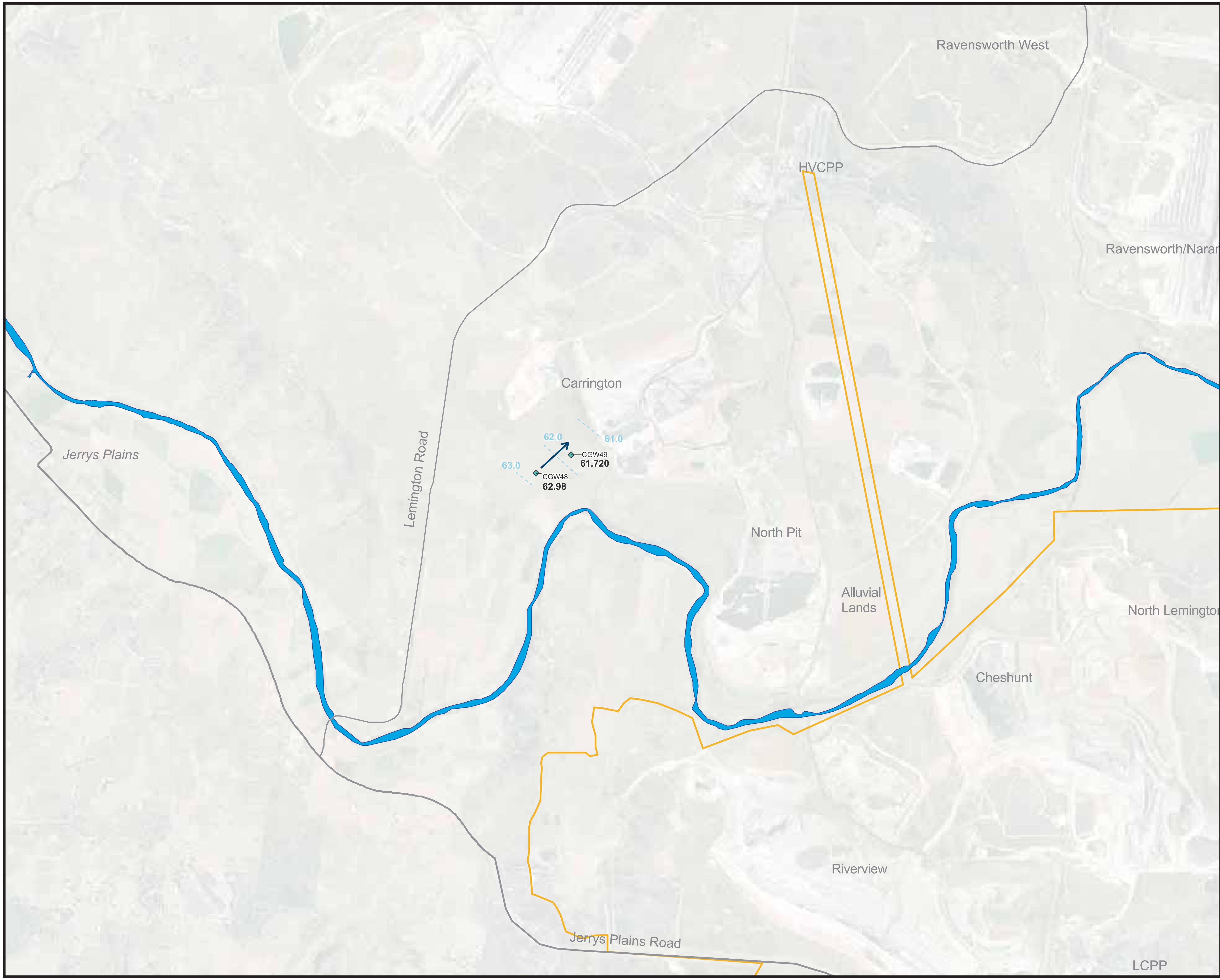

Legend

- Current Development Consent Boundary
- **61.14** Groundwater Elevations on 20/01/05 (mAHD)
- Estimated (mAHD) Groundwater Elevation Contour
- Estimated Groundwater Flow Direction

Figure 23

Groundwater Elevations and Piezometry in Bayswater Coal Seam

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_40
Date:	21/06/2007 Drawing size: A3
Drawn by:	ML Reviewed by: SAC
Source:	CNA Groundwater Monitoring Data
Scale:	Refer to Scale Bar

N 0 0.5 1km

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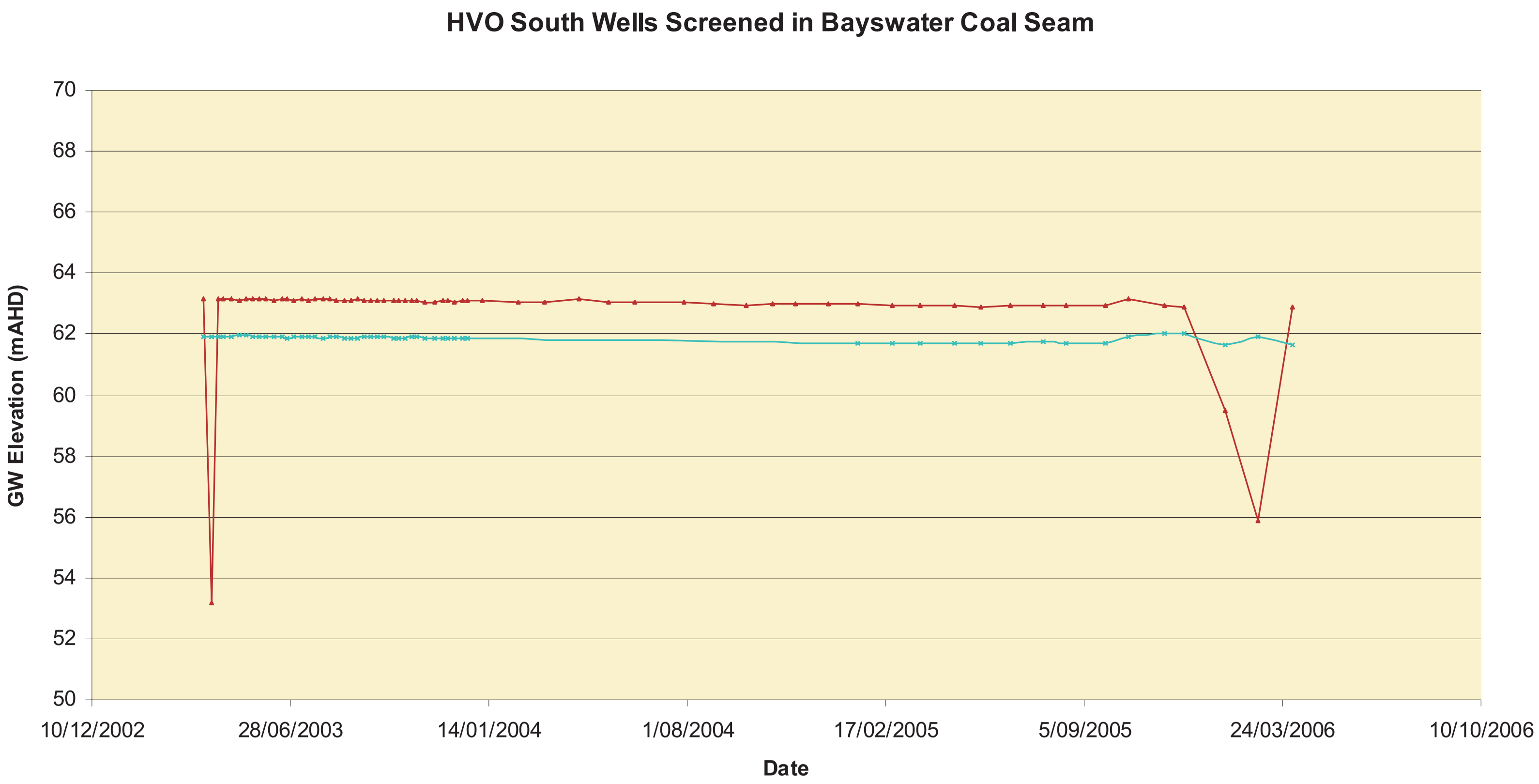

Figure 24

Time Variant Groundwater Elevation Data for the Bayswater Coal Seam

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_41
Date:	21/06/2007 Drawing size: A4
Drawn by:	ML Reviewed by: SAC
Source:	CNA Groundwater Monitoring Data
Scale:	N/A

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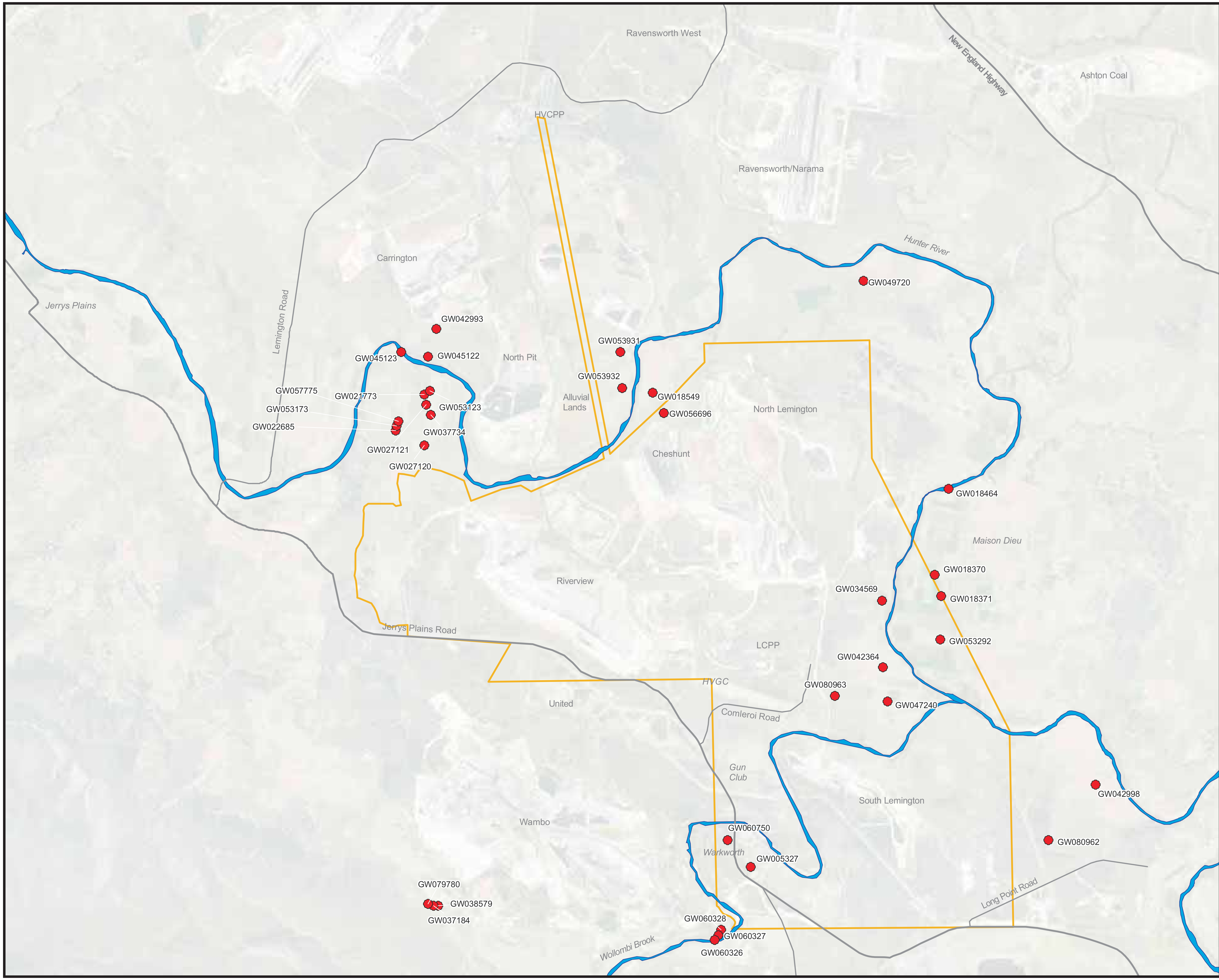

Legend

Current Development Consent Boundary

Listed DWE Bores

Figure 25

Registered DWE Water Wells within the HVO South Area

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_42_R1
Date:	06/09/2007 Drawing size: A3
Drawn by:	GC Reviewed by: SAC
Source:	DWE Registered Bore Data
Scale:	Refer to Scale Bar

N

0 1 2km

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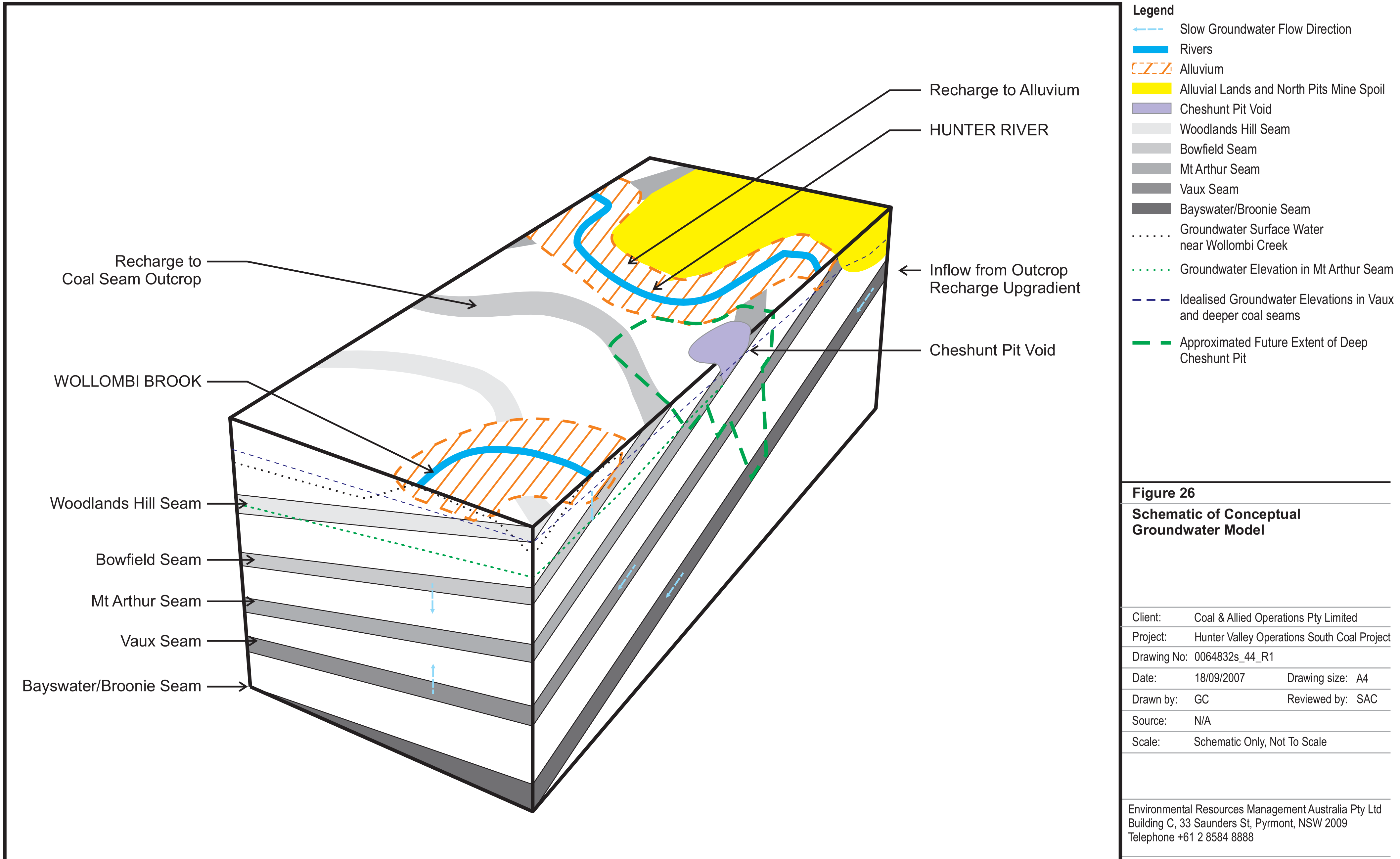

Figure 26

Schematic of Conceptual Groundwater Model

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_44_R1		
Date:	18/09/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SAC
Source:	N/A		
Scale:	Schematic Only, Not To Scale		

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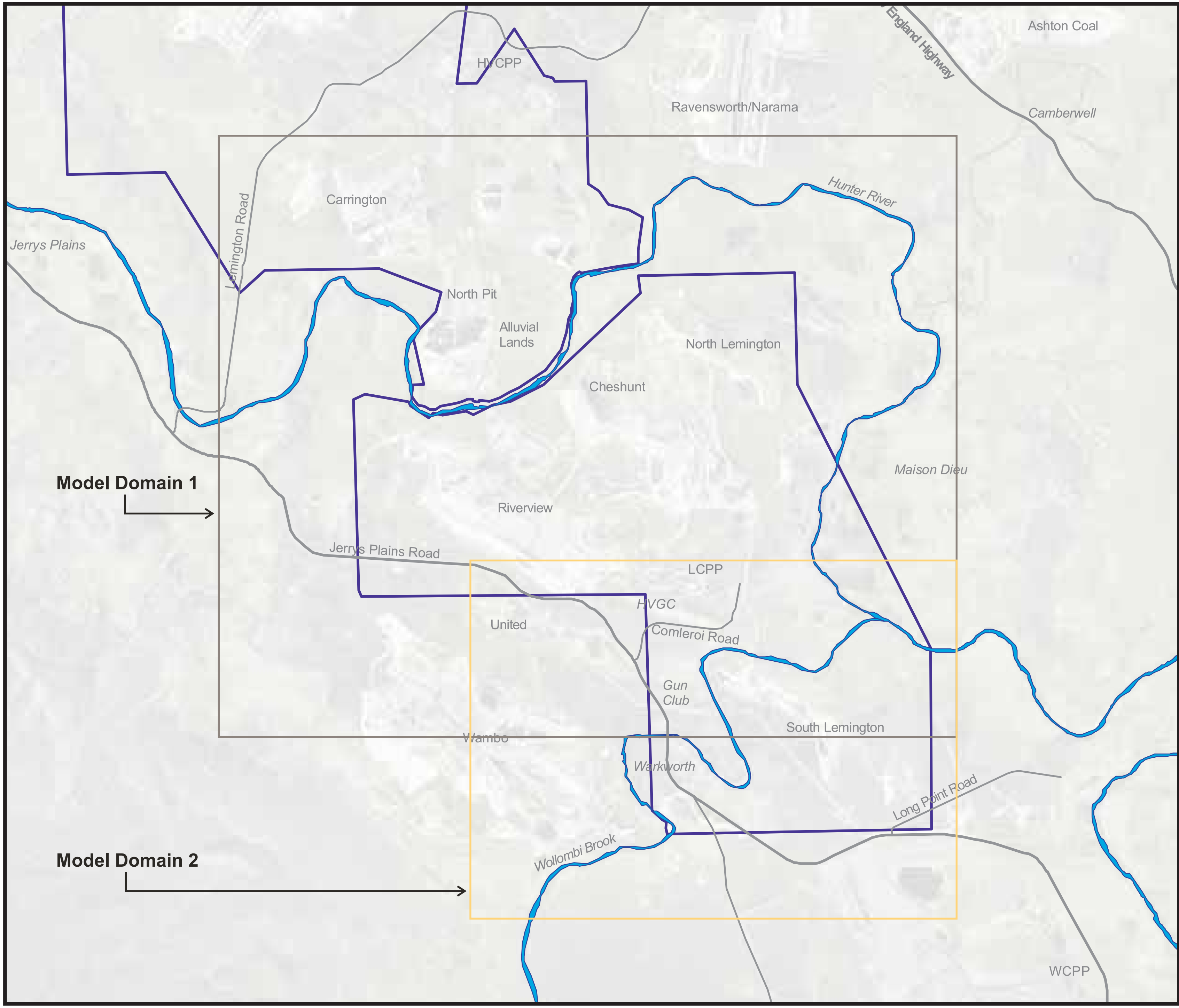

Legend
Current Mining Lease Boundary
Model Domain 1
Model Domain 2

Figure 27
Model Domain Locations

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_43		
Date:	21/06/2007	Drawing size:	A4
Drawn by:	ML	Reviewed by:	SAC
Source:	N/A		
Scale:	Refer to Scale Bar		

N
0 1 2 3km

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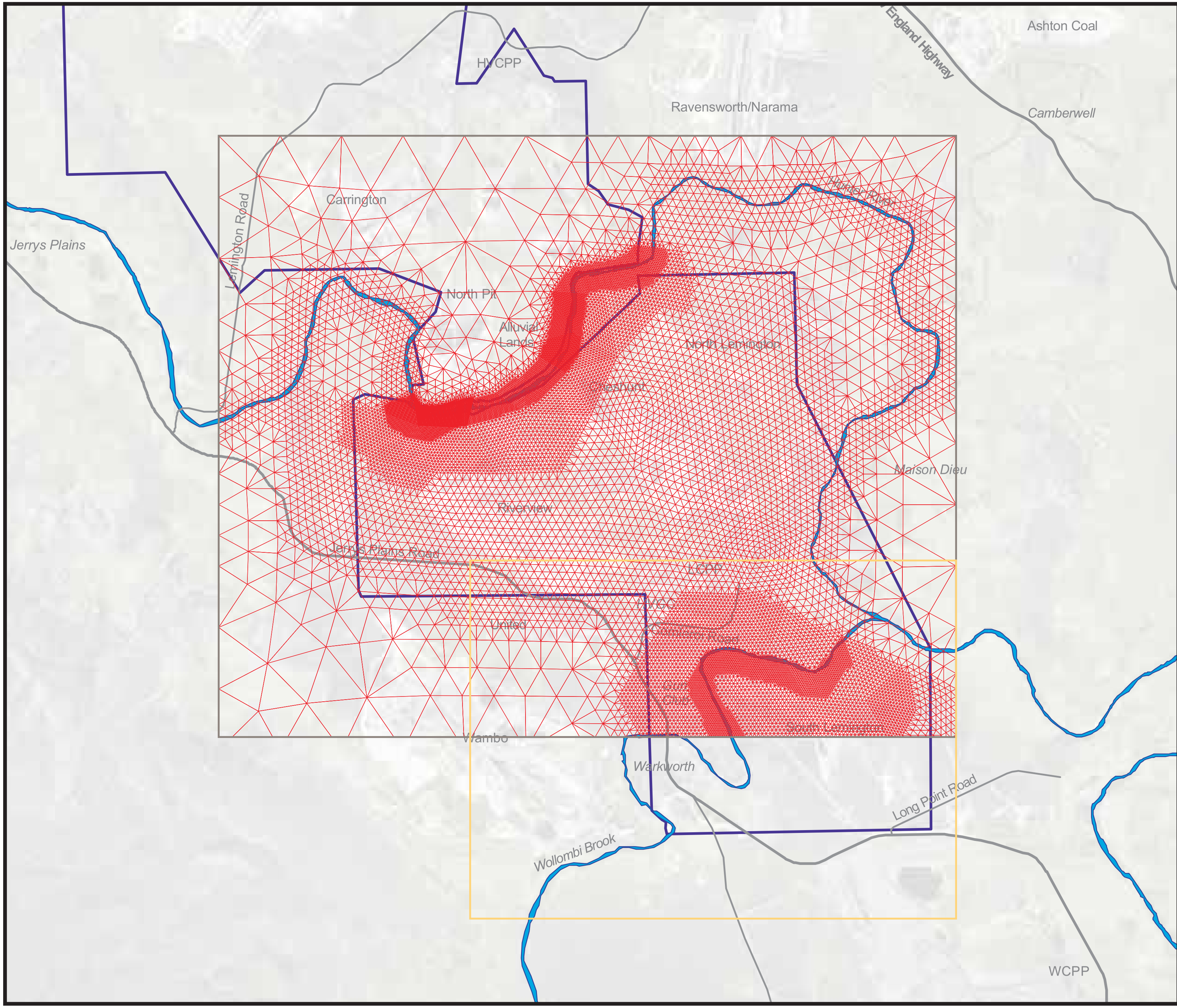

Legend

- Current Mining Lease Boundary
- Model Domain 1
- Model Domain 2

Figure 28

Model 1 Mesh Design

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_03		
Date:	24/05/2007	Drawing size:	A4
Drawn by:	ML	Reviewed by:	SAC
Source:	N/A		
Scale:	Refer to Scale Bar		

N

0 1 2 3km

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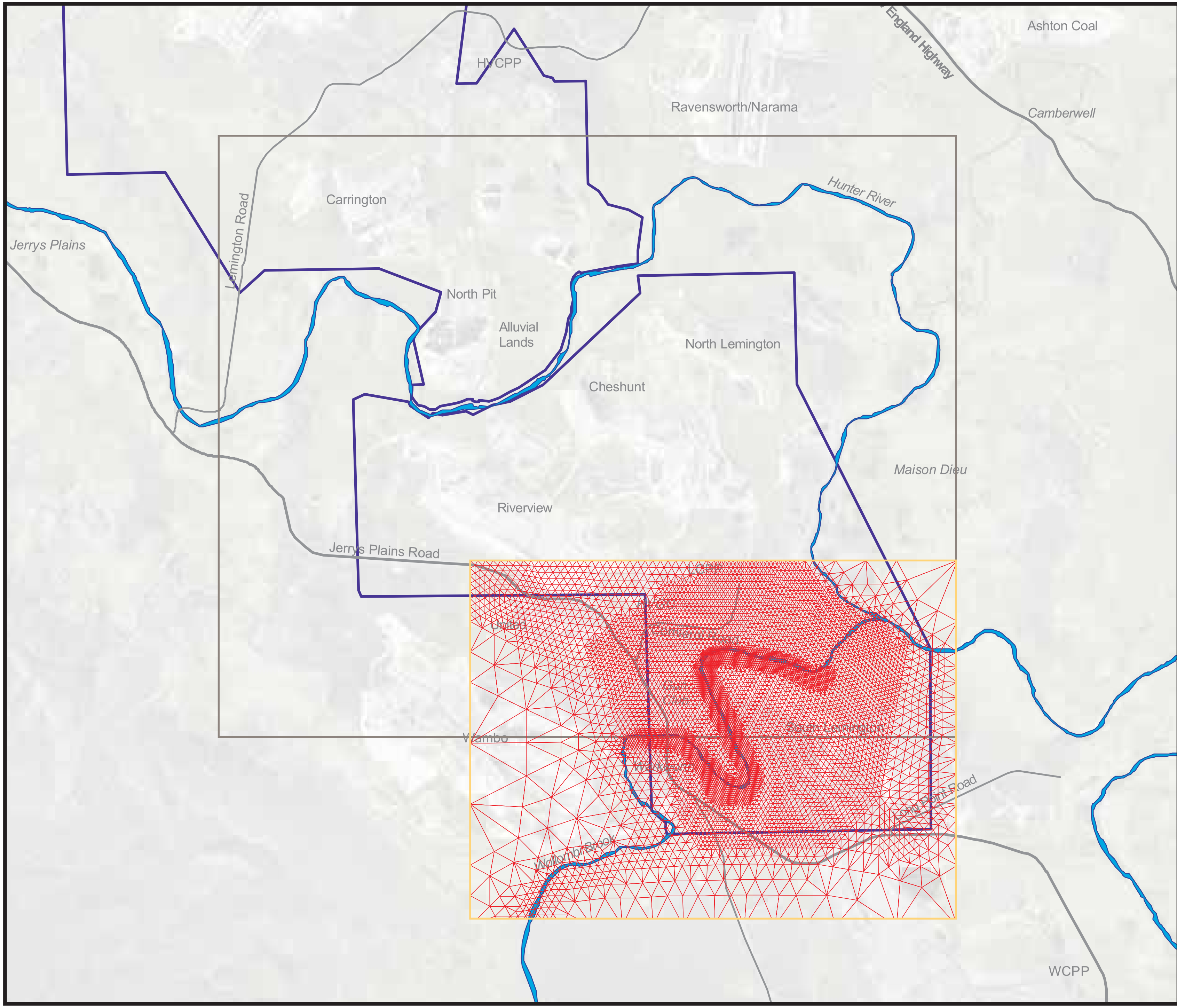

Legend

- Current Mining Lease Boundary
- Model Domain 1
- Model Domain 2

Figure 29

Model 2 Mesh Design

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_04
Date:	24/05/2007 — Drawing size: A4
Drawn by:	GC — Reviewed by: SAC
Source:	N/A
Scale:	Refer to Scale Bar

N

0 1 2 3km

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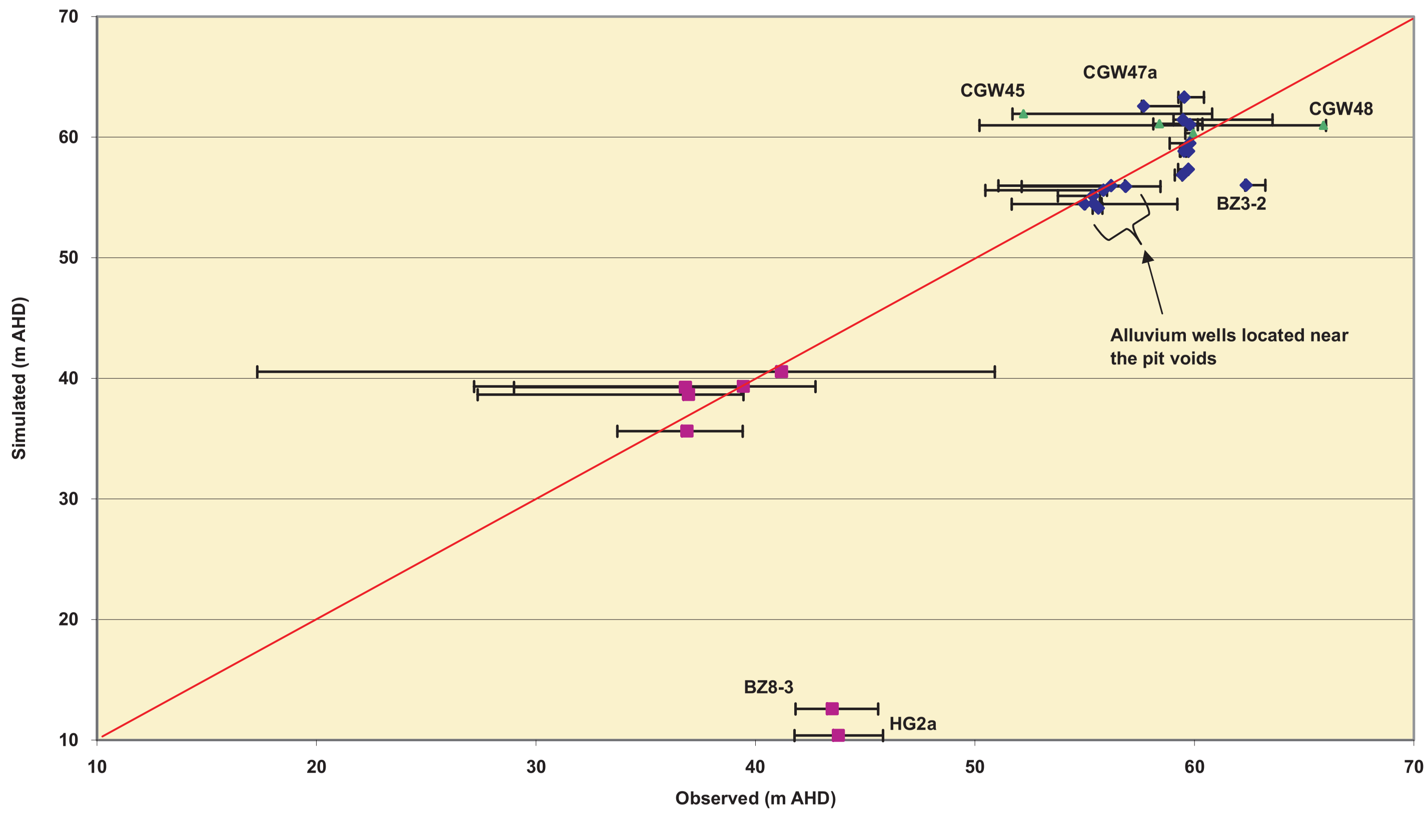

Figure 30

Observed versus Simulated Groundwater Elevations for Model 1

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_05		
Date:	24/05/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SAC
Source:	N/A		
Scale:	N/A		

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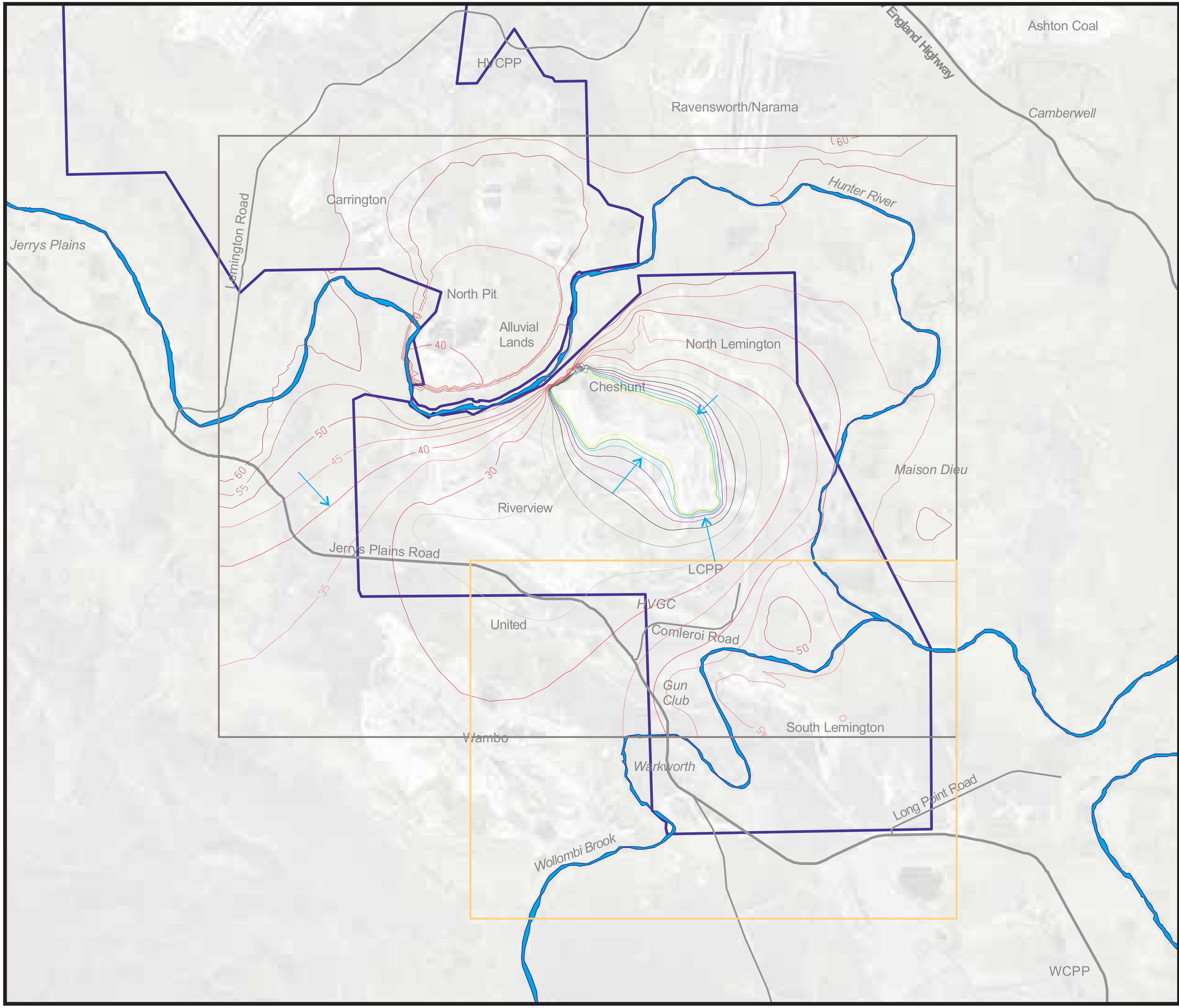

Legend

- Current Mining Lease Boundary
- Model Domain 1
- Model Domain 2
- GWL Contour (mAHD)
- Groundwater Flow Direction

Figure 31a

Model 1 Simulated Phreatic Surface including Alluvium Piezometry

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_06		
Date:	24/05/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SAC
Source:	N/A		
Scale:	Refer to Scale Bar		

N

0 1 2 3km

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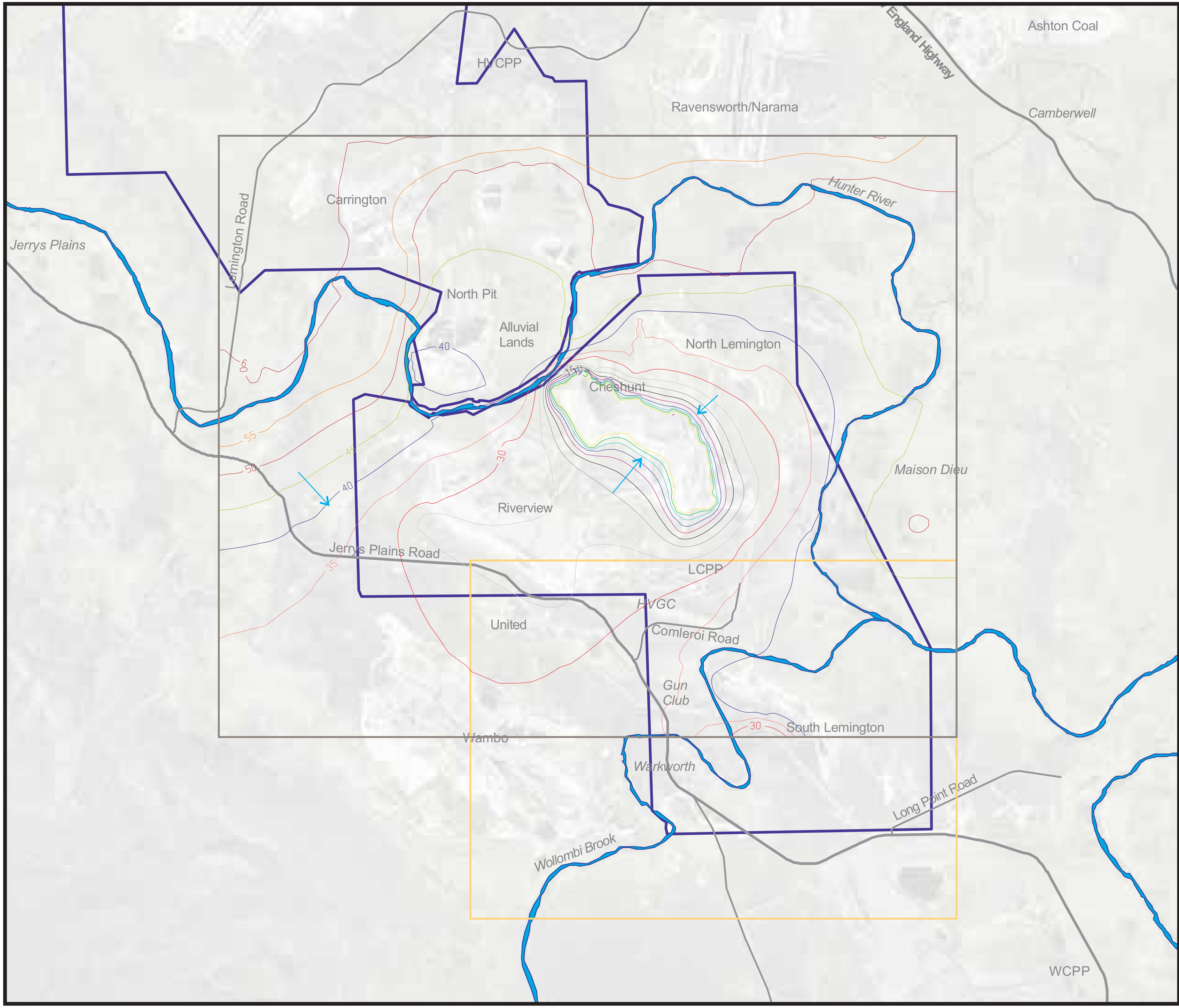
ERM



Legend

- Current Mining Lease Boundary
- Model Domain 1
- Model Domain 2
- GWL Contour (mAHD)
- Groundwater Flow Direction

Figure 31b

Model 1 Simulated Piezometry within Mt. Arthur Coal Seam

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_08		
Date:	24/05/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SAC
Source:	N/A		
Scale:	Refer to Scale Bar		

N

0 1 2 3km

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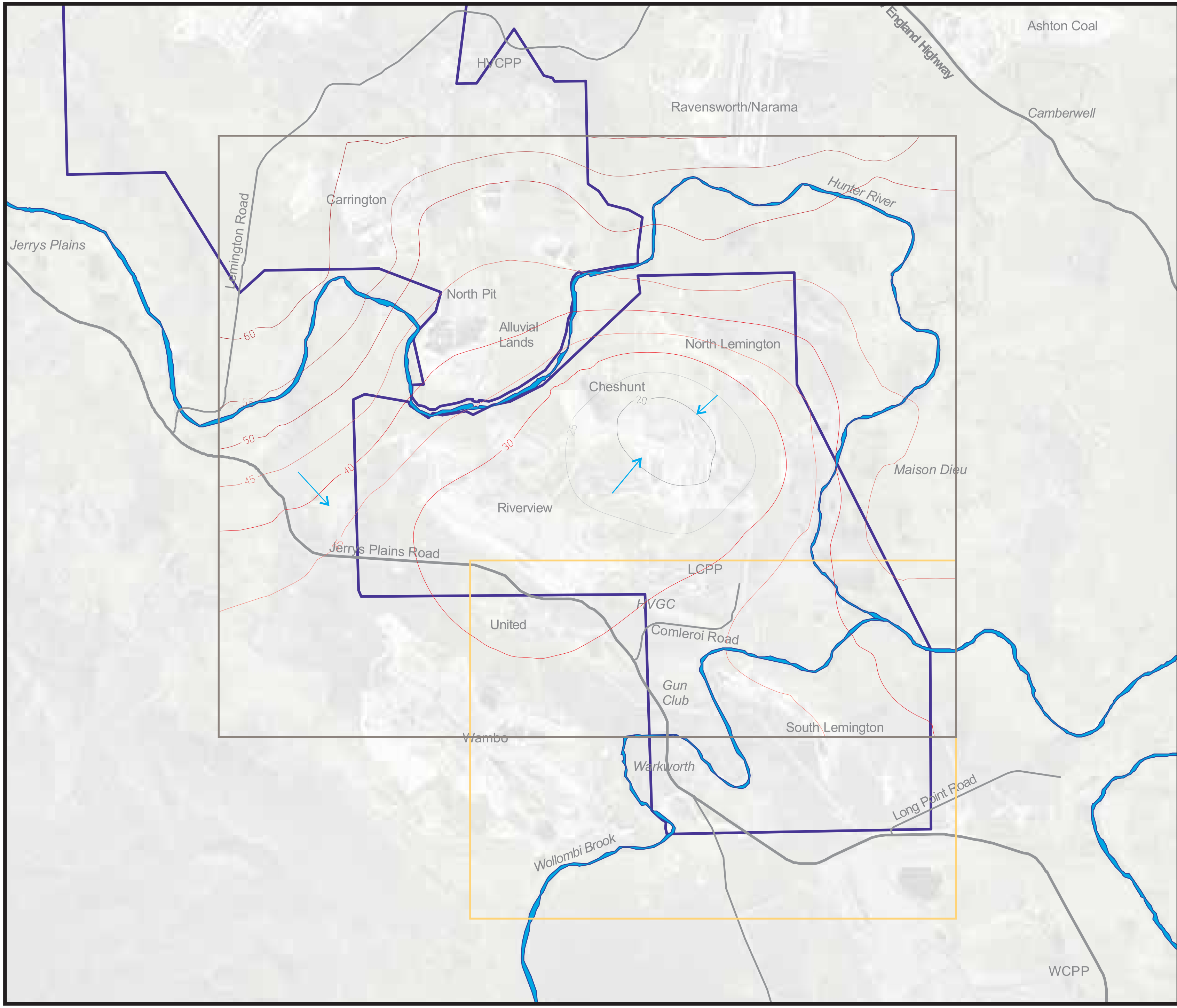

Legend

- Current Mining Lease Boundary
- Model Domain 1
- Model Domain 2
- GWL Contour (mAHD)
- Groundwater Flow Direction

Figure 31c

Model 1 Simulated Piezometry within Bayswater Coal Seam

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_07		
Date:	24/05/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SAC
Source:	N/A		
Scale:	Refer to Scale Bar		

N

0 1 2 3km

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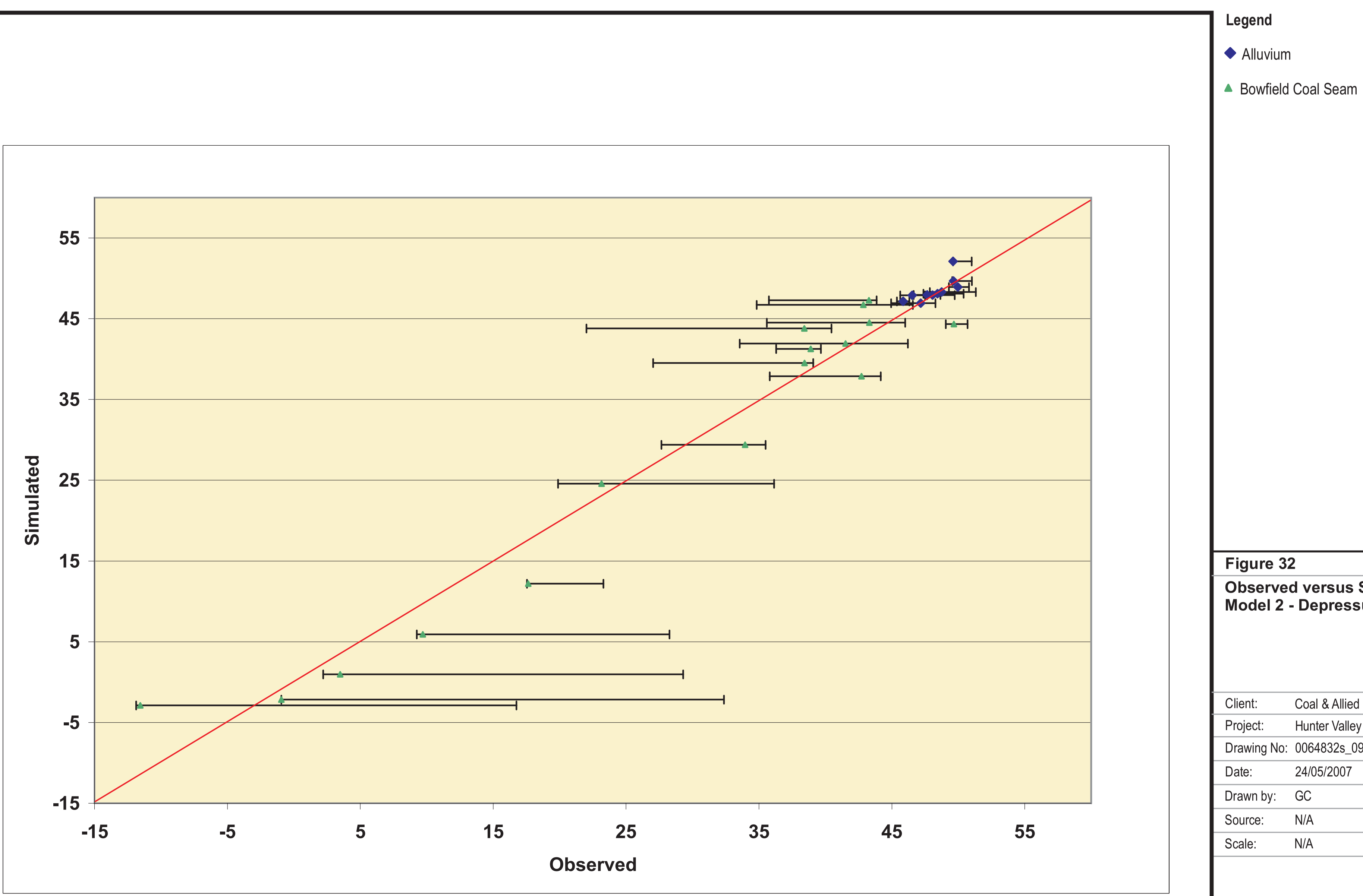

Figure 32

Observed versus Simulated Heads in Model 2 - Depressurised Conditions

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_09		
Date:	24/05/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SAC
Source:	N/A		
Scale:	N/A		

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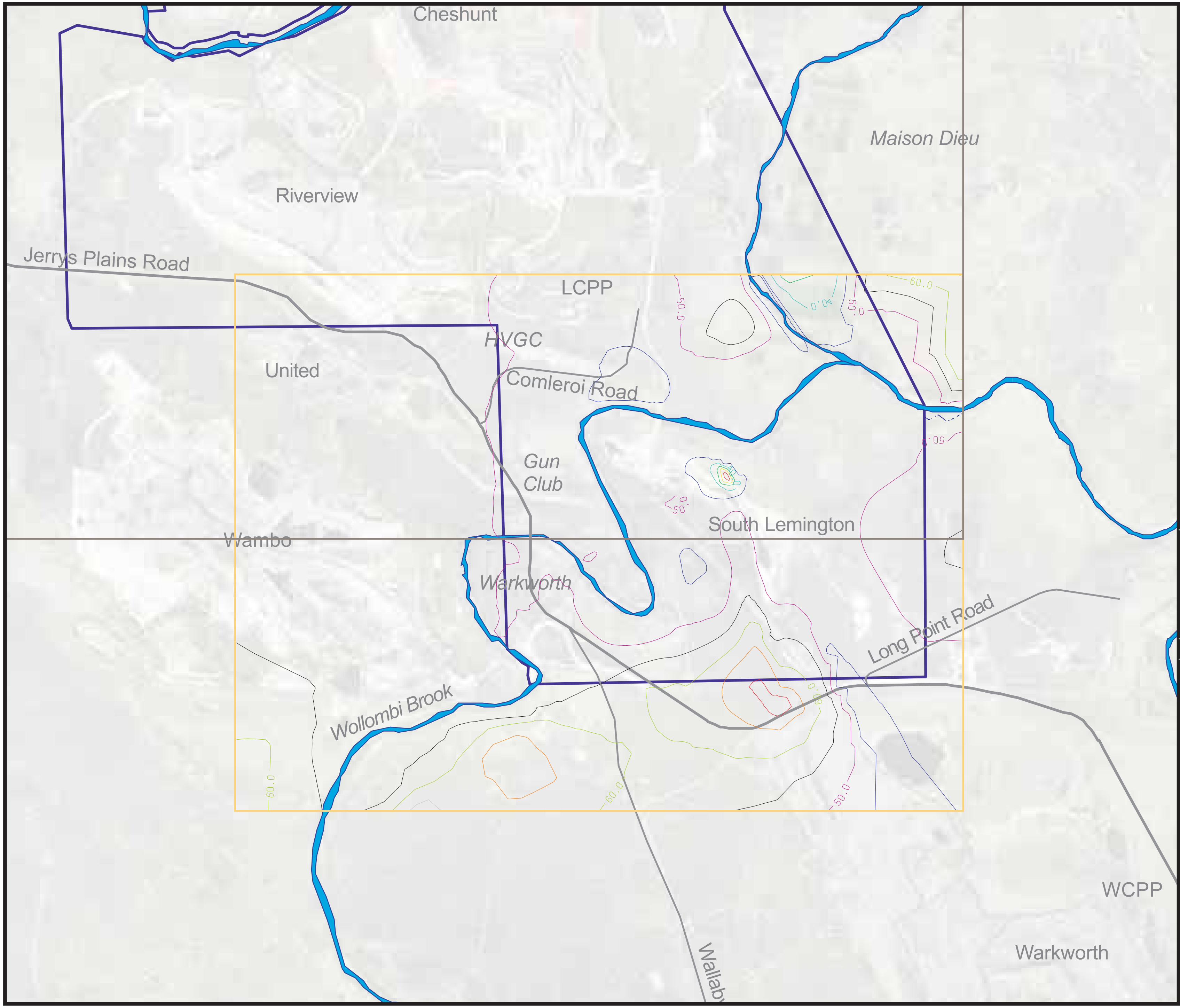

Figure 33

Model 2 Simulated Phreatic Surface including Alluvium - Depressurized Conditions (24/3/00)

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_11
Date:	24/05/2007 Drawing size: A4
Drawn by:	GC Reviewed by: SAC
Source:	N/A
Scale:	Refer to Scale Bar

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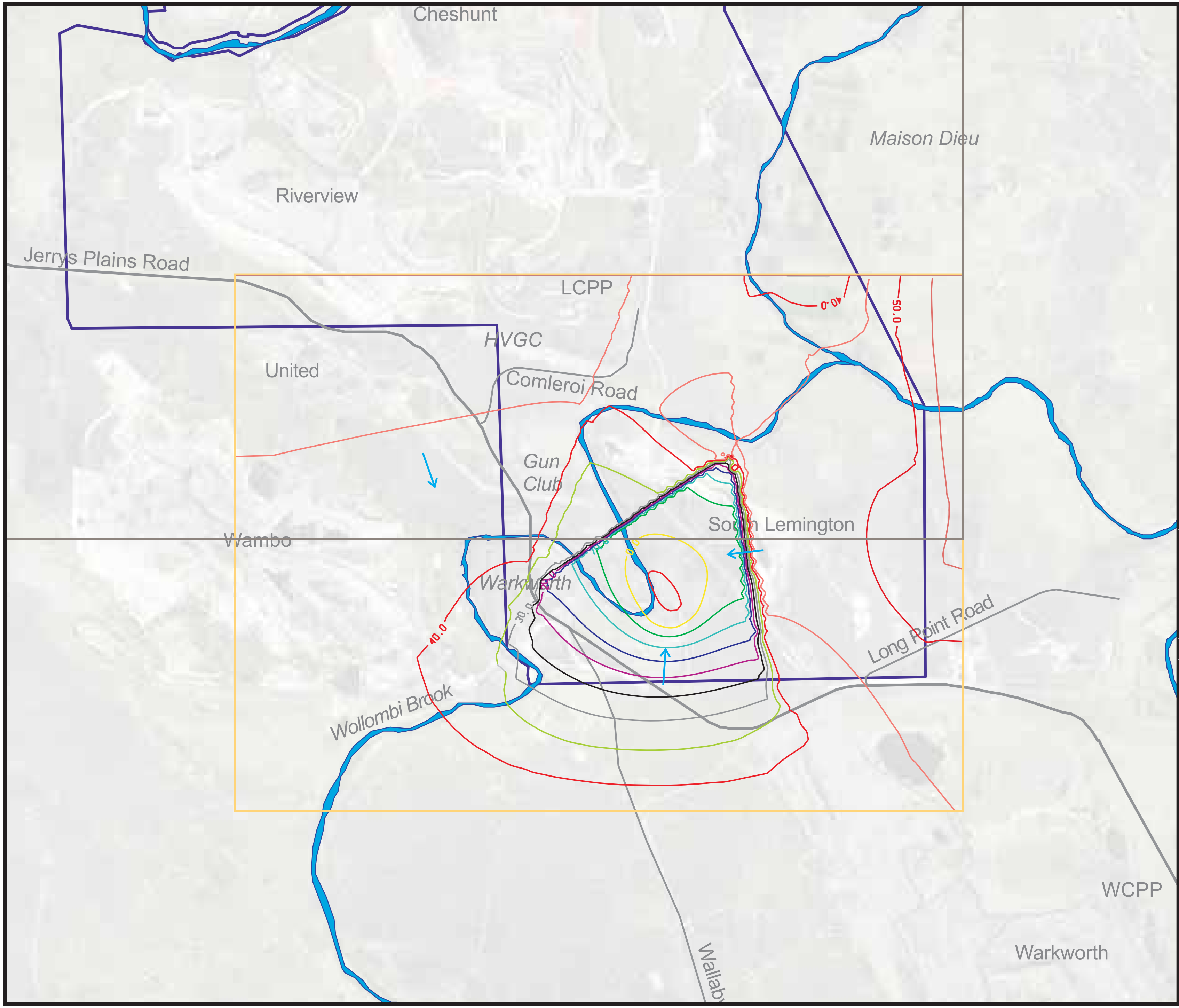

Legend

- Current Mining Lease Boundary
- Model Domain 1
- Model Domain 2
- GWL Contour (mAHD)
- Groundwater Flow Direction

Figure 34

Model 2 Simulated Piezometry within Bowfield Coal Seam - Depressurised Conditions (24/3/00)

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_12		
Date:	24/05/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SAC
Source:	N/A		
Scale:	Refer to Scale Bar		

N

0 1 2km

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Notes:
A negative value represents a net seepage to the River (out of the model).

Figure 35

Net Seepage for the Hunter River over the Proposed Mining Period

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_15_R0		
Date:	31/01/2008	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SC
Source:	-		
Scale:	N/A		

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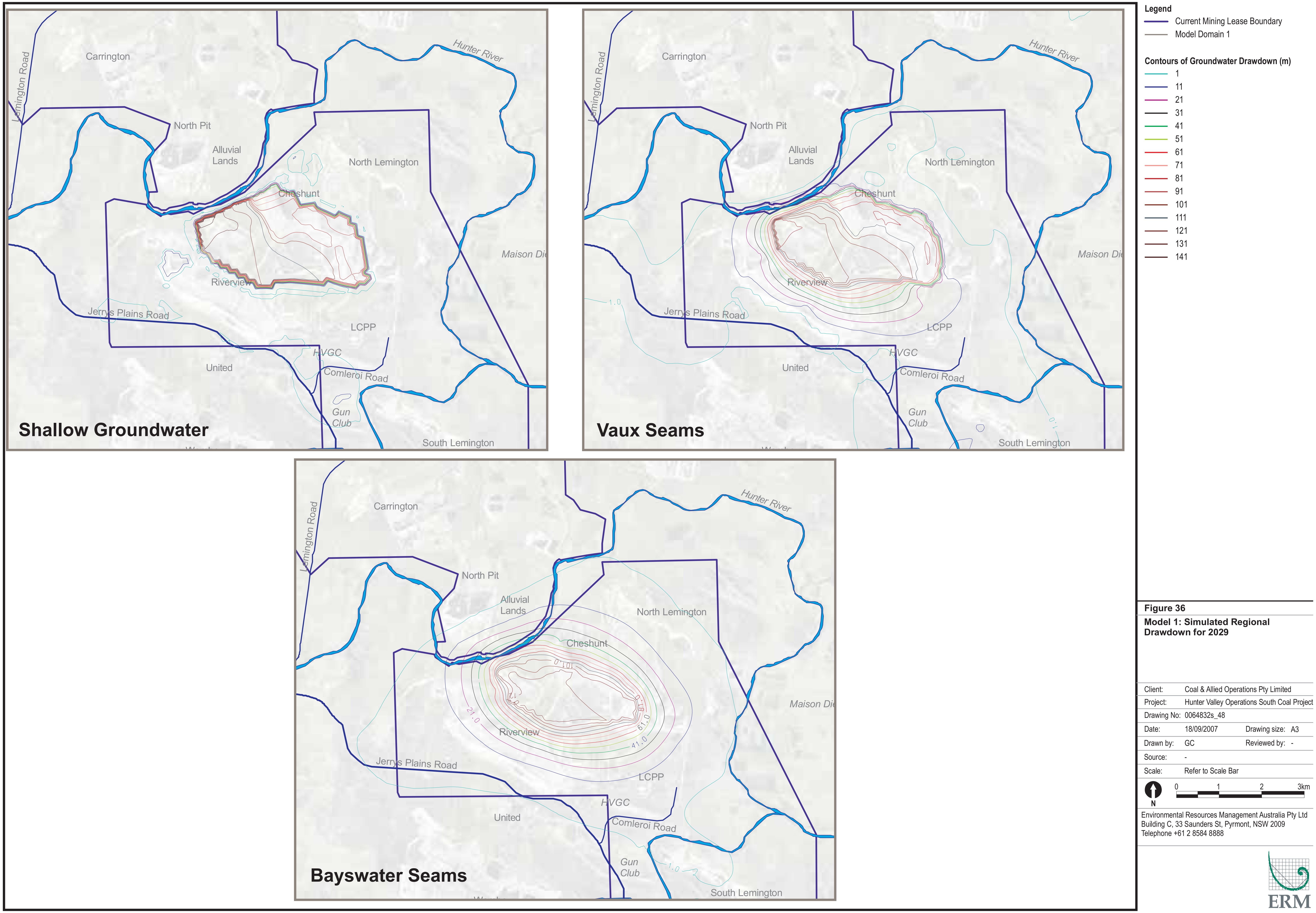

Figure 36

Model 1: Simulated Regional Drawdown for 2029

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_48
Date:	18/09/2007 — Drawing size: A3
Drawn by:	GC — Reviewed by: -
Source:	-
Scale:	Refer to Scale Bar

N 0 1 2 3km

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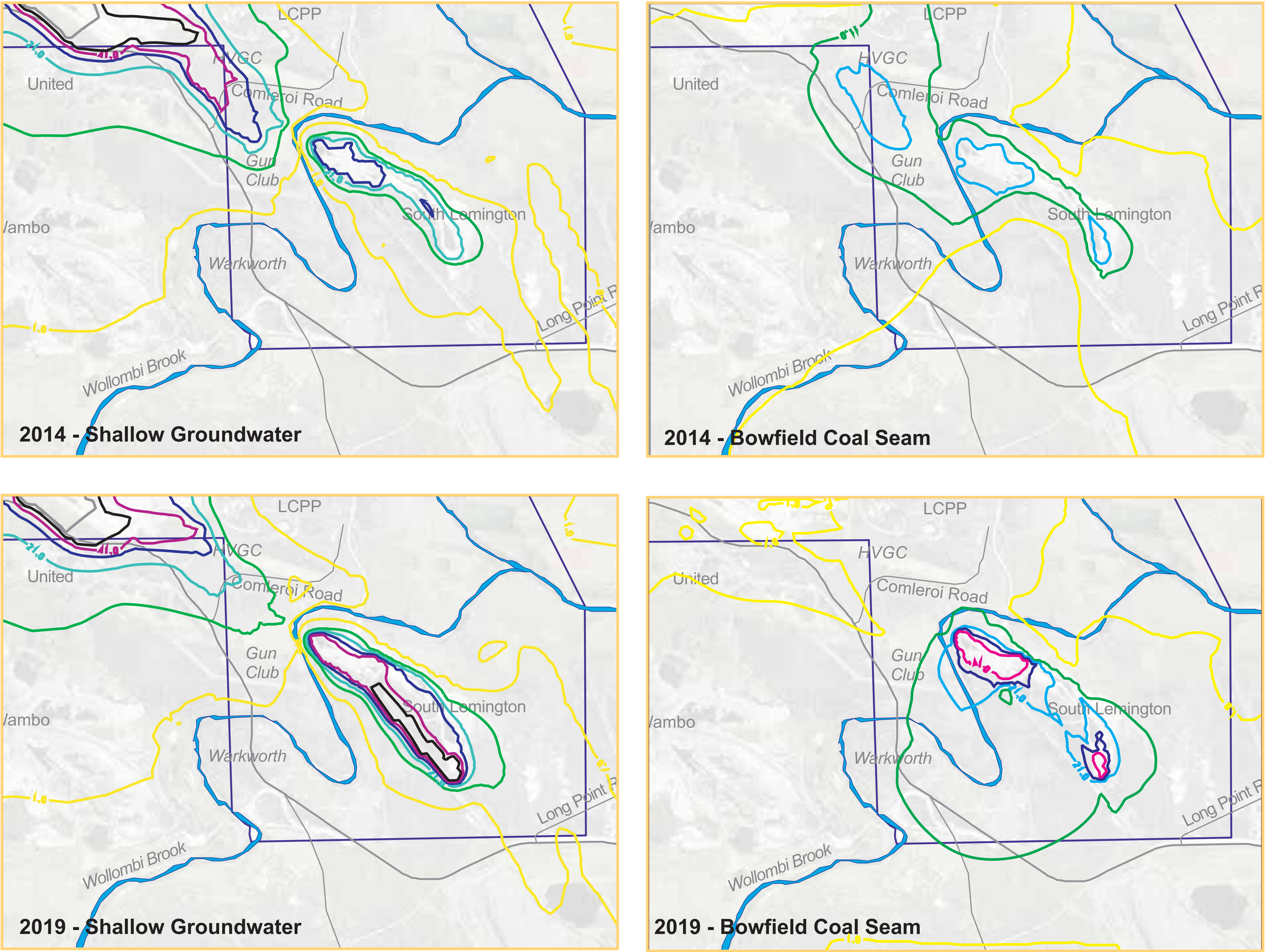

Legend

Current Mining Lease Boundary

Model Domain 2

Contours of Groundwater Drawdown (m)

1

11

21

31

41

51

Figure 37

Model 2: Simulated Regional Drawdown

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_47_R1
Date:	13/08/2007 — Drawing size: A3
Drawn by:	SAC — Reviewed by: -
Source:	-
Scale:	Refer to Scale Bar

N

0 1 2 3km

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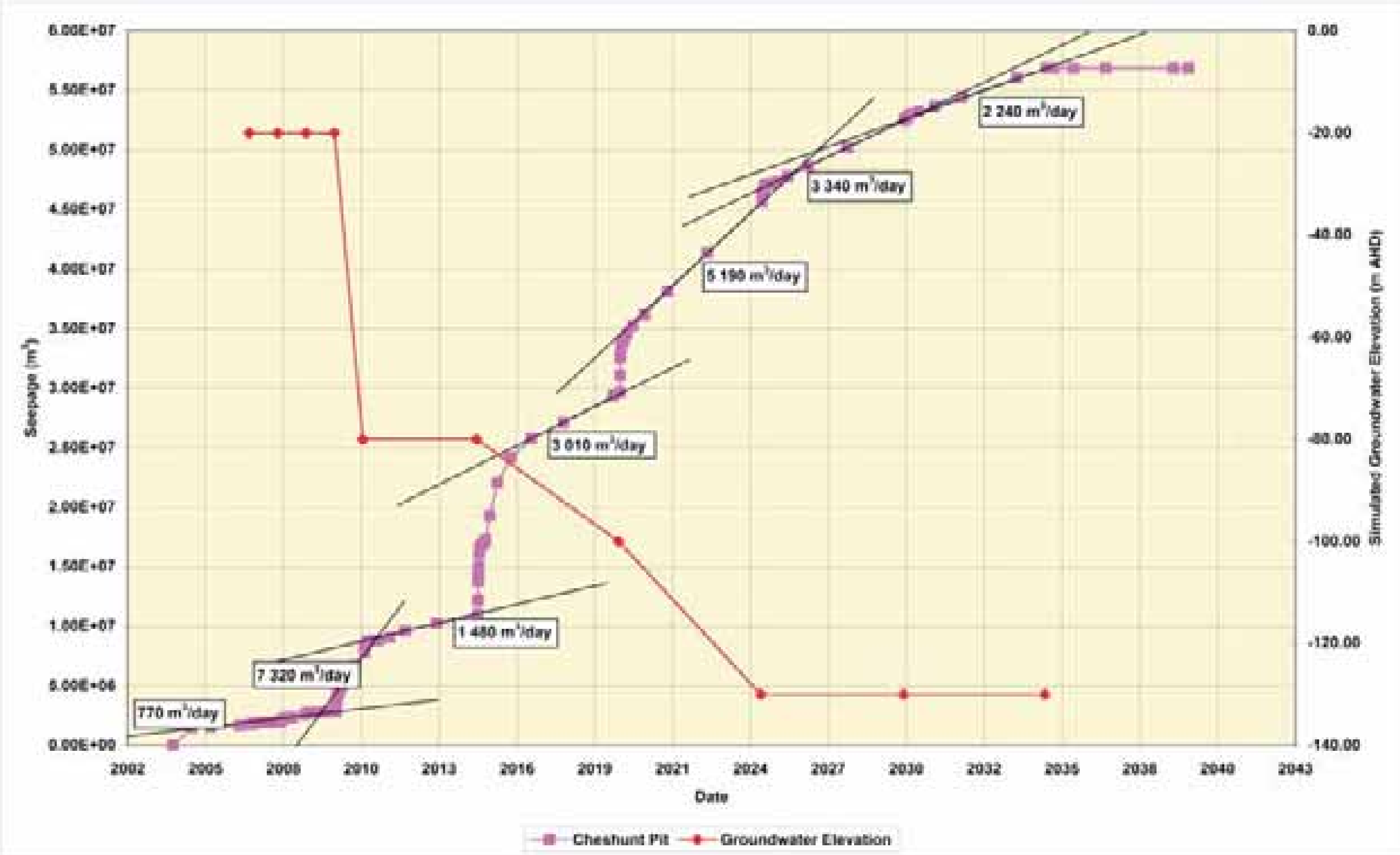

Figure 38

Cumulative Seepage to Cheshunt Pit over the Proposed Mining Period

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_46		
Date:	31/07/2007	Drawing size:	A4
Drawn by:	GC	Reviewed by:	SAC
Source:	-		
Scale:	N/A		

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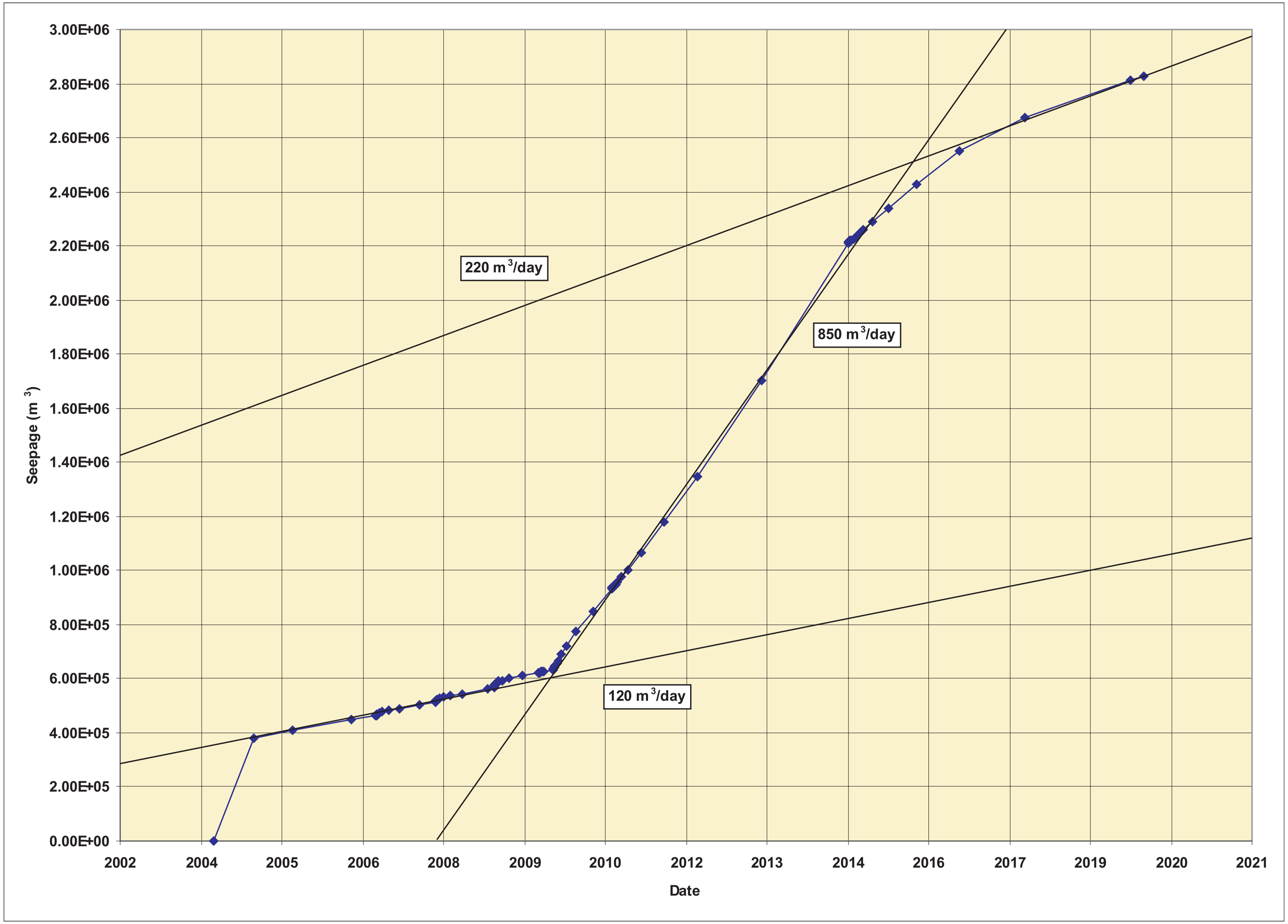

Figure 39

Cumulative Seepage to Riverview Pit over the Proposed Mining Period

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_17		
Date:	20/06/2007	Drawing size:	A4
Drawn by:	SAC	Reviewed by:	-
Source:	-		
Scale:	N/A		

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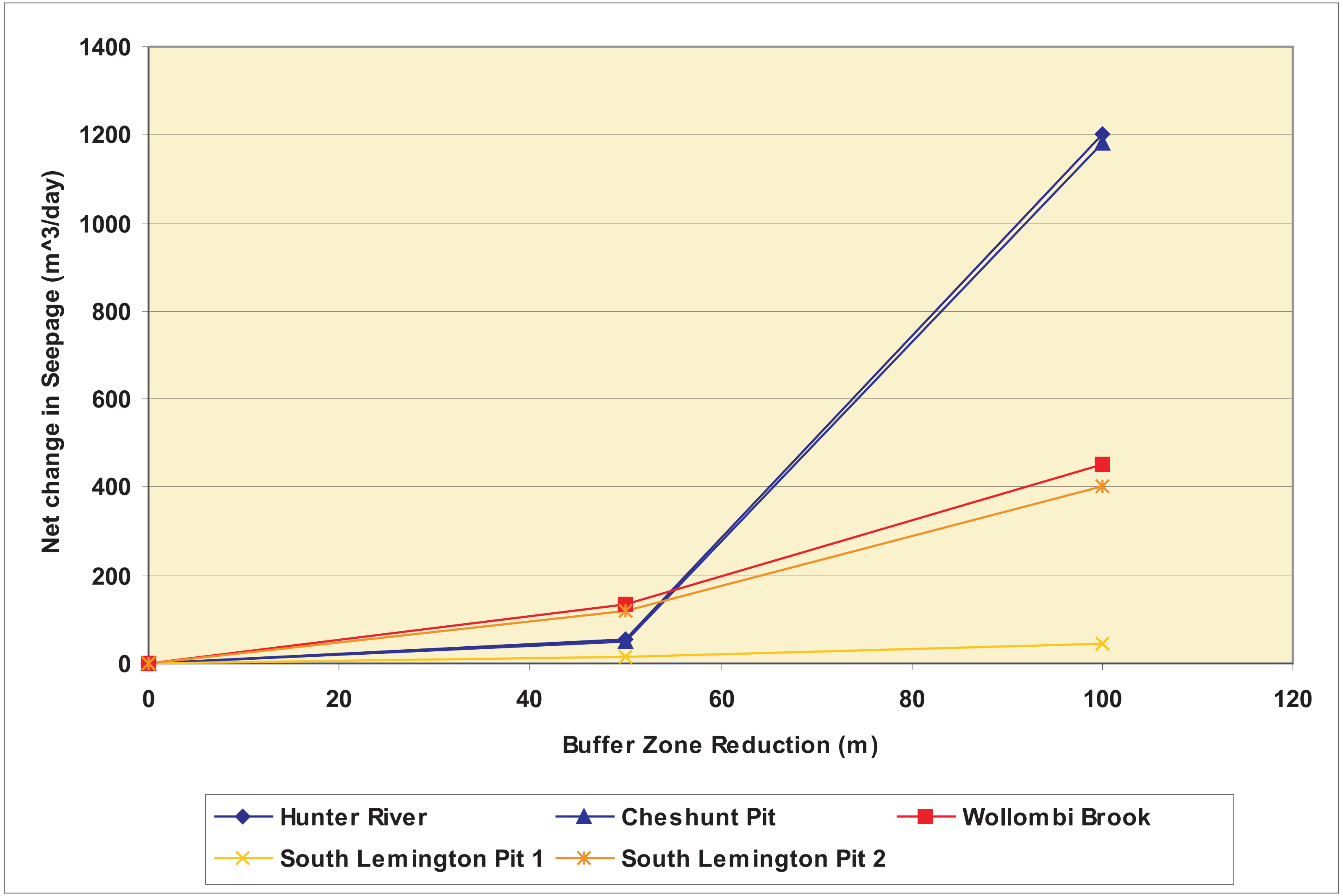

Figure 40

Simulated changes to River and Pit Seepage due to Buffer Zone reduction

Client:	Coal & Allied Operations Pty Limited		
Project:	Hunter Valley Operations South Coal Project		
Drawing No:	0064832s_18		
Date:	20/06/2007	Drawing size:	A4
Drawn by:	SAC	Reviewed by:	-
Source:	-		
Scale:	N/A		

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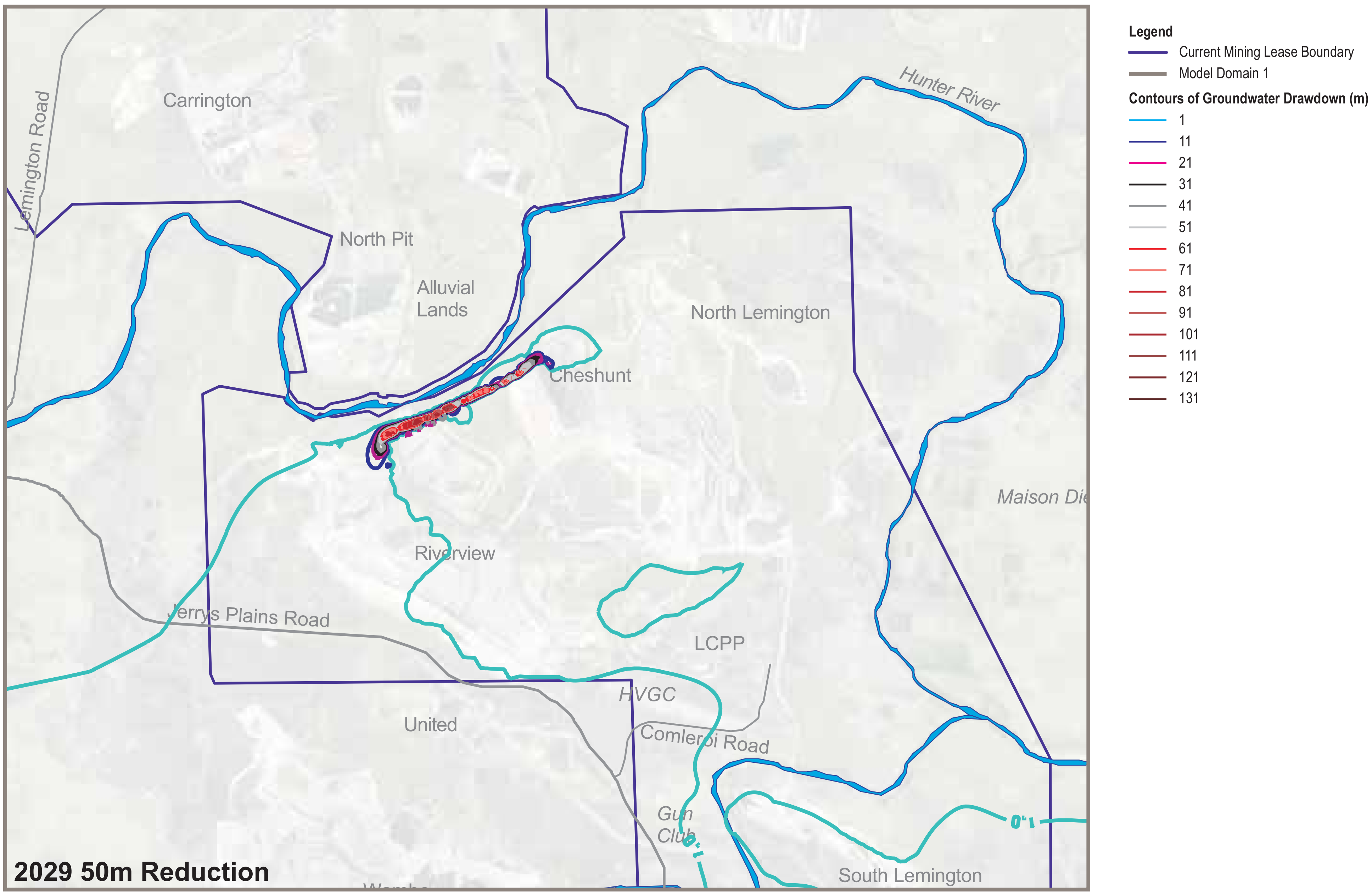

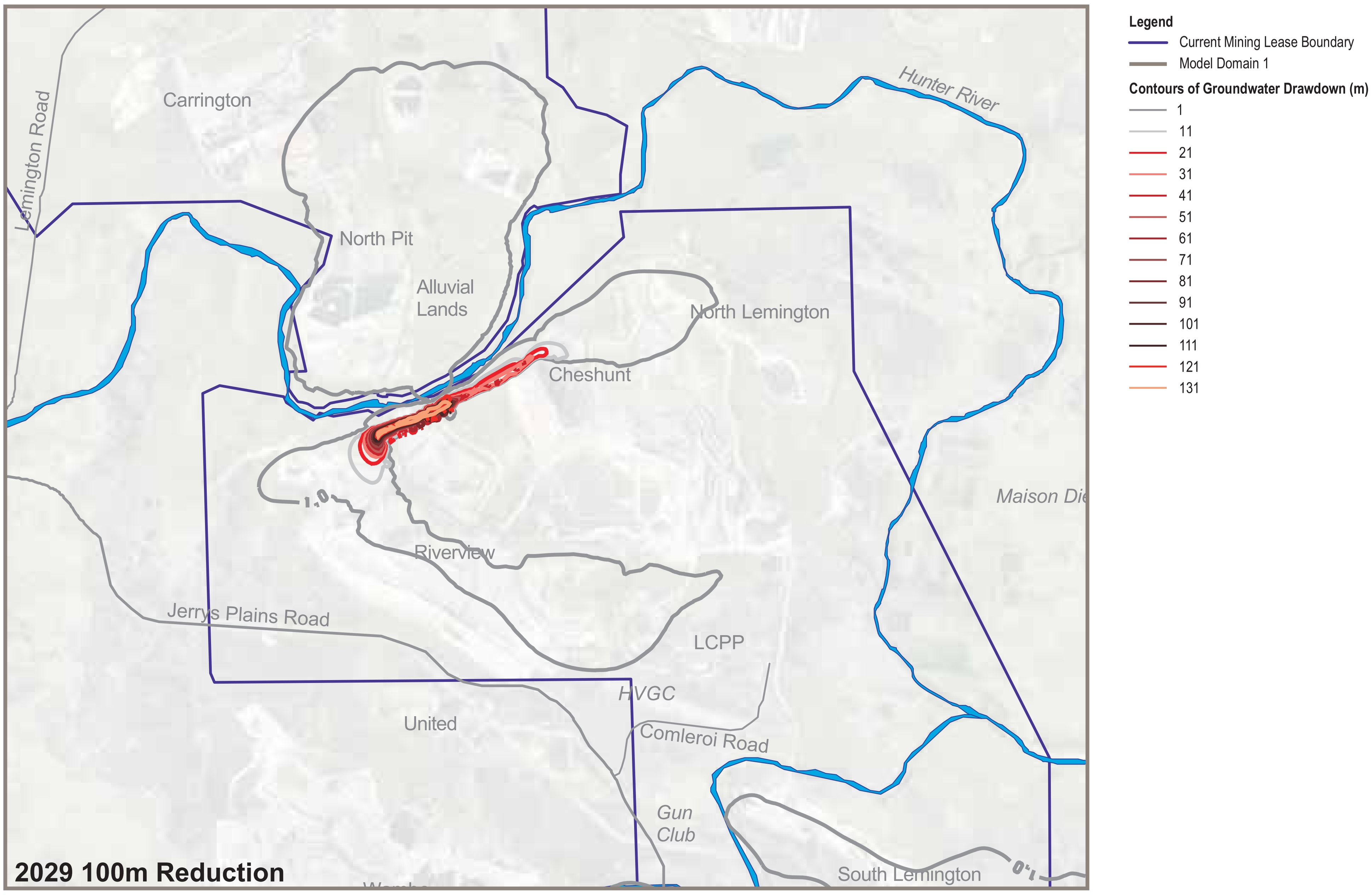

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_50
Date:	18/09/2007 Drawing size: A3
Drawn by:	GC Reviewed by: -
Source:	-
Scale:	Approximate only

N 0 1 2km

Figure 41

Model 1: Simulated Changes in Drawdown in Hunter River Alluvium with Reduction in Buffer Zone (2029)

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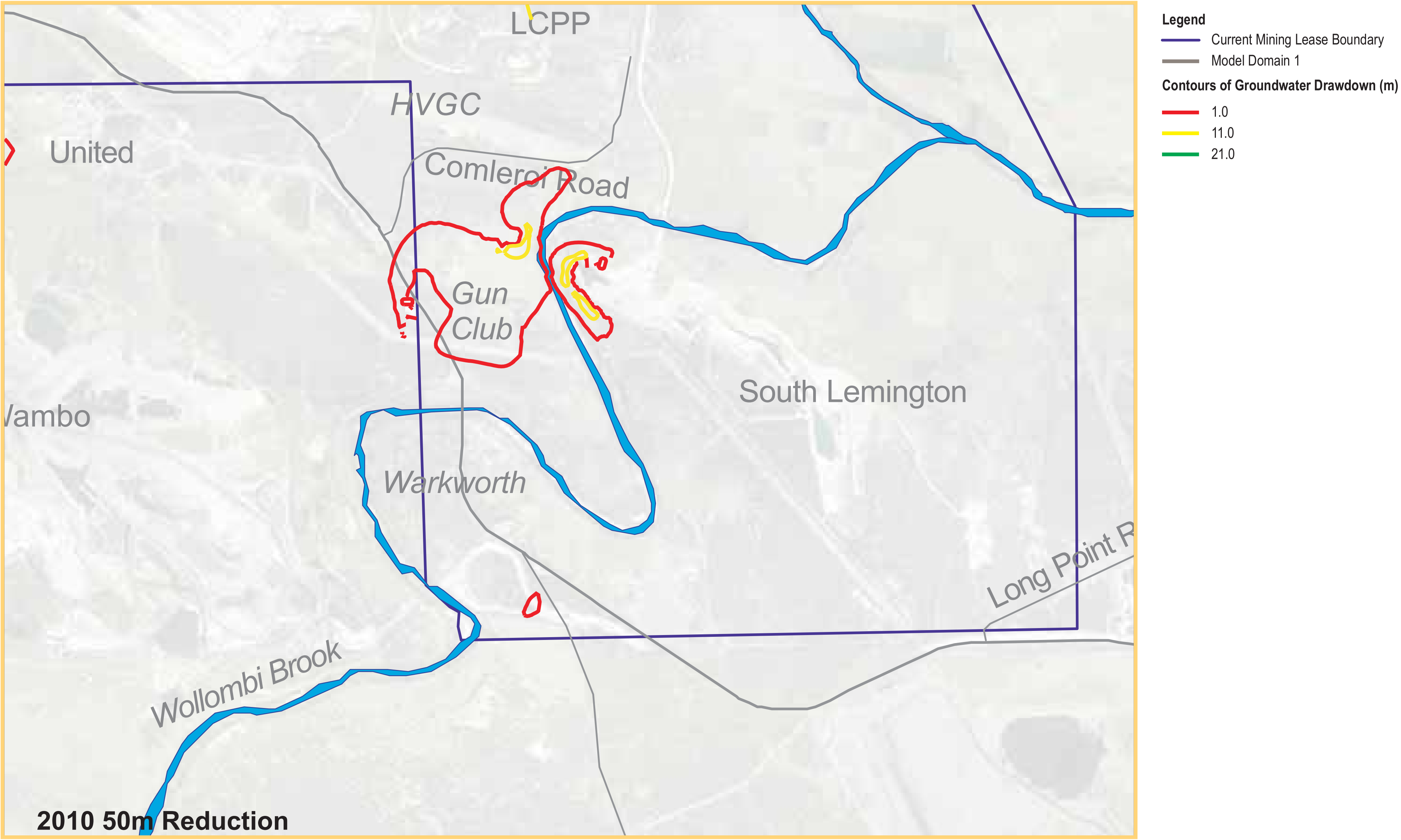

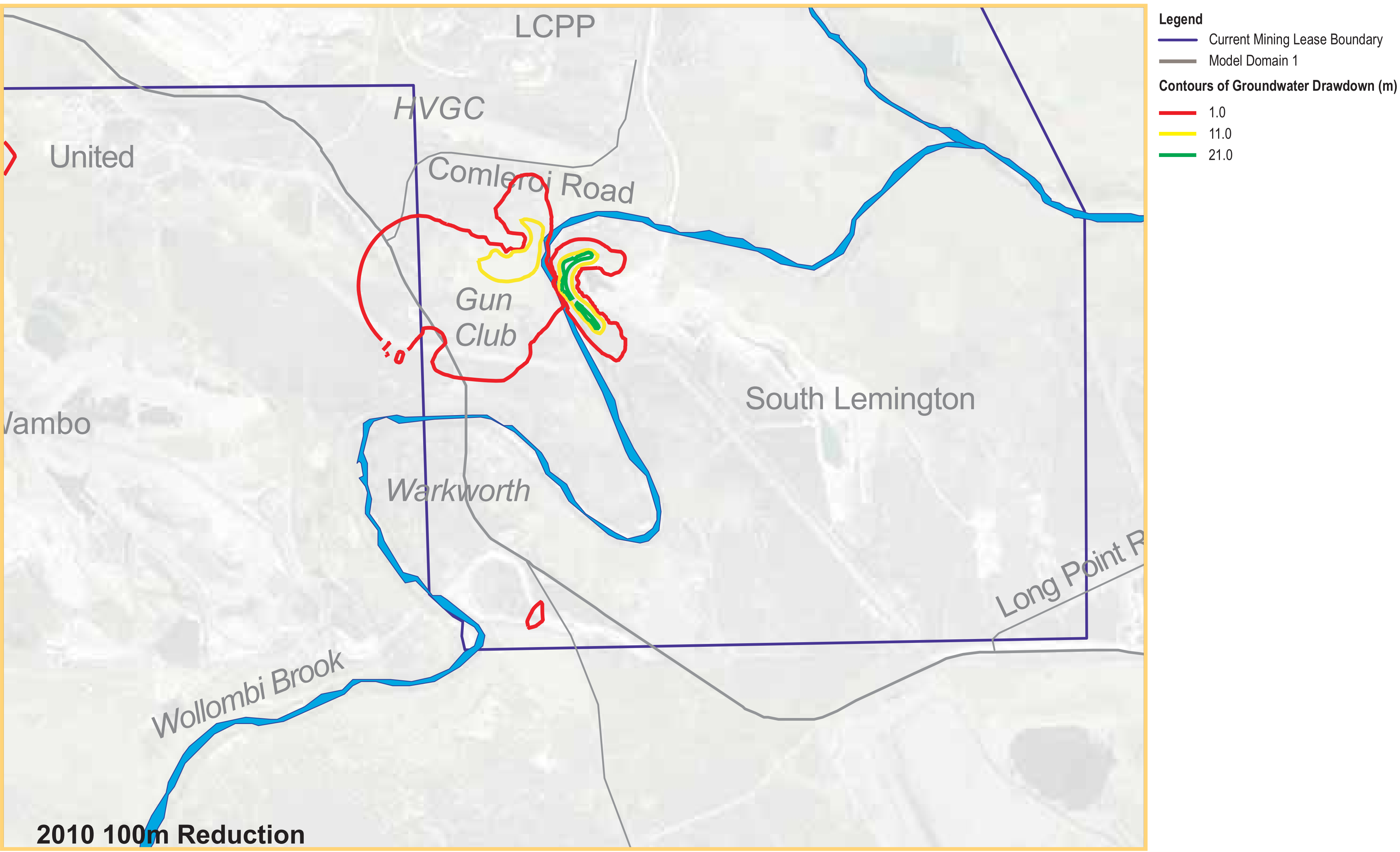

Figure 42

Model 2: Simulated Changes in Drawdown in Wollombi Brook Alluvium with Reduction in Buffer Zone (2010)

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_49
Date:	19/06/2007 Drawing size: A3
Drawn by:	JM Reviewed by: -
Source:	-
Scale:	Approximate only

N 0 2km

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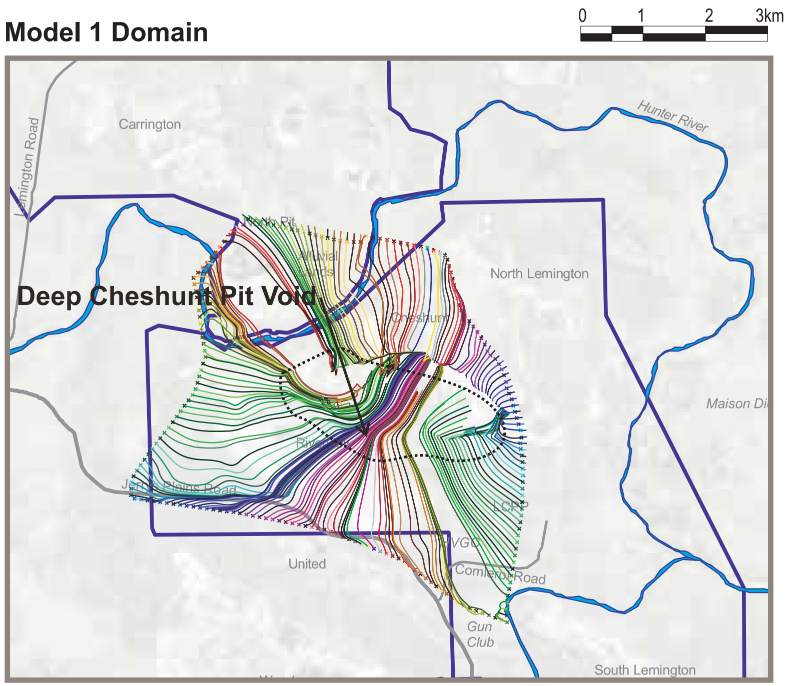
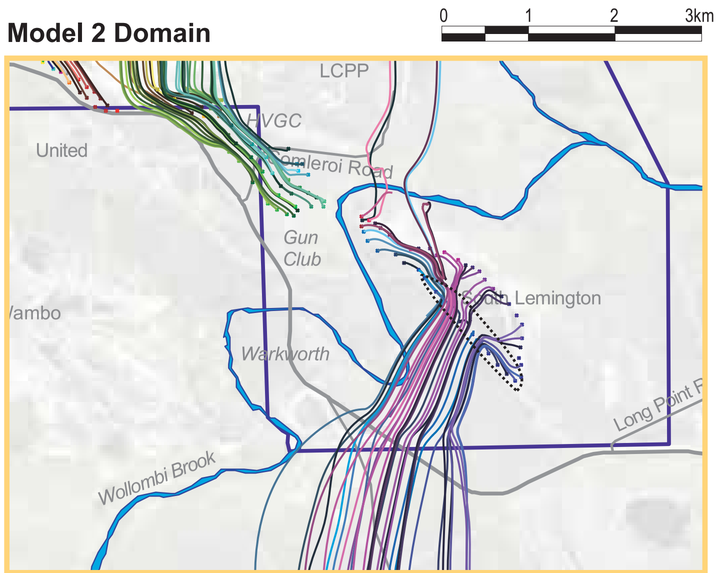
Model 1 Domain



Model 2 Domain



Legend

Current Mining Lease Boundary

Figure 43

Simulated Particle Flow Directions Post Mine Closure

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0064832s_51
Date:	19/06/2007 Drawing size: A4
Drawn by:	JM Reviewed by: -
Source:	-
Scale:	Refer to Scale Bars

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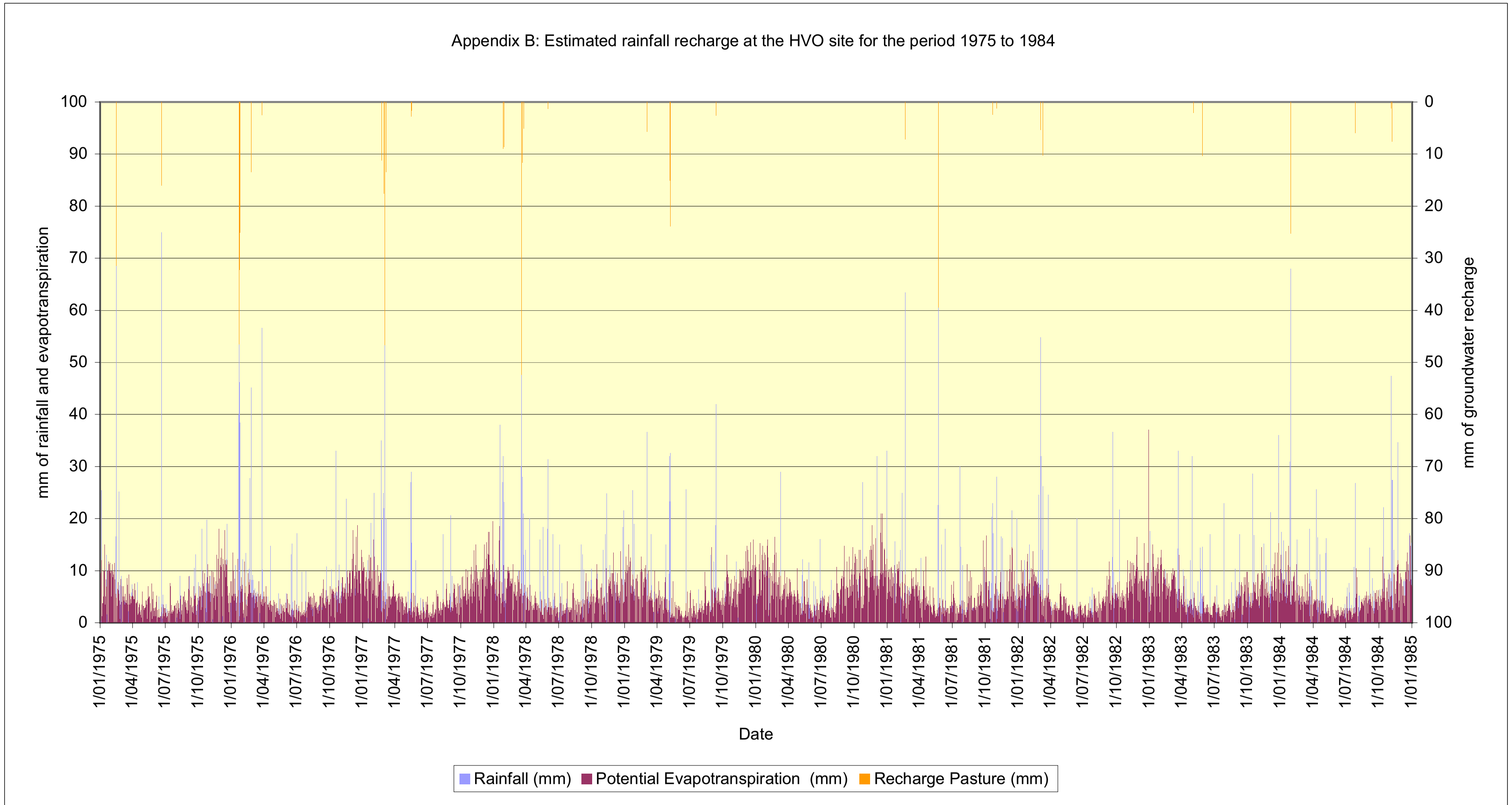
Appendix B

Rainfall Recharge And Runoff Estimates


Appendix B: Estimated rainfall recharge at the HVO site for the period 1975 to 1984
mm of rainfall and evapotranspiration
100
90
80
70
60
50
40
30
20
10
0
mm of groundwater recharge
0
10
20
30
40
50
60
70
80
90
100
1/01/1975
1/04/1975
1/07/1975
1/10/1975
1/01/1976
1/04/1976
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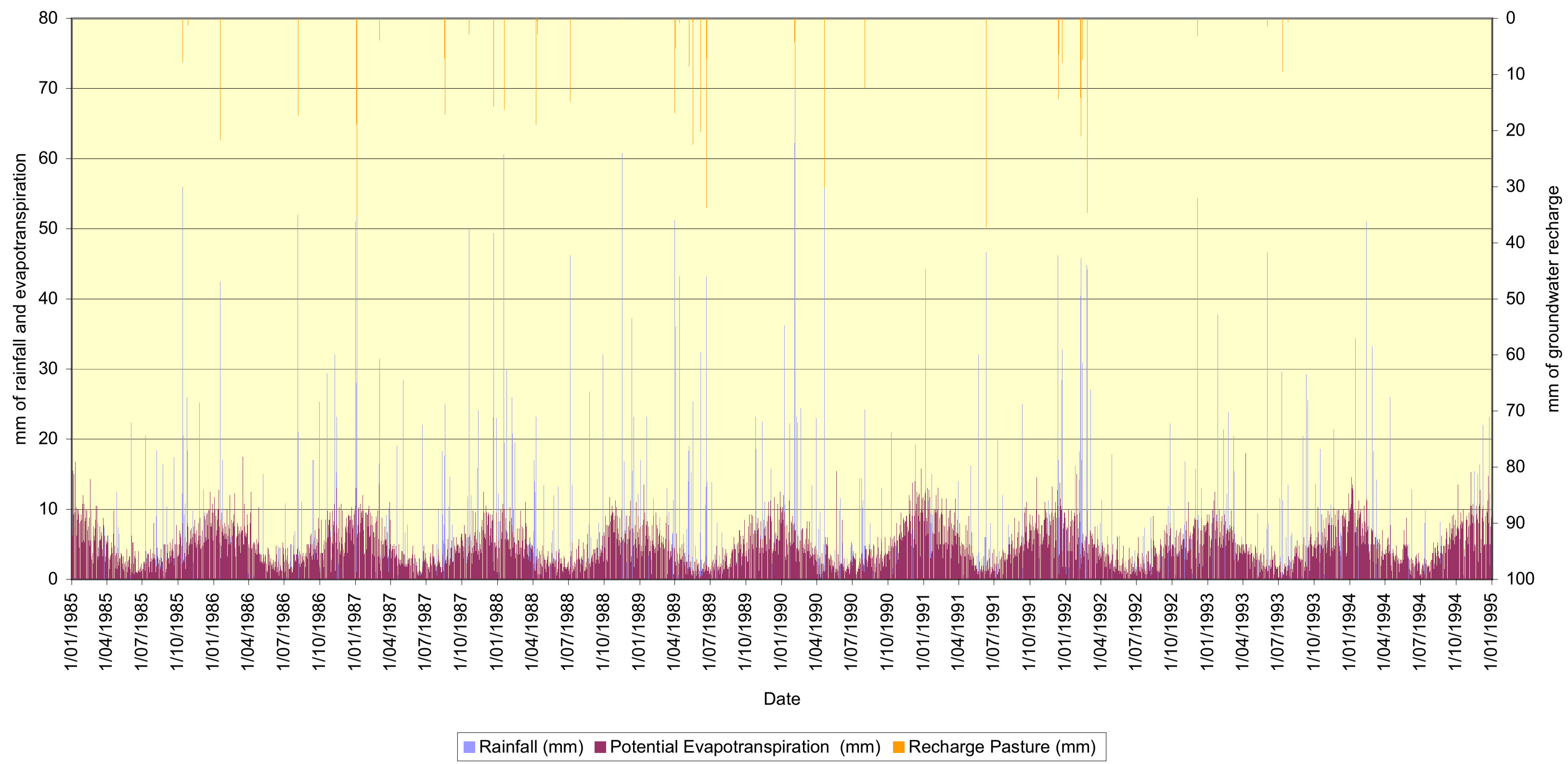
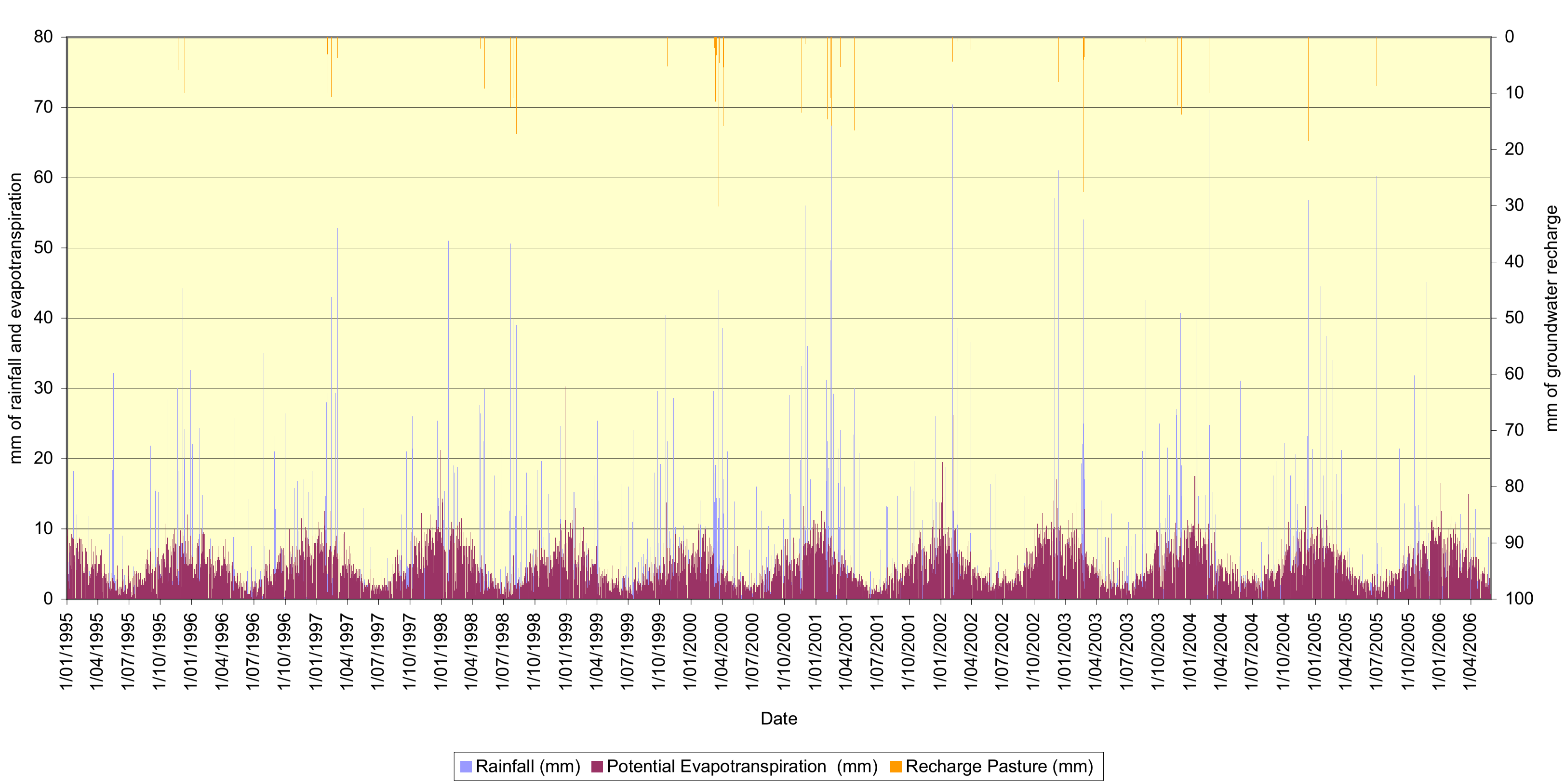
1/04/1983
1/07/1983
1/10/1983
1/01/1984
1/04/1984
1/07/1984
1/10/1984
1/01/1985
Date
Rainfall (mm)
Potential Evapotranspiration (mm)
Recharge Pasture (mm)

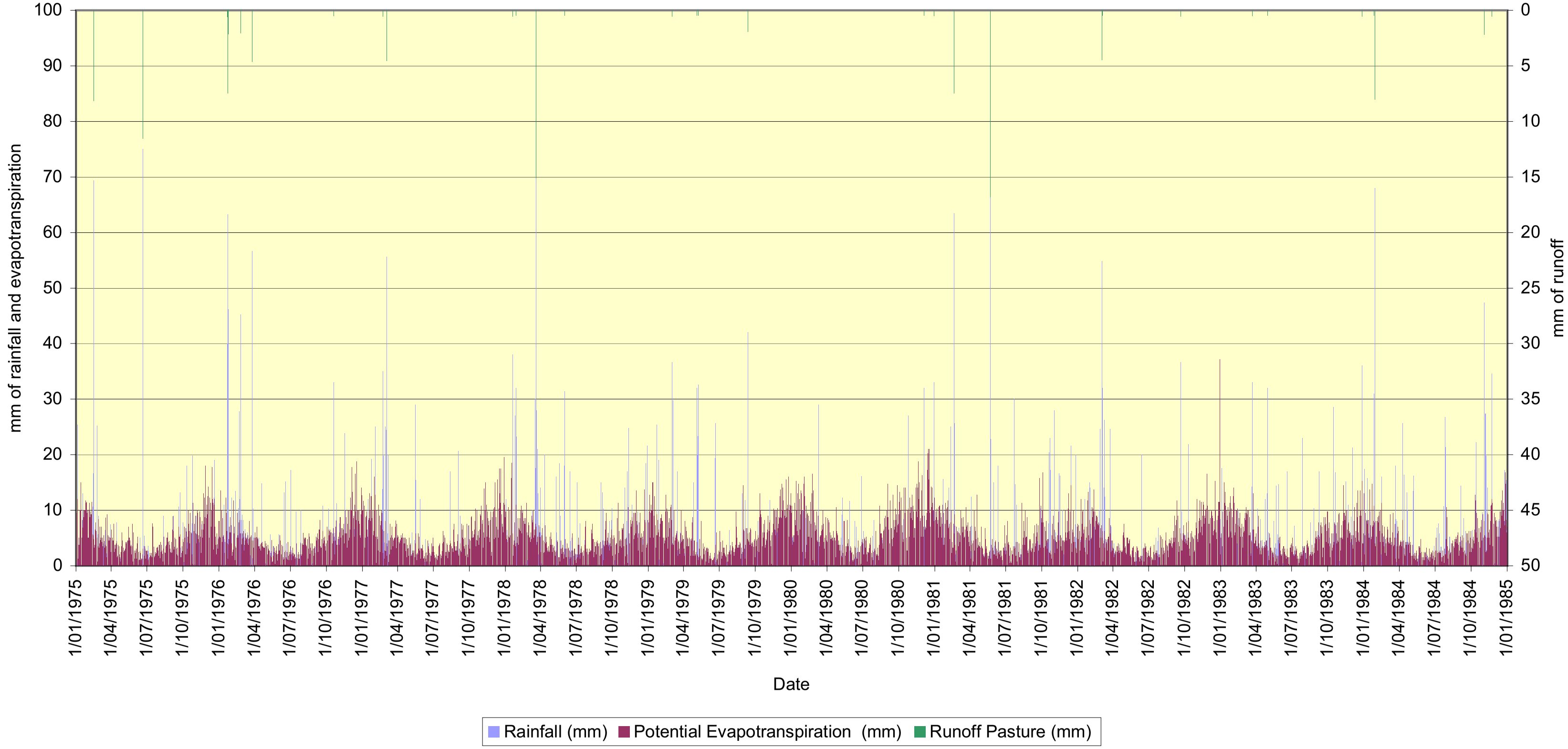
Appendix B: Estimated rainfall recharge at the HVO site for the period 1985 to 1994



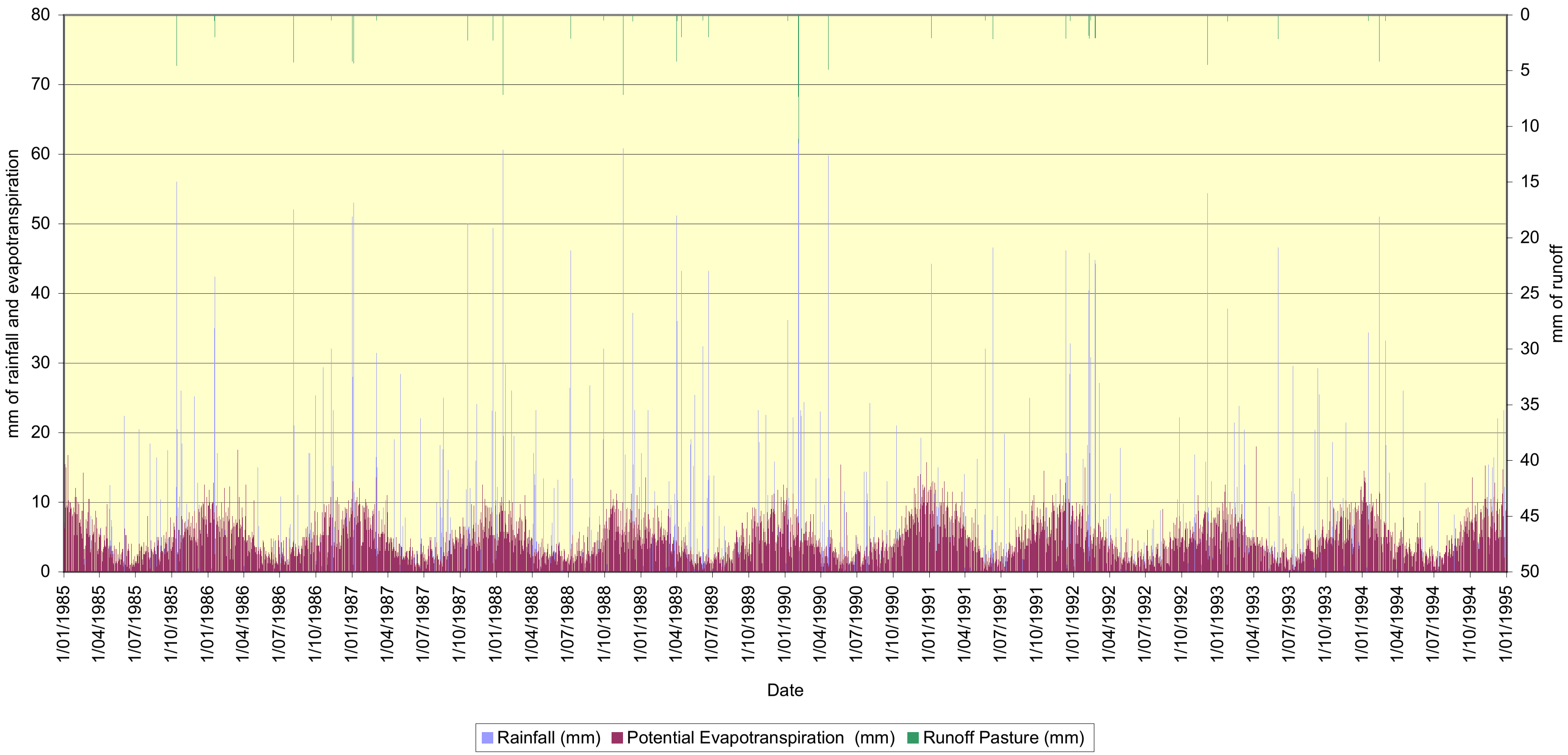
Appendix B: Estimated rainfall recharge and run-off at the HVO site for the period 1995 to 2006



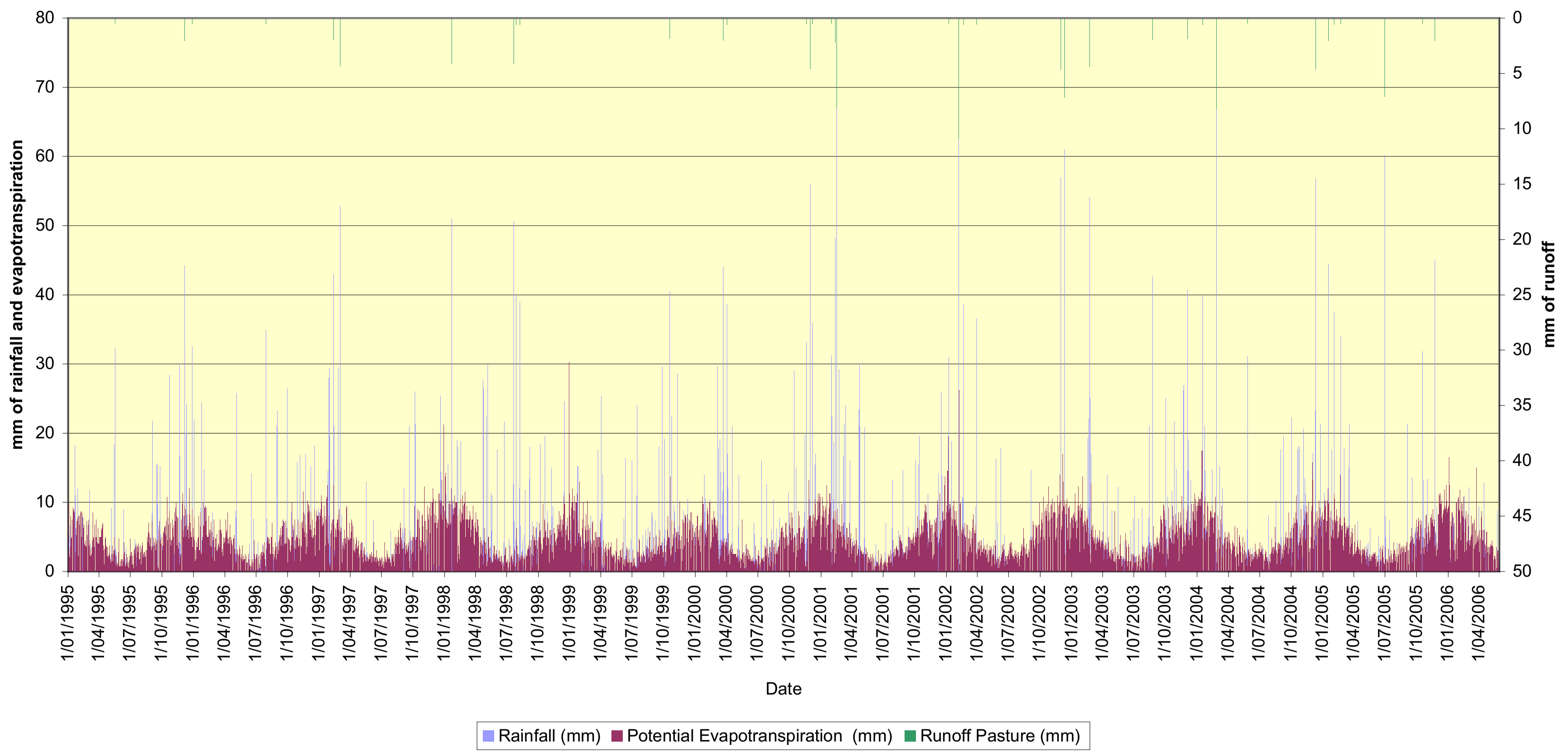
Appendix B: Estimated run-off at the HVO site for the period 1975 to 1984



Appendix B: Estimated run-off at the HVO site for the period 1985 to 1994



Appendix B: Estimated run-off at the HVO site for the period 1995 to 2006



Appendix C

Registered DWE Bore Details

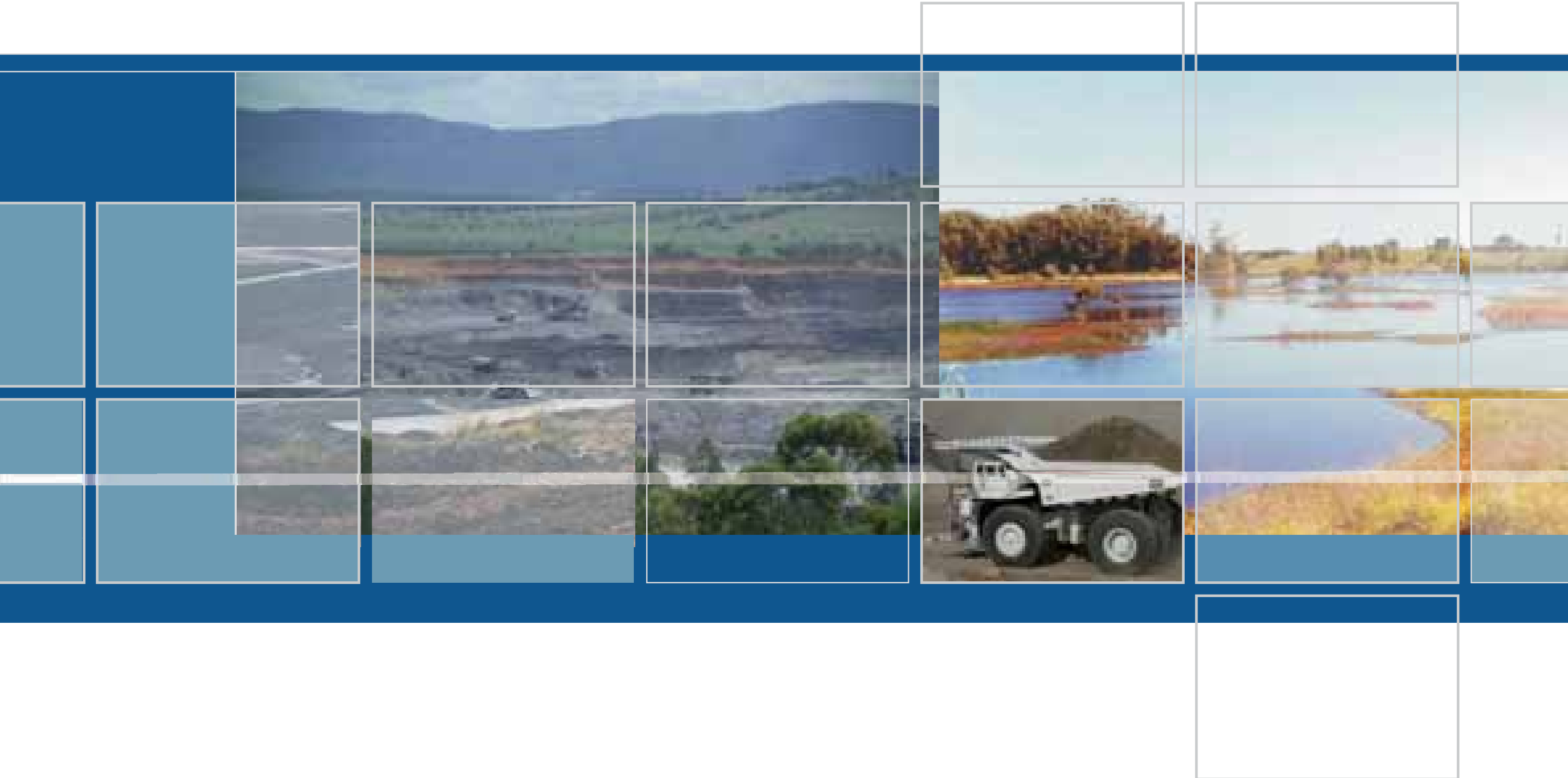
Groundwater Number	Licence Number	Easting	Northing	Final_Depth (metres)	Authorised-Purposes	Work-Type	Work-Status	Owner-Type	Completition-Date
GW030732		316573	6397443	16		Piezometer	Test Hole	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Feb-79
GW030733		316556	6397453	15.9		Piezometer	Abandoned Bore	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Mar-79
GW080952		314538	6394715			Piezometer			Jan-00
GW060328	20BL132468	314100.00	6393330.00	10	Mining	Well	Supply Obtained	Private	Jun-80
GW060327	20BL132467	314065.00	6393240.00	9.8	Mining	Well	Supply Obtained	Private	Jun-80
GW060326	20BL132466	314000.00	6393170.00	9.8	Mining	Well	Supply Obtained	Private	Jun-80
GW080519	20BL168885	313465.00	6393971.00	10.5	Test Bore	Bore			Jun-03
GW080518	20BL168885	313429.00	6394042.00	10.75	Test Bore	Bore			Jun-03
GW042364		316660	6397460	13.3		Well	(Unknown)	Private	Jan-00
GW030731		316410	6397500			Piezometer	Test Hole	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Jan-79
GW030734		316485	6397665	16.5		Piezometer	Collapsed Bore	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Feb-79
GW030735		316350	6397680	14		Piezometer	Abandoned Bore	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Mar-79

Groundwater Number	Licence Number	Easting	Northing	Final_Depth (metres)	Authorised-Purposes	Work-Type	Work-Status	Owner-Type	Completition-Date
GW030736		316533	6397782	17.5		Piezometer	Abandoned Bore	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Feb-79
GW030739		316460	6398170			Piezometer	Test Hole	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Mar-79
GW030737		316420	6397920			Piezometer	Test Hole	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Mar-79
GW030738		316480	6398015			Piezometer	Test Hole	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Mar-79
GW034568	20BL027195	316565.00	6398140.00	12.2	Test Bore	Well	(Unknown)	Private	Jun-71
GW030740		316536	6398175	16.3		Piezometer	Test Hole	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Apr-79
GW022685	20BL015155	308975.00	6401200.00	14.6	Irrigation	Well	Supply Obtained	Private	Mar-65
GW078383	20BL166640	309670.00	6402781.00	21.7	Test Bore	Bore	(Unknown)		Aug-97
GW067099	20BL143751	312553.00	6401800.00		Test Bore		(Unknown)		Jan-00
GW038579	20BL100550	309640.00	6393700.00	20.9	Test Bore	Bore	Supply Obtained	Private	May-74
GW037184	20BL100549	309570.00	6393710.00	21	Test Bore	Bore	Supply Obtained	Private	May-74
GW079780		309484	6393742			Well	(Unknown)		Jan-00
GW080514	20BL168881	310815.00	6394163.00	55	Test Bore	Bore			Jan-02
GW080516	20BL168883	312741.00	6394764.00	15	Test Bore	Bore			Jan-02

Groundwater Number	Licence Number	Easting	Northing	Final_Depth (metres)	Authorised-Purposes	Work-Type	Work-Status	Owner-Type	Completition-Date
GW080515	20BL168882	313261.00	6394604.00	8.1	Test Bore	Bore			Jun-03
GW080517	20BL168884	313416.00	6394552.00	15	Test Bore	Bore			Jan-02
GW060750	20BL132130	314210.00	6394740.00	24.4	Domestic	Bore	(Unknown)	Private	Feb-85
GW080951		314514	6394688			Piezometer	(Unknown)		Jan-00
GW005327	20BL009540	314570.00	6394315.00	10.4	Irrigation, Stock	Well	(Unknown)	Private	Jan-45
GW080962	20BL170102	319259.00	6394737.00	24	Fire Fighting, Monitoring Bore	Bore	Supply Obtained	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Oct-05
GW042998	20BL104734	320000.00	6395620.00	15.8	Domestic, Irrigation, Stock	Well	(Unknown)	Private	Jun-74
GW047240	20BL108936	316725.00	6396920.00	12.7	Domestic, Irrigation, Stock	Well	(Unknown)	Private	Jan-52
GW080963	20BL170103	315889.00	6397020.00	84	Fire Fighting, Monitoring Bore	Bore	Supply Obtained	D.W.R. (NSW Dept Infrastructure, Planning & Nat Resources)	Oct-05
GW034569	20BL030566	316640.00	6398515.00	12.2	Industrial	Well	Test Hole	Private	Jun-71
GW053292	20BL119690	317555.00	6397905.00	10	Domestic, Farimng, Irrigation, Stock	Well	Supply Obtained	Private	Aug-81
GW018371	20BL010483	317575.00	6398590.00	12.2	Irrigation	Well	Supply Obtained	Private	Jan-58
GW018464	20BL010603	317690.00	6400285.00	13	Not Known	Bore	Test Hole	Private	Mar-60
GW018370	20BL010484	317470.00	6398930.00	11.9	Irrigation	Well	Supply Obtained	Private	Jan-37

Groundwater Number	Licence Number	Easting	Northing	Final_Depth (metres)	Authorised-Purposes	Work-Type	Work-Status	Owner-Type	Completition-Date
GW049720	20BL110510	316340.00	6403560.00	10.7	Stock	Well	Supply Obtained	Private	Jan-79
GW056696	20BL123304	313200.00	6401475.00	10.5	Domestic, Stock	Well	Supply Obtained	Private	Dec-81
GW018549	20BL012095	313025.00	6401800.00	9.1	Not Known	Well	Supply Obtained	Private	Apr-56
GW053932	20BL120968	312537.00	6401875.00	7.3	Domestic, Irrigation, Stock	Well	(Unknown)	Private	Aug-81
GW053931	20BL120263	312517.00	6402437.00	10.4	Domestic, Irrigation, Stock	Well	(Unknown)	Private	Jul-81
GW018434	20BL010847	311040.00	6401255.00	11	Domestic, Stock	Well	(Unknown)	Private	Jan-60
GW067101	20BL144340	310715.00	6400943.00		Test Bore		(Unknown)		Jan-00
GW067110	20BL144342	310661.00	6400310.00		Test Bore		(Unknown)		Jan-00
GW067109	20BL144341	310035.00	6400703.00		Test Bore		(Unknown)		Jan-00
GW027120	20BL020353	309420.00	6400960.00	13.4	Irrigation	Well	(Unknown)	Private	Aug-64
GW053173	20BL118414	308990.00	6401270.00	14.8	Domestic, Irrigation, Stock	Well	(Unknown)	Private	Mar-81
GW057775	20BL120623	309012.00	6401337.00	13.4	Domestic, Irrigation, Stock	Trench	(Unknown)	Private	Mar-81
GW037734	20BL031436	309520.00	6401450.00	13.4	Irrigation, Stock	Well	(Unknown)	Private	Jan-65
GW027121	20BL016019	309450.00	6401605.00	15.8	Irrigation	Well	(Unknown)	Private	Mar-65

Groundwater Number	Licence Number	Easting	Northing	Final_Depth (metres)	Authorised-Purposes	Work-Type	Work-Status	Owner-Type	Completition-Date
GW021773	20BL014201	309420.00	6401760.00	12.5	Irrigation	Well	(Unknown)	Private	Jan-53
GW053123	20BL118095	309510.00	6401820.00	13.1	Domestic, Irrigation, Stock	Well	Supply Obtained	Private	Mar-81
GW078384	20BL166642	310244.68	6402609.00	13.2	Test Bore	Bore	(Unknown)	Mines	Aug-97
GW078208	20BL166957	309845.00	6402458.00	19.2	Monitoring Bore	Bore	(Unknown)	Mines	Aug-97
GW042993	20BL121565	309615.00	6402800.00	8.8	Domestic, Stock	Well	Supply Obtained	Private	Mar-77
GW045122	20BL105223	309475.00	6402365.00	12.2	Domestic, Stock	Well	Supply Obtained	Private	Jan-00
GW045123	20BL105224	309055.00	6402430.00	12.2	Domestic, Stock	Well	Supply Obtained	Private	Jan-00
GW078381	20BL166640	309529.00	6403181.00	22.5	Test Bore	Bore	(Unknown)	Mines	Aug-97
GW078209	20BL166957	309882.00	6403478.00	26.3	Monitroing Bore	Bore	(Unknown)	Mines	Aug-97



Annex K

HVO South Coal Project, Surface Water Report, ERM 2008

FINAL REPORT

Coal & Allied Operations Pty Limited

Hunter Valley Operations South Coal Project *Surface Water Assessment*

January 2008

Environmental Resources Management Australia
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Pyrmont, NSW 2009
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1 INTRODUCTION

1.1 BACKGROUND

Coal & Allied Operations Pty Limited (CNA) owns and operates the Hunter Valley Operations (HVO) mining complex. CNA proposes to undertake an environmental assessment and prepare a Project Application under Part 3A of the *Environmental Planning and Assessment Act 1979* to allow for the replacement of the existing consents, infrastructure upgrades, modifications and extension to mining at HVO South and ultimately obtain a single Project Approval. This report supports *Chapter 10* in the Environmental Assessment and deals with impacts on surface waters; including hydrology, mine water management, water supply, discharges, monitoring and other potential water-related environmental impacts resulting from the proposal.

Issues covered in this report include:

- the condition of natural watercourses and the impacts of demand on water resources;
- changes in water course hydrology and physical environment;
- identification and management of potential sources of water pollution;
- drainage systems and storages at all stages of mine development;
- potential impacts of floods on the proposed operations and of the works (operations and associated levees) on flood levels on surrounding lands;
- water balance and risks of shortages and overflows; and
- a plan for ongoing monitoring of water quality and maintenance of water quality controls.

1.2 SITE OVERVIEW

HVO is located approximately 18 km northwest of Singleton in the Upper Hunter Valley, New South Wales (NSW). The operations are bisected by the Hunter River, which divides HVO into HVO North of the Hunter River (HVO North) and HVO South. HVO South includes the Cheshunt, Riverview and South Lemington Pits and the Lemington Coal Preparation Plant (LCPP). South Lemington Pit is further divided by Wollombi Brook which flows between South Lemington Pit 1 and Pit 2.

Coal is transported from HVO South via internal haul roads to the Hunter Valley Coal Preparation Plant (HVCPP) or Howick Coal Preparation Plant (HCPP) in HVO North for processing, prior to being conveyed to the Hunter Valley Loading Point (HVLP) for rail transport to the Port of Newcastle.

The Cheshunt and Riverview Pits are active opencut operations with mining by truck and shovel and by dragline. The Riverview Pit is located in the western section of HVO South and Cheshunt Pit is in the central north of the area.

The Lemington Pits are located in the eastern sector of HVO South, consisting of a northern and southern mining area. Mining activities in the northern mining area are generally complete and the area is now being rehabilitated. Two pits are approved in the southern area. South Lemington Pit 1 was previously mined by opencut, truck and shovel operations and is now under care and maintenance. Pit 2 operations have not yet commenced.

The LCPP, located to the south of the North Lemington mining area, has approval to process run of mine (ROM) coal from the Lemington and the Cheshunt Pits. This facility is currently under care and maintenance.

Water is currently obtained from onsite runoff captured in storage dams, from intercepted groundwater and from the Hunter River. Separate water management plans are in place for each of the individual pits/mines. However, water is pumped between dams and to operational and processing areas throughout the entire HVO area as described in *Section 2.8.*

1.3 ASSESSMENT OBJECTIVES

The primary objective of this surface water report is to assess the specific and cumulative impacts of mining related activities on the local and regional surface water resources. This includes impacts related to consolidation of existing consents and operational management plans as well as changes to the overall mine plan for HVO South. The following assessment areas have been addressed:

- demand and water supply requirements – to determine if there will be potential changes in demand and consequential changes in the volume of water pumped from the Hunter River outside current water licences;

- changes to catchments and yields – to assess if physical changes to the catchments over the life of the operations will potentially impact on catchment yields and runoff volumes;

- diversions and surface drainage – to consider existing and modified drainage networks and to identify additional drainage required as a result of revised mine plans;

- flooding – to determine impacts of the operations and current and proposed levees on floods in adjacent waterways and of potential flood impacts on the operations themselves;

- water quality and discharges – to identify potential changes to existing water quality due to changes to operations as well as potential for changes to quantity and quality of water discharged from HVO South;

- legacy conditions – to assess expected final drainage networks including the final void and remediated areas; and

- water management and monitoring – to review current management activities and monitoring programmes and identify potential additional requirements.

Supply objectives, changes to catchments and diversion of clean water to natural waterways or to storages are based on the current mine water management plan(s) and any revisions as a consequence of consultations with Department of Water and Energy (DWE) and other authority requirements. Changes to the management plan(s) may occur. Water quality issues may relate to existing and modified onsite containment and treatment methods to ensure discharges meet established environmental guidelines and licence requirements.

1.4 *KEY WATER RESOURCES ISSUES*

Previous assessments have indicated that parts of HVO South are prone to flooding from the Hunter River and Wollombi Brook. Pit extensions under the revised mine plan will interrupt a number of additional natural streams. There may be changes to water demand due to altered mining and processing activities. There may also be changes to the quantity and quality of wastewater produced and to the capture, storage and treatment of saline and sediment laden water. Key issues include:

- water demand and demand management;
- flooding and impacts of flood mitigation measures;
- stream modifications and diversion of clean water flows;
- environmental flows;
- water supply storages;
- mine water management and risks of water shortages and overflows;
- ‘mine affected’ water storage, treatment and discharge;
- water treatment options;
- water reuse/recycling;
- erosion and sediment control;
- impacts on, and from, groundwater;
- modelling requirements and flow measurements; and
- water quality monitoring and response protocols.

In addition, options for rationalising and consolidating separate water management systems are expected to result in more efficient storage management with reductions in demand, discharges and losses.

1.5 METHODOLOGY

This environmental assessment integrates water resources data and objectives with the operational objectives of the mine. Assessment of surface water is based on background data from the previous Environmental Impact Statements (EISs) as well as the current consent conditions, augmented by data collected subsequent to the previous studies.

Mine plans have been reviewed to identify water courses, storages, diversions and other surface water features that are interrupted, subsumed or otherwise affected at all stages of development. Impacts on water quality as well as quantity and associated issues such as erosion, treatment, storage and discharge procedures have then been considered.

Climate data, flood data and topographic information has been input with proposed water management processes to hydrological models to determine the expected quantum of impacts. A separate water balance was also undertaken to assess the current and future uses of water for a number of development scenarios and the potential resulting consequent impacts on water demand, distribution, storage and discharges. *Figure 1.1* provides an example of the existing water balance across HVO as presented in the 2006 HVO AEMR (ie LCPP is not operational). Volumes presented are indicative with annual water balance varying in accordance with production rates, pit sizes and location, rainfall and evaporation. *Figure 1.1* presents volumes in a below average rainfall year (Bureau of Meteorology 2007).

Flood records and results from previous flood modelling have been reviewed to identify where existing and future operations and features may be affected as well as where proposed works and operations will encroach on flood affected areas.

Finally, water monitoring data has been reviewed and assessed against relevant standards and guidelines. Recommendations have then been developed to address potential shortcomings in the existing monitoring practices and modifications required to accommodate all stages of the proposed development. In addition, existing management measures were reviewed to identify additional measures required as a result of this proposal.

1.6 ASSESSMENT LIMITATIONS

Original hydrological data from previous studies has been used with augmentation from subsequent records. Records of water use, discharges, flows and flood levels etc., have been maintained for the existing mine areas. Although the quality of these records is good, there are some situations where records are not available.

CNA is in the process of developing a consolidated water management manual for HVO South. This plan will be guided by the outcomes of this environmental assessment. Conversely, this environmental assessment will be impacted to some extent by the anticipated form of the consolidated Water Management Manual which will include a Surface Water Management Plan (including levee plan), Groundwater Management Plan and Rivercare Management Plan. A number of assumptions have therefore been made regarding the configuration of the consolidated water management system based on existing water management practices and on plans developed for previous EISs.

Hydrological, hydraulic and catchment yield models developed for the previous EISs are assumed to be valid and relevant to this assessment. It is expected that a new consolidated hydrological model will be developed using appropriate software. This will model changes to runoff characteristics for the entire HVO South area as part of the consolidated water management manual and that flows will not vary significantly from previous estimates.

It is assumed that hydraulic modelling undertaken previously for the Hunter River and Wollombi Brook is valid and will not be affected by modified mine plans. Proposed activities and features are not expected to extend into flood prone areas, to any greater extent than previously consented.

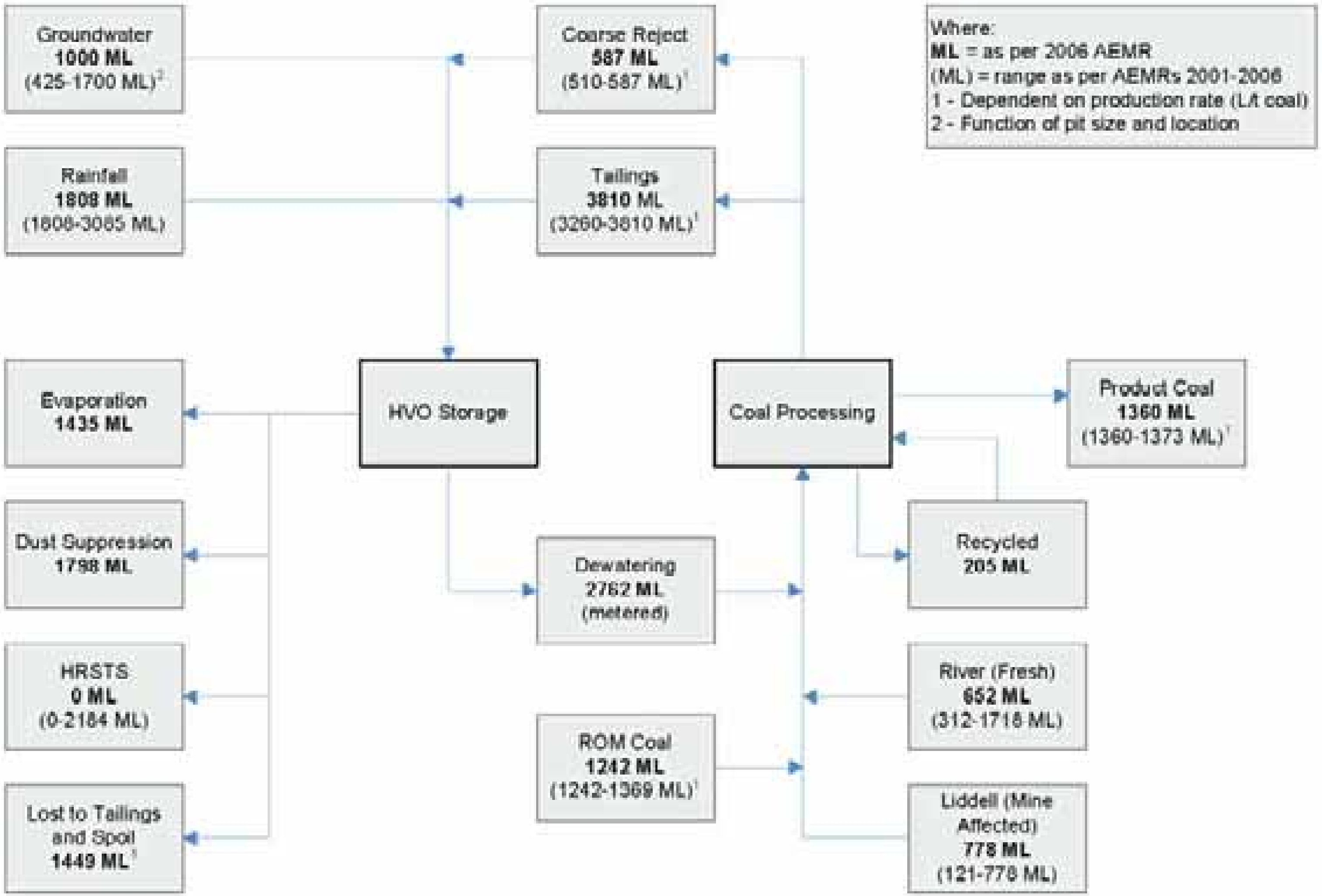

Figure 1.1

Indicative HVO Water Balance

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_SW_07_R0
Date:	21/12/2007 Drawing size: A4
Drawn by:	GC Reviewed by: LS
Source:	-
Scale:	-

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2 EXISTING ENVIRONMENT

2.1 REGIONAL DRAINAGE

HVO South is located close to the confluence of the Hunter River and Wollombi Brook approximately 28 km (by river) upstream of Singleton, NSW. The Hunter River has a total catchment area of approximately 22,000 km^2, approximately 14,000 km^2 of which is upstream of its confluence with Wollombi Brook near the eastern edge of HVO South. The Hunter River then continues to flow in an east-south-easterly direction from HVO South for approximately 170 km to its outlet to the Pacific Ocean at Newcastle.

The Hunter River catchment comprises a diverse range of land uses including agriculture (grapes, cereal crops, grazing, and dairy etc.), urban and rural residential areas, coal mining, power generation, heavy industry, tourism and fisheries.

Wollombi Brook has a total catchment area of 403 km^2 of which only approximately 13% has been cleared for agricultural uses (mainly vineyards and grazing) in the flat river valleys. The majority of the catchment comprises forests and bushland on steep to mountainous terrain.

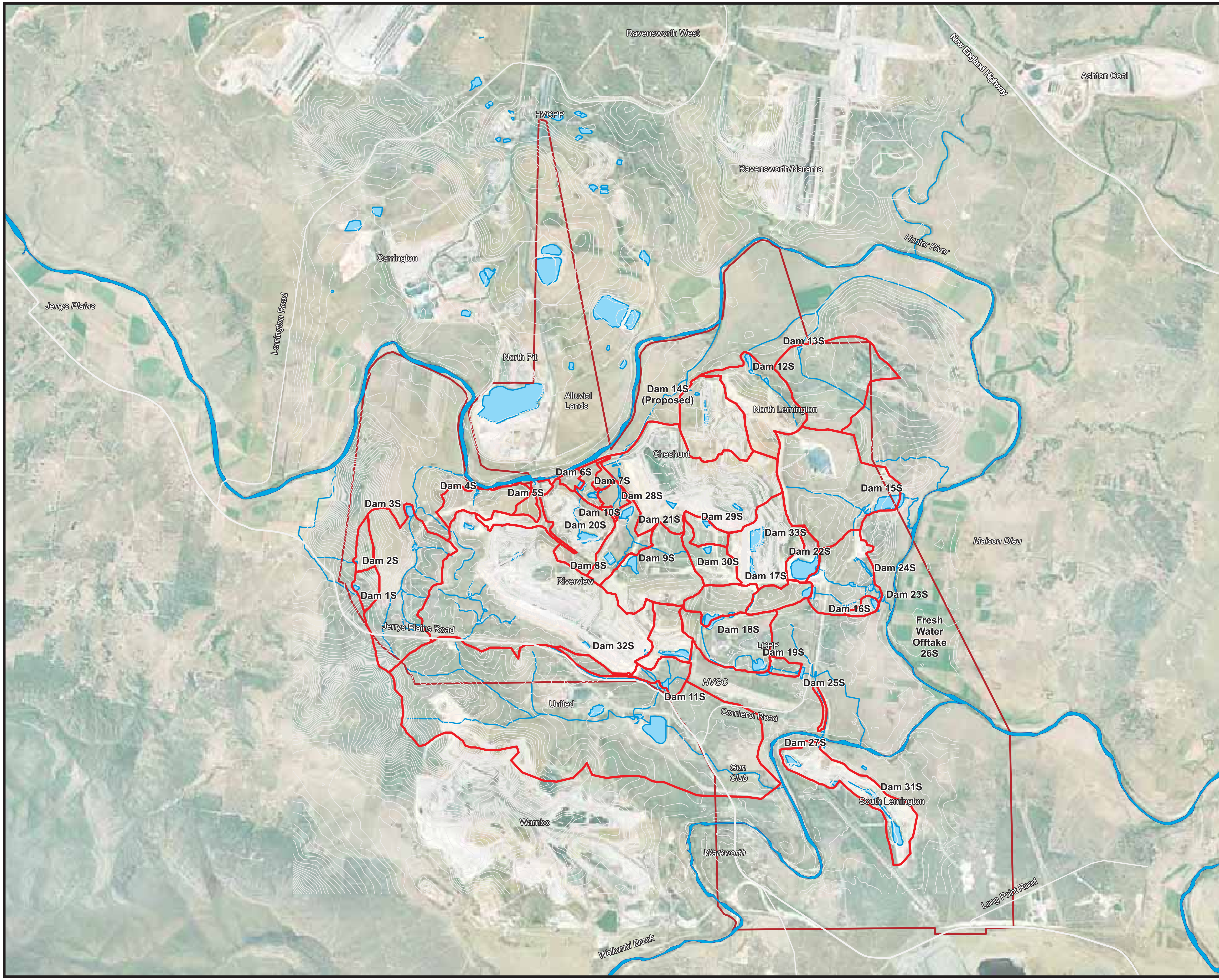
2.2 SITE DRAINAGE

HVO South occupies an approved mining area of 2,980 ha within the Hunter River Catchment. It is bounded to the north and east by the Hunter River. Wollombi Brook meanders in a north easterly direction through the southern part of the area, separating South Lemington Pits 1 and 2.

Longford Creek and several other small tributaries drain the area to the south of Wollombi Brook. Longford Creek flows in a northerly direction near the eastern edge of South Lemington Pit 1 to meet Wollombi Brook approximately 1 km upstream of its junction with the Hunter River.

To the north of Wollombi Brook, Redbank Creek and Comleroi Creek drain in a south easterly direction to Wollombi Brook. Comleroi Creek drains part of the eastern edge of the site while Redbank Creek drains the LCPP, the southern edges of South Lemington Pit 2 and the southern side of Jerrys Plains Road. The north western and central areas of the site drain to Hobden Gully which flows in a north easterly direction to meet the Hunter River.

A catchment plan is given in *Figure 2.1*. This shows some of the predevelopment conditions as well as existing conditions. It should be noted that runoff from approximately 90% of the HVO South mining area is intercepted either by pits or by storage or sediment dams for use on site. The 10% that drains directly to external waterways is undisturbed land. Approximately 16 ha south of Jerrys Plains Road contributes to flows within the HVO South mining consent boundaries.



Legend

- Catchment Boundary
- Contours
- Storages
- Streams / Rivers
- Roads
- Project Application Area

Figure 2.1

HVO South, Existing Catchments

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_SW_01_R1
Date:	08/03/2007 Drawing size: A3
Drawn by:	ML Reviewed by: LS
Source:	-
Scale:	Refer to Scale Bar

N 0 1 2km

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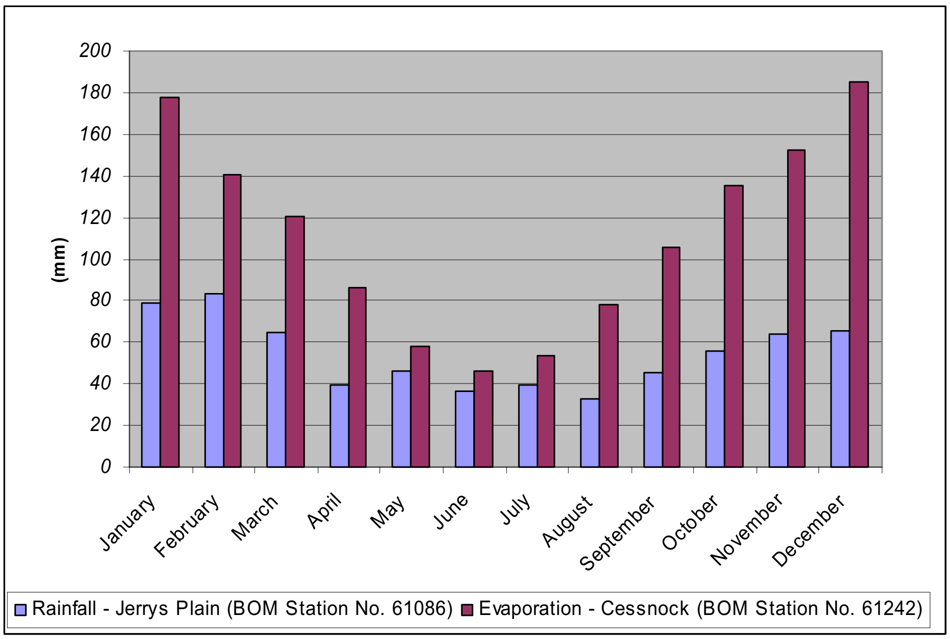
2.3 RAINFALL AND EVAPORATION

The nearest long term rainfall gauging station operated by the Bureau of Meteorology is located at Jerrys Plains. The average annual rainfall based on data collected between 1975 and 2006 is 657 mm. Rainfall data is also recorded at the Cheshunt meteorological station at HVO.

The nearest long term gauging station which records evaporation data operated by the Bureau of Meteorology is located at Cessnock. The average annual evaporation based on data collected between 1975 and 2006 is 1338 mm.

Rainfall and evaporation data are summarised in *Figure 2.2*.

Figure 2.2 Average Monthly Rainfall and Evaporation (1975 – 2006)



2.4 STREAMFLOW DATA

The DWE's PINNEENA database has streamflow and river gauging data for Wollombi Brook and the Hunter River at locations shown in *Figure 4.1*. Stream discharge-duration data for these locations are presented in *Appendix A.*

The gauging station on Wollombi Brook at Warkworth (Station no. 210004) has recorded data since 1908. Average daily flows at this location are 468 ML/d, with a maximum daily flow of 322,576 ML/d recorded on 26 February 1955 with a maximum gauge height of 10.13 m (equivalent to 59.42 mAHD). This is estimated to be approximately equivalent to the 147-year Average Recurrence Interval (ARI) flood level.

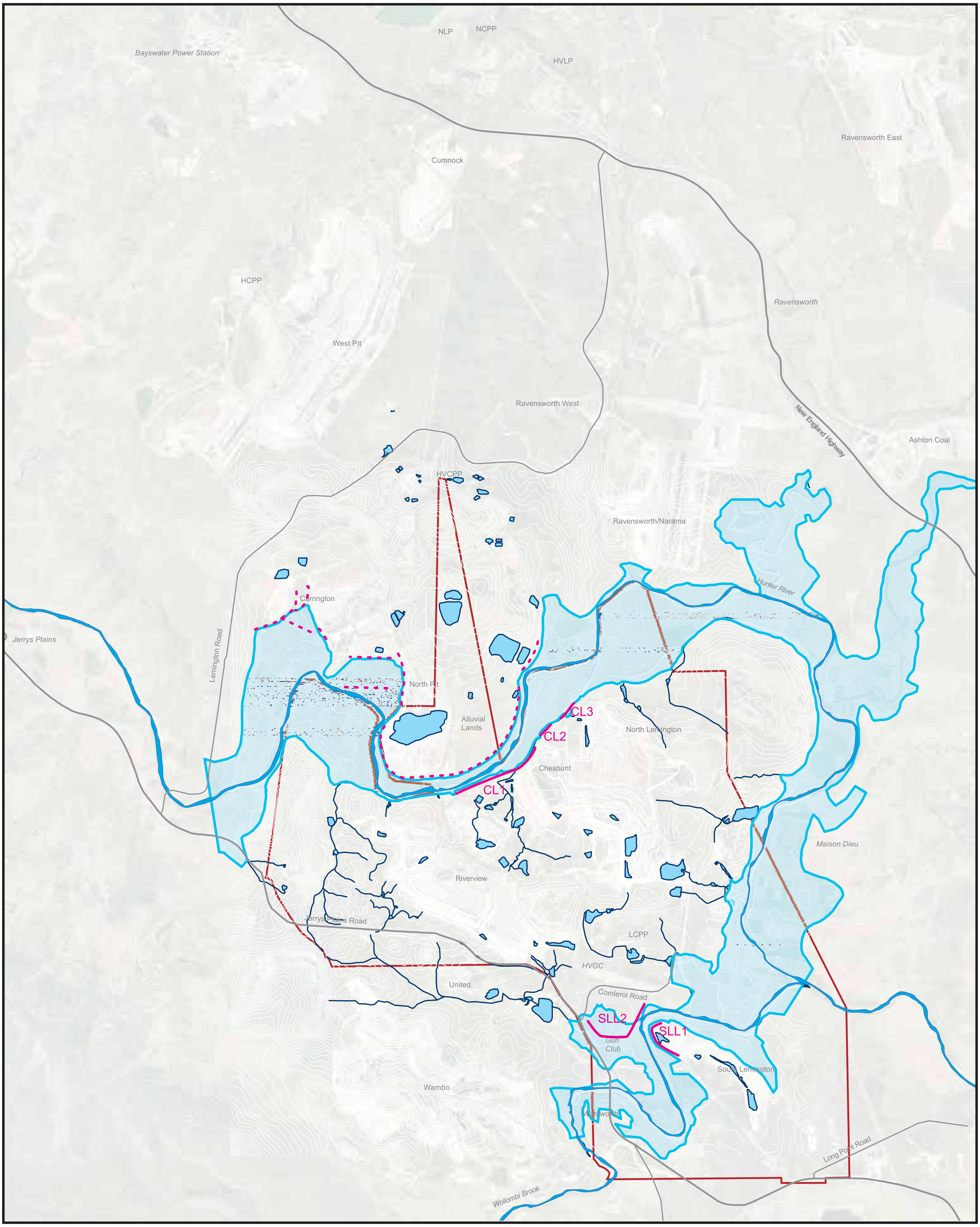
There are six gauging stations along the Hunter River in the vicinity of HVO South, with lengths of records varying from 11 years to 37 years. The station with the longest record (Station no. 210083) is located approximately 10 km upstream from HVO South and has recorded data since 1969. The average daily streamflow recorded at this station during this period was 1088 ML/day, and a maximum daily flow of 208,070 ML/day was recorded on 5 March 1977 (approximately equivalent to the 10-year ARI event). Gauging Station 210134, located approximately 6 km downstream of the junction of the Hunter River with Wollombi Brook, has recorded data since 1994. The average daily streamflow recorded at this station during this period was 1121 ML/day, and a maximum daily flow of 155,815 ML/day was recorded on 10 August 1998.

2.5 *FLOODING*

Estimates of 100-year ARI flood levels have been derived on a statistical basis from recorded flood levels in the Hunter River and Wollombi Brook. It is not possible to equate the 100-year level to a single event as each catchment has significantly different characteristics and will therefore respond differently to 100-year storm events of different durations and patterns. For consistency, however, a common (or envelope) 100-year level of 59.1 m AHD has been adopted for both the Hunter River and Wollombi Brook at the junction as a conservative estimate. An approximate extent of the 100-year ARI design flood is shown in *Figure 2.3*.

The impacts on flood levels of the constructed Hobden Gully and the two approved Cheshunt Pit levees in combination with all other constructed and proposed levees on the northern side of the Hunter River were estimated to be insignificant and less than 60 mm total maximum afflux (refer Annex C of Carrington Pit Extension, Lyall & Associates, 2005). Lyall & Associates reported in Annex H of the Cheshunt Extension SEE (2004) that the two proposed Cheshunt Pit levees would not have a measurable impact on flood levels in the Hunter River.

Similarly, the impacts on flood levels in Wollombi Brook of the levees around South Lemington Pits 1 and 2 proposed in the South Lemington EIS (May 1998) were modelled. These levees were estimated to create less than 30 mm total maximum afflux, which is considered to be insignificant. There would be no discernible impact on flood extent as a result of these levees. All approved levees constructed or proposed to be constructed for HVO South are shown in *Figure 2.3*.



Legend

- Extent 100 Year Flood
- Contours
- Storages
- Streams / Rivers
- Roads
- Project Application Area
- HVO South Levees:
  - CL1 Hobden Gully Levee
  - CL2 Cheshunt Pit Levee 1
  - CL3 Cheshunt Pit Levee 2
  - SLL1 South Lemington Pit Levee 1
  - SLL2 South Lemington Pit Levee 2
- HVO North Levees

Figure 2.3

Design 100 Year ARI Flood Extent and Levees

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_SW_02_R2
Date:	27/09/2007 Drawing size: A3
Drawn by:	GC Reviewed by: LS
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2.5.1 Wollombi Brook

Two major flood events have been recorded in the lower Wollombi Brook on 17-19 June 1949 and 24-27 Feb 1955. Records vary on maximum flood levels, however, it has been determined that the 1949 flood was the largest flood in Wollombi Brook upstream of Warkworth and the 1955 flood was the largest flood for most of the reach downstream of Warkworth.

The recorded/estimated flood levels for Wollombi Brook were as follows:

Wollombi Brook at junction with Hunter River:

- 1949 flood level 56.9 m AHD
- 1955 flood level 58.2 m AHD

Wollombi Brook at Warkworth:

- 1949 flood level between 59.2 and 60.2 m AHD
- 1955 flood level between 58.0 and 59.4 m AHD

Wollombi Brook at Bulga:

- 1949 flood level 65.7 m AHD
- 1955 flood level 62.7 m AHD

The differences in recorded levels at Warkworth may have been due to confusion as to which datum was used (WCD or NWWCD) as well as the different sources that were used. In addition, the gauge was relocated in 1954.

For the South Lemington EIS, design flood levels were calculated using a multiple regression analysis in conjunction with discharge frequency curves at Singleton and Bulga (SKM, 1997). Flood level profiles were calculated using the HEC-2 computer programme. While these estimated levels may be subject to change as flood records are extended and as refinements and changes occur to the hydraulic model, until a formal flood study is undertaken by DWE or other authorities, the estimates made in the South Lemington EIS and given below in *Table 2.1* will be adopted.

Table 2.1 Design Flood Levels at South Lemington

ARI (Years)	Flood Level at Warkworth (mAHD)	Flood Level at South Lemington (mAHD)	Flow Rate at South Lemington (m^3/sec)	Channel Velocity South Lemington (m/sec)
5	53.3	53.4	600	1.33
10	55.4	54.9	1400	1.52
20	57.5	57.2	1900	1.38
50	59.0	58.9	2500	1.39
100	59.4	59.3	2700	1.41

2.5.2 *Hunter River*

For the Hunter River, near the HVO South site, the maximum flood event is believed to have occurred on 24 February 1955. The recorded flood level at Singleton on this date was 42.2 mAHD. Insufficient recorded information is available from other nearby stations to confirm the 1955 flood levels at the HVO site.

In addition to levees constructed on the north side of the Hunter River to protect HVO North, a levee (the Hobden Gully levee) was constructed across the mouth of Hobden Gully to protect the Cheshunt and Riverview Pits from flood events up to the 185-year ARI (approximately 71.0 mAHD), which is equivalent to the estimated 100-year ARI flood level in this section of the river plus 1 m freeboard.

The 100-year ARI flood level in the Hunter River is estimated to vary from 59.1 m AHD at the junction with Wollombi Brook to 60.2 m AHD adjacent to Dam 23S to 66.5 m AHD adjacent to Dam 12S and 73.2 m AHD adjacent to Dam 4S (*Figure 2.4*).

2.6 *ENVIRONMENTAL VALUE OF RECEIVING WATERS*

The Hunter River is the ultimate receiving water for all discharges from HVO South. Approximately 20% of the total area within the existing merged HVO South consent boundaries drains to the Hunter River via Wollombi Brook.

The NSW DEC has established interim water quality objectives for the Hunter River Catchment (DEC, 1999). These objectives establish the desired beneficial use of the receiving waters. The Hunter River, in the vicinity of HVO South, is classified by the DEC as a regulated river, and the other creeks and tributaries in the vicinity of HVO South are classified as uncontrolled streams. The environmental values assigned by the DEC for these waters are for the protection of water quality for:

- aquatic ecosystems;
- primary and secondary contact recreation;
- visual amenity;
- livestock, irrigation and homestead water supply;
- drinking water – disinfection only and groundwater; and
- aquatic foods (to be cooked before eating).

Numerical water quality criteria for the protection of the above values are provided in both the DEC Guidelines and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000) and are summarised in *Appendix B*.

2.7 *WATER QUALITY MONITORING*

Surface water monitoring is undertaken at HVO on a monthly basis to assess both the quality of mine water in onsite dams and the possible impact of mining on the surrounding surface waters. The results of this monitoring, as reported in the HVO Annual Environmental Management Reports for the years 2003 to 2005 indicate that:

- dry conditions generally lead to an increase in mine water salinity and pH and a decrease in total suspended solids (TSS). These trends are reversed during wet conditions with an increase in TSS and a decrease in pH and salinity;

- Dam 15S (Lake James) is the licensed discharge dam for HVO South. In general water quality monitoring results indicate pH readings from 8.9 to 9.4 and Electrical Conductivity (EC) of 5010 - 6180 µS/cm with low TSS (<50 mg/L). TSS has occasionally exceeded 50 mg/L but no releases are made when approved discharge conditions (TSS of 120 mg/L) are not met. No releases have occurred from this dam since at least 2001;

- Dam 16S (East Opencut) is located adjacent to the Hunter River within the Project Application area. In general water quality monitoring results indicate pH readings from 8.9 to 9.4 and EC of 2110 - 3050 µS/cm with low TSS (<50 mg/L);

- Hunter River water quality is monitored at seven sampling sites, located over an area from upstream of the mine operations to a point downstream of the junction with Wollombi Brook. WL1 is the site located furthest downstream and is influenced by saline water from Wollombi Brook. Water quality is influenced significantly by weather and flow conditions, with raised TSS and lowered pH and EC being associated with high river flow. All seven sites have similar water quality and similar responses to rainfall events;

- water is monitored at three locations on Wollombi Brook which has historically had saline water. One of the monitoring sites has been dry during many of the monitoring events, with the other two sites being located where flow is typically present. EC values typically range from 480 µS/cm to 3390 µS/cm. The pH readings for the Wollombi Brook were neutral to alkaline with values ranging from 7.4 to 9.2; and

- Comleroi Creek has had relatively constant pH, which is typically close to neutral. EC is typically in the range of 200 µS/cm to 900 µS/cm and TSS remains constant and below 50mg/L throughout the year.

Table 2.2 presents the EC values (average and range 2004 – 2007) for dams at HVO representing a TSF, mine water dam and discharge point.

Table 2.2 Representative Electrical Conductivity Values for Dams Across HVO

EC (uS/cm) 2004-2007	**Function and Location**		
	TSF	Mine Water Dam/ Discharge Point	Mine Water Dam
	North Pit TSF	Dam 11N	Dam 16S (EOC)
Average	5245	6556	2361
Range	4970 - 5520	3060 - 8900	570 - 5490

HVO participates in the Hunter River Salinity Trading Scheme (HRSTS), allowing it to discharge from Lake James to the Hunter River. These discharges can only take place during high flow and flood flow conditions in compliance with strict HRSTS regulations. No discharges were made under the scheme during the 2003 to 2005 period.

2.8 *EXISTING WATER MANAGEMENT*

The existing water management system comprises a number of clean water and 'mine affected' water drainage systems connected by a network of pumps and pipelines to transfer water between locations. Mine affected water storages include TSFs, pit storages and other dams containing saline or otherwise contaminated water. An arrangement plan showing key elements is given in *Figure 10.2*. A summary of the water management facilities and operating protocols is also given in *Appendix C of Annex K*.

Various catch drains, channels, contour drains and culverts collect and convey runoff from clean and disturbed areas to the appropriate storages and watercourses. Silt traps and other pollution control devices are also used at various locations along these drains to reduce the quantities of suspended sediment reaching sedimentation dams. Overflows from most sedimentation dams flow directly to external waterways, all of which eventually flow to Wollombi Brook or the Hunter River.

Clean water runoff from undisturbed and fully rehabilitated areas is directed away from opencut mining areas, haul roads, TSFs and other disturbed areas. Catch drains also divert clean runoff from undisturbed areas around mine constructed storages wherever practical. Contour drains divert runoff towards storages from newly rehabilitated areas and from other areas where it may pick up sediment.

Current practice is to maintain sufficient freeboard in key mine water storages with overflows that flow directly to external waterways. The aim is to provide sufficient reserve capacity (air space) in these dams to store the 100-year ARI runoff from the contributing catchments.

Dams 15S, 16S, 17S and 20S are the main mine water storages. These dams contain water with elevated salinity levels and all are interconnected by the pipeline network. Water is able to be transferred north and south of the Hunter River via the Hunter River bridge, to HVO North Dams and the North Pit void

Dams 23S and 24S are downstream of the Lemington workshop and also receive decant water and seepage from the No. 5 TSF (22S). Water quality in these dams is consequently degraded with elevated Biochemical Oxygen Demand (BOD), Carbon Oxygen Demand (COD), nutrients and hydrocarbons.

Dam locations are shown on *Figure 2.4.*

2.8.1 *Existing HVO South Water Supply*

There are four existing (high security) water licences that permit CNA to pump water from the Hunter River. The combined entitlement is 4165 Units (ML/annum or a share of the available resources). These licences were revised in March 2005 and are summarised in *Table 2.3*.

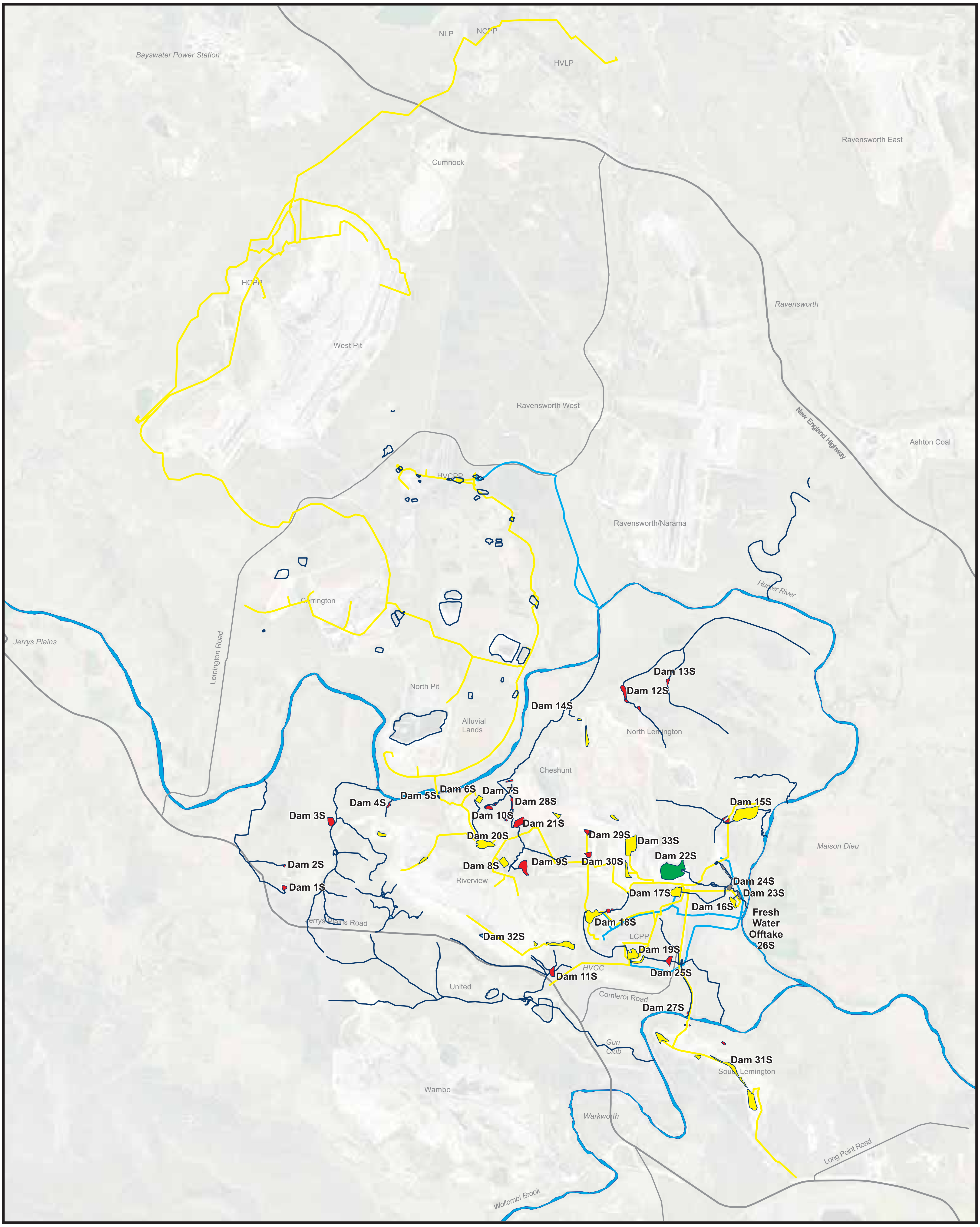
Table 2.3 CNA Water Licences

Licence No.	DWE Reference	Shared Component (Units)	Location/Purpose
962	20AL201237	2,665	Hunter River between Goulbourn River junction and Glennies Creek junction. Used mainly for HVCPP, truckwash and dust suppression when required.
970	20AL201256	500	Hunter River between Glennies Creek junction and Wollombi Brook junction. Previous and proposed use mainly for LCPP and dust suppression when required.
1006	20AL201337	500	Hunter River between Glennies Creek junction and Wollombi Brook junction. Previous and proposed use mainly for LCPP and dust suppression when required.
1070	20AL201500	500	Hunter River between Glennies Creek junction and Wollombi Brook junction. Previous and proposed use mainly for LCPP and dust suppression when required.

All licences have continuing tenure and do not limit extraction rates or times.

2.8.2 Tailings Storage Facilities

Current TSFs 1a, 1b, 2, 3, 4a, 4b and 5 are located in Lemington (northern area). TSFs 1a, 1b, 2, 3 and 4a are capped and rehabilitated. TSF 4b is inactive and is partially capped and rehabilitated, with completion of rehabilitation following consolidation and drying of the remaining tailings. TSF 5 is currently inactive but remains available for additional future tailings storage.



Legend

- Saline Water
- Sedimentation
- Tailings
- Degraded Water
- Saline Water Pipelines
- Fresh Water Pipelines
- Streams / Rivers
- Roads

Figure 2.4

Water Management Arrangement

Client:	Coal & Allied Operations Pty Ltd
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_SW_03_R1
Date:	20/06/2007 Drawing size: A3
Drawn by:	GC Reviewed by: LS
Source:	-
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3 IMPACT ASSESSMENT

3.1 DEMAND AND WATER SUPPLY REQUIREMENTS

Mining of additional areas has been assessed as having a minor impact on overall water demand and consequently on the management of water supply storages. The currently licensed water extraction volume of 4165 MLpa should be adequate for both HVO North and HVO South requirements provided internal water use continues to be actively managed, and provided high security water licence allocations are maintained at the current levels.

The reactivation of the LCPP to higher production levels than were previously approved will result in an increase in water demand. Up to 4500 MLpa may be required for the processing of up to 16 Mtpa ROM of which 2,700 MLpa would need to be consistently drawn from the Hunter River unless the current water system is modified. The most effective option for minimising the risk of shortage and the consequent need to pump from the Hunter River was found to be installation of direct pumping capacity from the main HVO South storage (Dam 20S) to the LCPP. As mining progresses, a replacement storage to provide capacity for storage of mine water, and an increase in pumping capacity to the LCPP will be required.

Seepage into the Cheshunt Pit is predicted to range from 0.7 ML/day (281 MLpa) to 7.3 ML/day (2900 MLpa), dominated by water contained within the material disturbed by mining. Groundwater modelling has predicted that this may vary by up to 100% in initial stages of mining. Pit seepage accumulation will be reduced by evaporation losses. These losses are predicted to reduce maximum pit seepage accumulation from 7.3 ML/day to between 6.5 ML/day in Winter to 5.0 ML/day in Summer.

Cheshunt Pit can eventually replace Dam 20S as the main source of water for the LCPP; however, the relocated Dam 20S may continue to operate as a central balance storage until late in the progression of mining in the Riverview Pit area. In addition, the increasing rate of seepage into Cheshunt Pit will eventually eliminate all requirements to pump from the Hunter River.

Modifications to the water management system should result in the ability to cope with changes in demand. In addition, reduction in losses, through the coordinated use of the North Pit Void as a large balance storage, is expected to improve the proportion of recycled water used and consequently reduce the risk of water shortages during extended dry periods. The North Pit Void has a theoretical ultimate capacity to store up to 29,000 ML but the proportion of useable storage will depend on modifications to the water retrieval system. The use of this storage would depend on stages of mining operations, tailings disposal options and installation of appropriate pumps and pipe networks.

Several sedimentation and mine water dams may require relocation or augmentation as a result of modifications to the final landform that differ from previously approved mine plans. However, there will be little change to the overall storage capacity of the system and its ability to supply water.

3.2 *CHANGES TO CATCHMENTS AND YIELDS*

Several small sub-catchments will be altered in size and shape as mining progresses in accordance with the proposed mine plan. This will have an insignificant impact on overall catchment yields (<1000 MLpa).

Riverview Pit will now be backfilled rather than be left as a void so that rainfall will eventually run off this sub-catchment rather than be retained in the void. The relocated final void in Deep Cheshunt will be approximately 300 ha in area and will not drain to the Hunter River. The total yield of the Hunter River catchment above Wollombi Brook will therefore be reduced by approximately 0.03% in relation to pre-mining conditions. This is insignificant in both absolute and cumulative impact terms. This new void is likely to take a considerable time to fill with water from groundwater inflows and from direct rainfall. Changes to final landforms in South Lemington Pits 1 and 2 inclusive of TSFs will not alter the final sub-catchment areas contributing to flows in Wollombi Brook.

In summary, there will be minor local changes to some final sub-catchments as a result of modified final landforms. However, the proposal will have a negligible impact on flows in Wollombi Brook and the Hunter River on the basis that the total contributing catchment area will be unchanged and only a slight change will occur in proportions of flows to the Hunter River and Wollombi Brook. The arrangement for final catchments is shown in *Figure 3.1*.

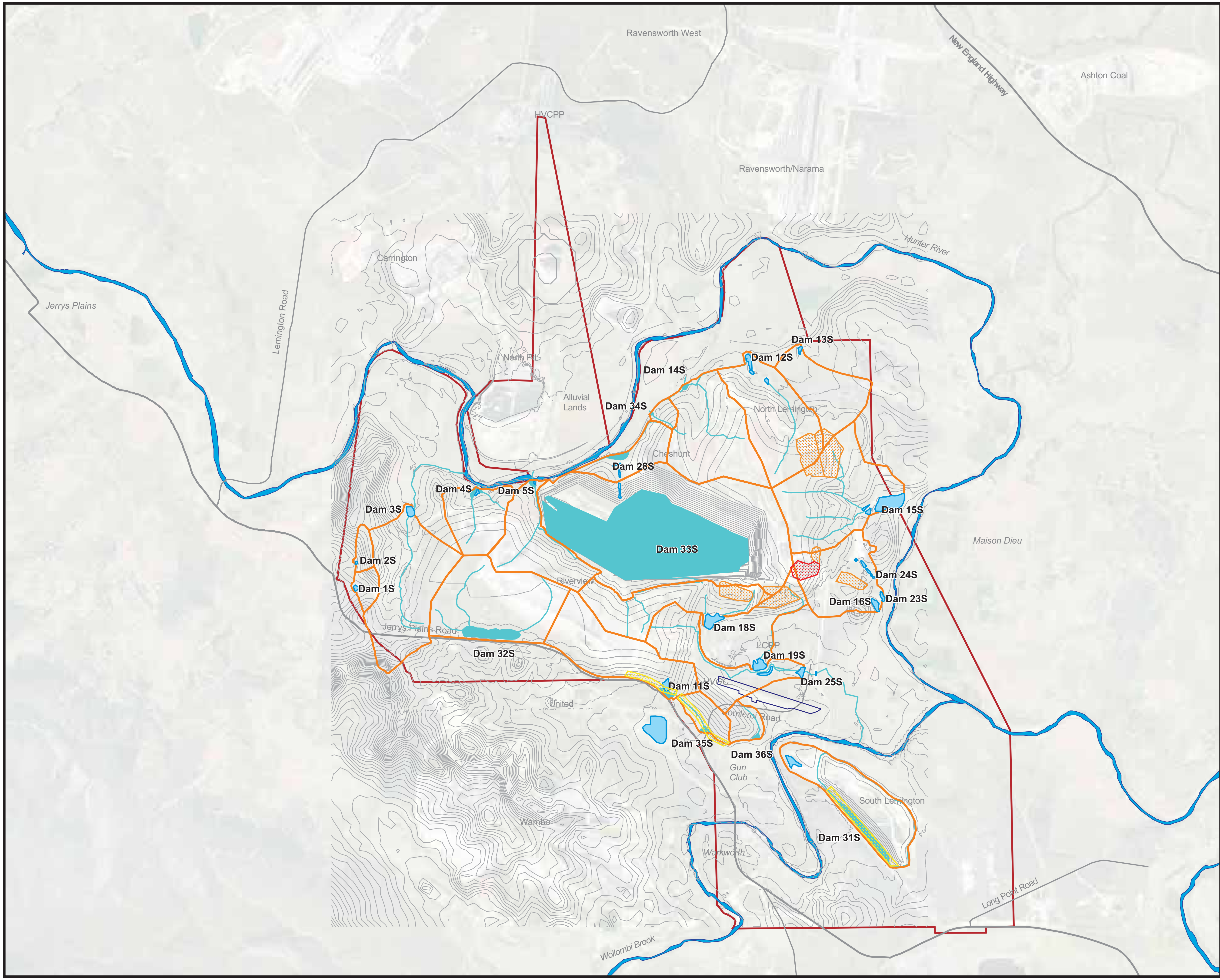

Figure 3.1

HVO South, Final Catchments

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_SW_04_R2
Date:	27/09/2007 Drawing size: A3
Drawn by:	GC Reviewed by: LS
Source:	-
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3.3 *DIVERSIONS AND DRAINAGE*

The proposed extensions to the opencut pits will intercept several existing small watercourses which will require diversion. Some of the existing dams, channels and other drainage structures will be affected as mining operations progress and will need to be reassessed, relocated, modified or replaced by other drainage arrangements. This will ensure that clean water runoff continues to be diverted around disturbed areas and that all mine affected water is directed into the mine water management system.

Future mining and associated alterations to landforms may modify overland flow paths to a minor extent. However, there will be no significant changes to flows and local flooding as a result.

Within the Project Application area and for the revised mine plan there will be no significant changes to the water management activities previously approved with the following exceptions:

- the relocation or reconfiguration of the HVGC airstrip will require a new drainage system but will not impact on adjacent drainage systems;

- the upgraded or reconstructed LCPP may considerably alter the runoff characteristics of the existing drainage system in this area;

- increases in activity at the Lemington workshop will increase the loads on the water treatment system between the workshop and Dam 23S. This system is already considered to be inadequate so that there is no capacity for these increased loads; and

- the levee around South Lemington Pit 2 will become permanent rather than be removed (as detailed below). However, because the area behind the levee will be filled to levels above probable maximum flood level, there will be no possibility of failure of this levee after the final landform has been achieved.

3.4 *FLOODING*

Mining operations can only extend further into the Hunter River or Wollombi Brook floodplains with the approval of relevant regulatory authorities. In fact, the proposed levee around South Lemington Pit 2 will encroach to a lesser extent than previously planned and will therefore reduce the expected impact on flooding in Wollombi Brook, which was previously estimated to be less than 30 mm of afflux in a 100-year ARI flood. The South Lemington Pit 1 levee will remain unchanged as a result of this proposal. These levees are shown as SLL1 and SLL2 on *Figure 2.3.*

Levees have already been constructed across the mouth of Hobden Gully and adjacent to Cheshunt Pit (Levees CL1, CL2 and CL3 on *Figure 2.3*). The combined impact of these levees with levees on the north side of the Hunter River was previously shown to be negligible (60 mm afflux as a result of all Hunter River levees). These levees were constructed to the 100-year ARI flood level plus 1 m freeboard providing nominal protection against the 185-year ARI flood with no freeboard.

The Cheshunt Pit will be protected by levees CL1, CL2 and CL3 during mining operations. After completion of mining when the Deep Cheshunt final void remains, only levee CL1 (the Hobden Gully levee) may be required for long term flood protection. Options are discussed in *Section 4.4.* CL1 is capable of withstanding floods up to the 100-year ARI event with freeboard (or approximately the 180-year ARI event at the point of overtopping). Failure or overtopping of all levees as a result of floods in the Hunter River catchment will be addressed in the levee management section of the Water Management Manual.

An emergency plan for evacuation and pumping out of inundated pits during flood events was prepared in consultation with DEC and will be implemented as required for flood management purposes. There should be no significant changes required to this plan as a result of the revised mine plan.

The final landform in the vicinity of South Lemington Pit 2 will be significantly different to that shown in the 1997 EIS for this mine (as amended in 1998). The currently consented plan is to construct a levee (SLL2) to protect against the 100-year ARI flood with 0.7 m freeboard (i.e. crest level 60 mAHD) around Pit 2 until mining is complete. The levee would then be dozed into the pit and final surface restored to levels similar to existing. The revised plan for this proposal is to leave the levee in place and to fill behind the levee to higher levels than existing surface levels. The realignment of Comleroi Road will result in the construction of the road on top of or inside the levee (*Figure 5.8 of Volume 1*).

The impact of the South Lemington levees was previously estimated to produce a 30 mm increase (afflux) in the 100-year ARI flood, which was considered insignificant.

3.5 WATER QUALITY

During mining operations there is potential for runoff from haul roads and other disturbed areas to transport sediment to receiving waters. There is also potential for saline groundwater and water from the mining process which can also be saline or otherwise contaminated, to be discharged to the environment.

Several of the sedimentation dams that overflow to the Hunter River or Wollombi Brook require pumping out to ensure they have capacity to contain the 100-year ARI runoff from their respective catchments. If they are not able to contain this runoff, there is potential for sediment laden water to overflow to receiving waters. Some smaller sedimentation dams, particularly Dam 5S, have occasionally discharged to receiving waters. There is no current requirement for monitoring of discharge water quality from these dams, but event sampling has been undertaken on some of these dams immediately after significant rainfall.

Discharges of surface water from opencut voids and other disturbed areas have the potential to adversely impact on the water quality of receiving waters, including increasing sediment loads and salinity, unless the runoff is adequately treated and managed. Continued implementation of surface water management measures already in place at HVO South, including erosion and sediment control measures and containment of saline water will minimise any adverse impacts on water quality. Long term changes to surface water quality following the completion of rehabilitation works are unlikely. However, because the revised mine plan includes higher and, in some locations, steeper final landforms, there is potential for increased erosion until vegetation is re-established.

The potential for increasing salinity of receiving waters is associated with leaching of soluble salts from the spoils, tailings and surrounding ground. The potential impacts of saline water discharge into the Hunter River are addressed by implementation of the Hunter River Salinity Trading Scheme. This scheme was initiated by the EPA and only permits discharges at times of high flow in the Hunter River. It is generally found that saline leachate diminishes rapidly after capping and revegetation of TSFs and spoil mounds. It is more common that salinity is affected by voids and their interaction with groundwater. This issue is dealt with in more detail in the *Groundwater Assessment Report* presented as *Annex J*.

3.6 ENVIRONMENTAL FLOWS

No specific requirements exist for environmental flows from HVO South to receiving waters. Flows from many catchments are essentially uncontrolled after spillway discharges from sedimentation dams. The total discharge from all catchments will vary as pits are extended or filled and spoil areas are rehabilitated. There will be no change to this regime as a result of the modified mine plan.

3.7 FINAL VOIDS

One final void is now proposed for HVO South; the Deep Cheshunt final void. The location and size of this void and void management details are provided in detail *Chapter 19 - Mine Landscape Planning*. Water in the Deep Cheshunt Pit final void may take up to 250 years to reach an estimated equilibrium level of RL 0 mAHD, which is approximately 50 to 60 m below current ground surface in this area. The time to fill the void would be significantly shortened if flood flows from the Hunter River were allowed to enter the void or if the levee were overtopped by a flood in excess of the 180-year ARI event.

3.7.1 Tailings Storage Facilities

The existing TSF 5 is available for an estimated additional tailings deposition capacity of 230,000 m^3. A four metre lift on the TSF is fully designed and approved by the Dam Safety Committee. It is estimated the lift will provide a further 745,000 m^3 capacity. Beyond the four metre lift, a concept design for a second lift has been prepared to provide for a further 820,000m^3 capacity.

Whilst TSF 5 has capacity for some of the tailings generated by the LCPP, an additional volume of approximately 11.8 million m^3 of material must be located within HVO South. To accommodate this volume of material, additional TSFs are proposed within the South Lemington Pit 1, the eastern section of the Riverview Pit and within the south eastern Riverview Pit extension area. Consequently there will be no impacts from TSFs on surface water.

The management of tailings is described further in *Chapter 2*. The locations of rehabilitated, inactive and proposed TSFs are shown on *Figure 3.1*

4 *HVO SOUTH SURFACE WATER MANAGEMENT AND MONITORING MEASURES*

This Section discusses current and proposed measures to address the potential impacts identified in *Section 3*. Some of these measures will be the result of obtaining a single Project Approval with one set of conditions and some will be related to impacts from proposed modifications to the overall mine plan. Where shortcomings in previous water management are identified they are noted in this section.

4.1 WATER DEMAND

The minor changes in water demand will be easily accommodated in the HVO South Water Management Manual currently being prepared to consolidate all water management activities undertaken across HVO South. It is anticipated that the current capacity to transfer water across HVO will be further improved. Increased water storage capacity and reduced water losses resulting from smaller total storage surface area should significantly reduce the risk of water shortages and consequently reduce the extent to which water is extracted from the Hunter River.

The increase in demand at the LCPP can be met by increasing the pump capacity to supply peak demand flows from other storages (Dam 20S).

With improved water recycling, it may be possible to reduce the need to extract water from the Hunter River other than in extreme dry conditions.

4.2 WATER MANAGEMENT SYSTEM

The HVO South Water Management Manual will be developed incorporating the modified mine plan for the whole of HVO South.

Of the existing mine water dams, sedimentation dams and other storage structures, some will be mined through as mining progresses, several may require relocation or modification and the remainder can remain in place over the life of the mine until assessed by the Mine Life Plan to be no longer required. *Table 4.1* details the current status and potential modifications associated with the proposal.

Additional sedimentation dams will be constructed at any location where runoff from disturbed areas is redirected from existing channels or where new areas are disturbed. Rehabilitation areas will include contour drains and other drainage channels to direct potentially sediment laden water to new or existing sedimentation dams.

Table 4.1 Potential Modifications to Storages

Struct. No.	Name	Purpose	Potential Modification	Expected Date
1S	*Dam 1S*	Sedimentation	None	-
2S	*Dam 2S*	Sedimentation	None	-
3S	*Dam 3S*	Future mine water management	Small sediment dam exists - final dam to be constructed. (Approved under Riverview SEE 2006)	-
4S	*Dam 4S*	Sedimentation	None	-
5S	*Dam 5S*	Sedimentation	None	-
6S	*Dam 6S:*	Mine water management	To be mined through. Potential to relocate to new water cart filling station.	2014
7S	*Dam 7S*	Sedimentation	To be mined through. Direct flows to Cheshunt Pit (Dam 33S).	2014
8S	*Elle's Dam*	Mine water management	None	-
9S	*Dam 9S*	Sedimentation	To be mined through. Relocate upstream of Deep Cheshunt final void.	2021
10S	*Dam 10S*	Sedimentation	To be mined through. Direct flows to Cheshunt Pit (Dam 33S).	2016
11S	*Dam 11S*	Sedimentation	To be mined through. Relocate downstream, south east beyond toe of spoil.	2011
12S	*Dam 12S*	Sedimentation	None	-
13S	*Dam 13S*	Sedimentation	None	-
14S	*Dam 14S*	Existing sedimentation dam	To be mined through. May be relocated.	2007
15S	*Lake James (*HRSTS discharge point that can release 100 ML/day.)	Mine water storage, discharge and transfer	None	-
16S	*East Opencut (EOC)*	Mine water management	Option to relocate as part of LCPP upgrade.	-
17S	*No. 1 Dam*	Mine water management and process water	None	-
18S	*No. 2 Dam*	Process water	May be enlarged for increased demand for LCPP.	-
19S	*Swan Pond*	Mine water management	May require enlargement for increased flows from LCPP.	TBA
20S	*Riverview East Void*	Mine water management	To be mined through. Option to relocate into pit during mining.	2022
21S	*Dam 21S*	Sedimentation	To be mined through. Direct flows to Cheshunt Pit (Dam 33S).	2009

Struct. No.	Name	Purpose	Potential Modification	Expected Date
22S	*No. 5 TSF*	Fine tailings impoundment	May be reactivated as interim tailings disposal for LCPP until new tailings disposal location established.	2010
23S	*Overflow Dam*	Mine water management Settles sediment Diverts runoff into Dam 16S	Modify water management system to support upgraded LCPP.	2010
24S	*Collector Dam*	Mine water management Sedimentation	Modify water management system to support upgraded LCPP.	2010
25S	*Road Dam*	Sedimentation	May require enlargement for increased flows from LCPP.	TBA
26S	*Lemington River Pumps*	Water Supply	Upgrade to provide potential supply source to LCPP	2010
27S	*Dam 27S*	Sedimentation	May be modified when haul road removed.	-
28S	*Dam 28S*	Sedimentation	To be mined through. Direct flows to Cheshunt Pit (Dam 33S).	2008
29S	*Dam 29S*	Sedimentation	To be mined through. Direct flows to Cheshunt Pit (Dam 33S).	2011
30S	*Dam 30S*	Sedimentation	To be mined through. Direct flows to Cheshunt Pit (Dam 33S).	2015
31S	*South Lemington Pit 1 Void*	Mine Water Management	Will cease to exist as pit is backfilled. Potential TSF.	2019
32S	*Riverview Pit Void*	Mine Water Management	Varies as pit is extended. Will cease to exist as pit is backfilled. Potential TSF.	2019
33S	*Cheshunt Pit Void*	Mine Water Management	Varies as pit is extended. A Deep Cheshunt final void will remain on completion of mining.	2024

Note: Dates are approximate only and are based on the revised mine plan.

The mine water balance will be reviewed for the HVO South Water Management Manual and will be reassessed periodically as conditions change. It is not expected that the revised mine plan will impact significantly on the mine water balance and the associated supply, storage and discharge quantities.

The relevant procedures of the Environmental Management System (EMS) will continue to apply to the operation. In particular, the requirements of the Environmental Procedures EP1.10 (Monitoring and Measurement), EP7.01 (Water Management) and EP7.02 (Water Discharge) will be relevant to surface water management and monitoring. A copy of the current CNA EMS procedural documentation is provided as a CD insert.

A review of the HVO Closure Plan will be required in accordance with EP4.01 (Closure Planning) to consider the revised mine plan for HVO South. Special consideration will be needed for the Deep Cheshunt final void, which will be larger than the previously approved voids for Riverview Pit and will behave as a permanent water storage in a different manner than previously planned.

4.3 DRAINAGE

In accordance with previous EIS provisions, clean water runoff will continue to be intercepted and diverted around pit perimeters, haul roads, mine water storages and other disturbed areas through contour drains and open grassed channels. Wherever diversions become contaminated by suspended solids they will be directed through additional sedimentation ponds.

Runoff from overburden dumps and rehabilitation areas will also be intercepted and generally diverted through open grassed lined channels to sedimentation ponds.

4.4 FLOOD IMPACT MANAGEMENT

4.4.1 Existing Hobden Gully Levee (CL1)

If the Hobden Gully levee was completely removed, Hunter River flows in excess of the 20-year ARI (approximately) would enter the final void. For example, if 50% of the river flow entered the void during a 50-year ARI flood, the void could fill in approximately 30 hours.

If it is determined that the levee across Hobden Gully is required for permanent flood protection of the Deep Cheshunt final void, two options are available:

1) The levee can be left in place in perpetuity to prevent floodwaters in the Hunter River from entering the final void. This would require a long term commitment to levee maintenance and may require raising of the levee if protection against the PMF is required.

2) The levee can be modified to allow flood peaks of different recurrence intervals to enter the final void. For example, if the levee were lowered to the 50-year ARI level (approximately 70 mAHD), only the peaks of floods in excess of this recurrence interval would enter the void. A spillway structure would need to be constructed for this option.

The acceptability of options to remove, retain or modify the Hobden Gully levee as currently approved to allow the use of the Deep Cheshunt final void as a form of flood mitigation or flood harvesting, or as an off-river storage system, would require more detailed investigations in consultation with the DWE and other authorities. Consultation on these options will occur in accordance with current levee license conditions and further assessment conducted as required.

4.4.2 *Approved Cheshunt Levees (CL2 and CL3)*

These levees will become part of the final landform as mining backfill progresses in the Deep Cheshunt Pit. They will consequently cease to function as levees and any licence conditions will need to be reassessed as part of the licence renewal process.

4.4.3 *Proposed South Lemington Pit Levees (SLL1 and SLL2)*

SLL1 will be removed on completion of mining and tailings deposition in South Lemington Pit 1.

For the levee SLL2 around South Lemington Pit 2, the changes to the mine plan will result in the levee location being revised and remaining permanently in place after construction with spoil placed to higher levels behind the levee so that the afflux of less than 30 mm in the 100-year ARI flood will be a permanent condition. No mitigation measures are considered necessary as a consequence, on the basis that no upstream properties are adversely affected. The outer face of the levee will need to be designed and constructed to withstand 100-year ARI flood flow velocities without erosion or other forms of failure.

4.4.4 *Other Drainage Structures*

Any sedimentation dam that remains in place after rehabilitation is complete will be constructed with appropriate freeboard and spillway capacity to withstand 100-year ARI flows from its own catchment. Periodic inspections will be required to confirm silt accumulation has not reduced the flood storage capacity and that the dams are in good condition. The Mine Life Plan will identify dams to be removed or retained as well as long term monitoring and maintenance requirements.

All new or rehabilitated watercourses from the final landform will be constructed to convey flood flows without scour or erosion.

4.5 *WATER QUALITY MONITORING AND MANAGEMENT*

The current water quality monitoring programme undertaken by CNA will be reviewed to ensure all areas that could potentially be impacted by the proposal are monitored. Different monitoring locations to those previously identified may need to be included to account for currently proposed variations to final landform design.

The level of risk of contaminated water flowing into receiving waters has been managed through existing surface water management plans. The consolidation of water management plans into a single plan will provide greater efficiencies and flexibility in achieving water quality objectives.

A comprehensive analysis of water quality is undertaken annually at specific locations within HVO South in accordance with Schedule 2 of the Clean Waters regulations. Parameters monitored include pH, electrical conductivity/salinity (EC), total suspended solids (TSS), total dissolved solids (TDS), biochemical oxygen demand (BOD), nitrogen compounds, sulphates, chloride, fluoride, oil and grease, total phenols, heavy and trace metals and methylene blue active substances. Monitoring of these parameters enables assessment of overall water quality, and where sampled in natural waterways, facilitates confirmation of the effectiveness of sediment control structures. In addition, all sites are monitored on a monthly basis for basic parameters including pH, EC and TSS. Sampling of waters is carried out in accordance with AS/NZS 5667 – 1998 and analysis performed in accordance with APHA or manufacturers standards by a NATA or equivalent accredited laboratory.

Sampling locations to be retained comprise the network of sites within mine-site dams and surrounding natural watercourses, including the Hunter River, Wollombi Brook and a number of Hunter River tributary creek sites (if flowing), as depicted in *Figure 4.1*. Monitoring will generally continue on a monthly basis, though dependent on assessed risk, some dams may be monitored less frequently. These locations and the frequency of monitoring will be reviewed as part of the development of the Water Management Manual.

The quantity of water being supplied to, and used by, HVO South will continue to be managed by monitoring of weather conditions. This includes monitoring parameters such as rainfall, evaporation and wind, and monitoring of volumes used for dust suppression, truck wash down and coal preparation as well as pump rates between storages, to TSFs and from recovery/recycling processes.

HVO participates in the Hunter River Salinity Trading Scheme (HRSTS) which permits discharge into the Hunter River (including its tributaries) via specified Licensed Discharge Points during high flow and flood flow conditions in the river, subject to strict HRSTS regulations. All monitoring of licensed discharges, including for compliance purposes and for measurement of discharge volumes, and all reporting, will be conducted in accordance with the conditions of the HRSTS.

The most effective way to monitor potential negative effects on the surrounding environment is to monitor data trends over time. This way, consecutive data trending towards a negative impact from previous data or trends can be assessed and will initiate further action. If consecutive data measured at monitoring locations over a period of 6 months (minimum of three consecutive readings) exhibit adverse impacts or increasing divergence from previous data or from the established or predicted trend; then the situation will trigger more intensive monitoring and remedial actions if the cause is attributed to mining operations. Additional monitoring events may be required to confirm the effectiveness of remedial actions. All monitoring data will be reviewed regularly, reported in the Annual Environmental Management Report and submitted to the DWE. Exceptions reporting will occur as required. CNA has established guideline values for most water parameters. Where there are no guideline values established, data will be compared against Australian and New Zealand Guidelines for Fresh and marine water Quality (ANZECC & ARMCANZ, 2000).

Inspections of surface water management facilities will continue in accordance with current procedures. Some dams may be inspected at a lesser frequency, dependent on assessed risk. The dam inspections consider general condition (vegetation, scour, water condition), structural integrity and silt capacity. Water levels are also monitored and this data is used to ensure that the sediment dams have at least 75% of their design capacity available for sediment containment. Regular checks of contour banks, channels and diversions are also undertaken to ensure stable grassed surfaces are present, and thus the potential for erosion is minimised. The inspection reports will continue to be used to prioritise maintenance works and to schedule and undertake desilting of dams requiring attention.

Because the Deep Cheshunt final void will collect water from groundwater inflows as well as direct rainfall while being subject to high evaporation rates, salinity levels may become elevated over time. This may be modified significantly if water from the Hunter River is diverted into the void during floods. As a precaution, the water level in the void would be kept below river bed level to prevent potentially saline exfiltration through groundwater. The void may also take a considerable time to fill. In addition to water levels, water quality in the void will need to be monitored at least annually after mining operations have ceased in accordance with the Mine Life Plan.

Section 4.4 of EP1.10 (Monitoring and Measurement) requires regular review of monitoring locations. A review will be conducted following Project Approval and ongoing reviews will be made when monitoring locations are mined through or otherwise substantially impacted by mining operations. With the proposed redevelopment of the LCPP and associated facilities, the current monitoring programme will be reviewed to ensure adequate monitoring in the vicinity of the LCPP and facilities before construction work commences in these areas. In addition, discharge monitoring requirements for all sedimentation dams will be reviewed to ensure adequate data is collected. This will be included in the Water Management Manual.

Table 4.2 identifies surface water elements, existing management measures and specific actions relating to the proposal. It should be noted that management and monitoring measures may be applicable for more than one element.

Table 4.2 Summary of Surface Water Management Recommendations

Element	Existing Management Measure	Specific Actions Relating to Proposal
Water Supply	• Current licence volumes to pump water from the Hunter River are expected to be adequate provided existing HVO South water system is modified by increasing pump capacity from Dam 20S to the LCPP; • Monitor and record abstraction quantities; • Reporting on Abstraction License in accordance with license conditions.	Minor improvements required to existing HVO South water system with design of LCPP to minimise need to pump from Hunter River. Manage operations to minimise future extractions. The Surface Water Management Plan prepared for HVO outlines current licences and related conditions.
EMS and Plans	• CNA EMS Procedures 7.1 and 7.2 – Water Management and Water Discharge; • CNA Erosion and Sediment Control Management Plan and Riverview/ Cheshunt Pits Dewatering and Water Management Plan; • CNA EMS Procedure 4.1 – Closure Plan.	Surface Water Management Plan incorporating HVO South water management will be reviewed and updated to include revised mine plan. Develop a consolidated Land Management Plan incorporating erosion and sediment control. Update Mine Life Plan to reflect revised mine plan.
Surface Water Management	• CNA EMS Procedures 7.1 Water Management and 7.2 Water Discharge - clean water runoff is intercepted and diverted around disturbed areas through contour drains and open grassed channels. If contaminated, diversions are directed through additional sedimentation ponds; • Contaminated water is directed to mine water storages.	Review current conditions and incorporate where applicable into the consolidated Surface Water Management Plan. The plan will document relevant HVO South activities and detail management measures as detailed in the Operations Water Management Plan. Review surface water storages and drainage structures in accordance with *Table 4.1.*
Soil Erosion	• CNA EMS Procedure 7.1 Water Management ; • CNA Erosion and Sediment Control Management Plan and Riverview/ Cheshunt Pits Dewatering and Water Management Plan; • Contaminated water is directed to mine water storages .	Review applicable conditions and incorporate where appropriate into the consolidated Land Management Plan. The Erosion and Sediment Control Management Plan will include the following: • Construct additional sedimentation dams at any location where runoff from disturbed areas is redirected from existing channels or where new areas are disturbed; • Rehabilitation areas will include contour drains and other drainage channels to direct potentially sediment laden water to new or existing sedimentation dams.

Element	Existing Management Measure	Specific Actions Relating to Proposal
Flood Mitigation	• CNA EMS Procedure 7.1 Water Management; • Undertake activities in accordance with current levee licenses.	New condition required for approval of Lemington levee SLL2 to become permanent. Possible modifications to Hobden Gully levee to protect final void may also be required. The outer face of the levee (SLL2) around South Lemington Pit 2 will be constructed to withstand 100-year ARI flood flow velocities. Any sedimentation dam that remains in place following rehabilitation will be constructed with appropriate freeboard and spillway capacity to withstand 100-year ARI flows from its own catchment. All new or rehabilitated watercourses from the final landform will be constructed to convey flood flows without scour or erosion.
Water Disposal/ Discharge	• CNA EMS Procedures 7.1 Water Management and 7.2 Water Discharge; • Minimise discharges through reuse and recycling; • Discharge from authorised discharge points in accordance with HRSTS protocols.	Objective will be to minimise future discharges through improved reuse & recycling measures.
Surface Water Monitoring	• CNA EMS Procedure 1.10 – Monitoring and Measurement; • Monitoring of licensed discharges and all associated reporting undertaken in accordance with the conditions of the HRSTS; • Water quality monitoring results will be compared against ANZECC and DEC Guidelines as well as baseline conditions; • If results indicate adverse water quality impacts, the reason for failure will be ascertained and remedial measures initiated to rectify the problem; • All monitoring data reviewed regularly as part of compliance procedures, reported in the AEMR and submitted to DWE; • Site inspections of surface water management dams undertaken by a qualified, independent contractor and a written report prepared. Frequency of inspections dependent on level of assessed risk;	Current water quality monitoring points to be reviewed. Additional monitoring sites will need to be located on any new drainage lines that are not currently monitored and which could potentially be impacted by the proposed new areas of mining. Monitoring parameters to be reviewed. Sediment dam overflows to be monitored. CNA EMS Procedure 1.10 – Monitoring and Measurement will be updated and will include new drainage lines. Monitoring locations will need to reflect variation in final landform design. Review current monitoring programme to ensure adequate monitoring in the vicinity of the LCPP and associated facilities.

Element	Existing Management Measure	Specific Actions Relating to Proposal
	• Regular checks of contour banks, channels and diversions are undertaken to ensure stable grassed surfaces are present.	Water level and water quality will be monitored in the final void at least annually after mining operations have ceased as part of the Post Closure Monitoring Programme. Monitoring will continue in accordance with regulatory requirements.
Tailings Disposal	• CNA EMS Procedure 6.2 – Coarse Rejects and Tailings Disposal; and CNA EMS Procedure 12.1 – Acid Mine Drainage Prevention and Control; • At least quarterly monitoring and inspections in accordance with the Operations and Maintenance Manual developed for the TSF, including downstream surface and groundwater monitoring with increased frequency of monitoring following any exceptional results.	Review current conditions and incorporate where applicable into a revised Waste Management Plan, to be utilised for proposed TSFs.
Environmental Reporting	• Surface water is one component of the AEMR.	Confirm suitability/ adequacy of reporting to date and adjust if necessary. A single report for all of HVO may be preferred.

Legend

- SW Monitoring Locations
- Discharge Points

Figure 4.1

Monitoring Locations

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_SW_05_R1
Date:	08/03/2007 — Drawing size: A3
Drawn by:	ML — Reviewed by:
Source:	-
Scale:	Refer to Scale Bar

N

0 1 2 3km

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ERM

5 CONCLUSIONS

Overall impacts on surface water as a result of the proposal will be minor. The major changes that may influence surface water management include:

- increased water usage for the upgraded or reconstructed LCPP and support facilities;
- retention of South Lemington Pit 2 levee (SLL2);
- revision of the mine plan resulting in a final void in the Deep Cheshunt Pit; and
- modification to final landforms and changes to catchments.

These impacts will generally be addressed through improvements to the storages and drainage networks and development of a consolidated Water Management Manual. Extension of modified landforms into new areas will require review and modification of existing drainage systems only and will not require new systems.

Enlargement and improvements to supply storages and to water quality management systems are proposed to fully mitigate the impacts of changes to the LCPP. It is proposed that all contaminated runoff from the new or upgraded LCPP will be captured and treated as necessary for reuse or transfer to other mine areas.

The retention of the South Lemington Pit 2 levee will not cause significant impacts and mitigation measures are not proposed.

The management of the Deep Cheshunt final void will be incorporated into the HVO Mine Life Plan for closure. The key requirements are to ensure the ongoing stability of the void and safety for the community. Management options for the final void will be developed in accordance with legislative requirements and considering community expectations.

REFERENCES

Bureau of Meteorology (2007) http://www.bom.gov.au/climate/current/annual/nsw/NSW2006raindec.gif

CNA (2003) *Erosion and Sediment Control Management Plan.*

CNA (2002) *HVO – Riverview/Cheshunt Pits Dewatering and Water Management Plan.*

CNA (2004) *HVO North Water Management Plan.*

ERM (2005) *Cheshunt Extension Statement of Environmental Effects*.

ERM (2008) *HVO South Coal Project, Groundwater Assessment Report. .*

Lyall & Associates *(2005) Carrington Pit Extended - Hydraulic Analysis* (in Carrington Pit Extended SEE, ERM 2005).

SKM (1997) *South Lemington Mine Environmental Impact Statement.*

University of NSW Water Research Laboratory (1996) *Flooding in Wollombi Brook* (in Appendix K, South Lemington EIS, SKM 1997).

Appendix A

Stream Gauge Data

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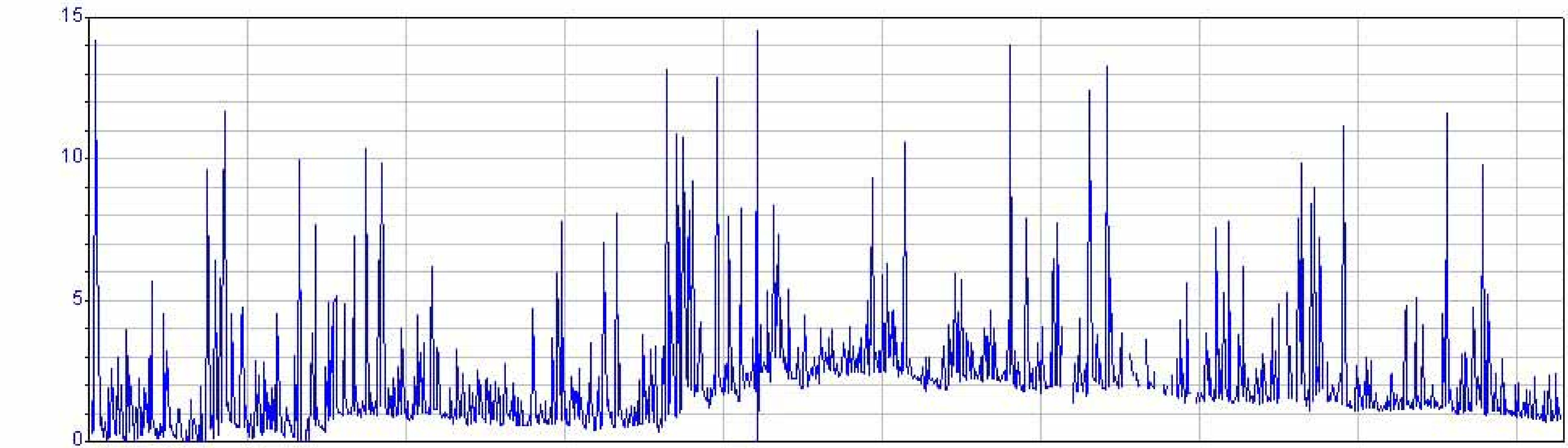
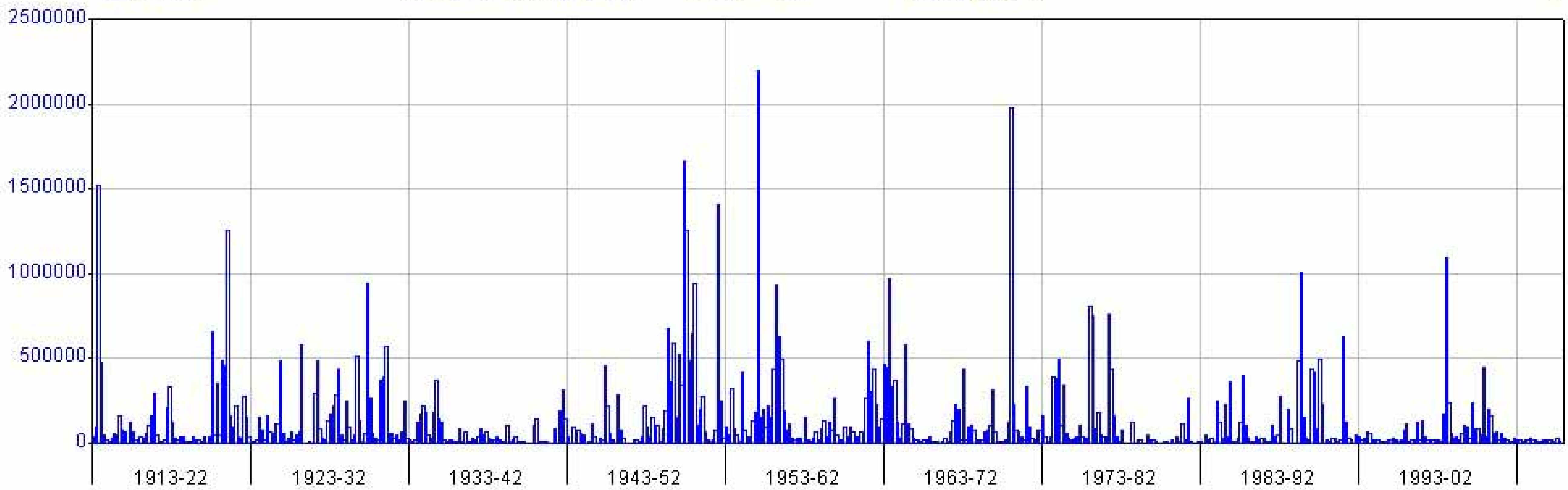
HYPLOT V129 Output 21/08/2006

Period	93 Year	Plot Start	00:00_01/01/1913	1913-06
Interval	2 Month	Plot End	00:00_01/01/2006	

— 210001 HUNTER RV@SINGLETON 100.00 Max & Min Level (Metres) 0



□ 210001 HUNTER RV@SINGLETON 151.00 Total Discharge (ML) 0



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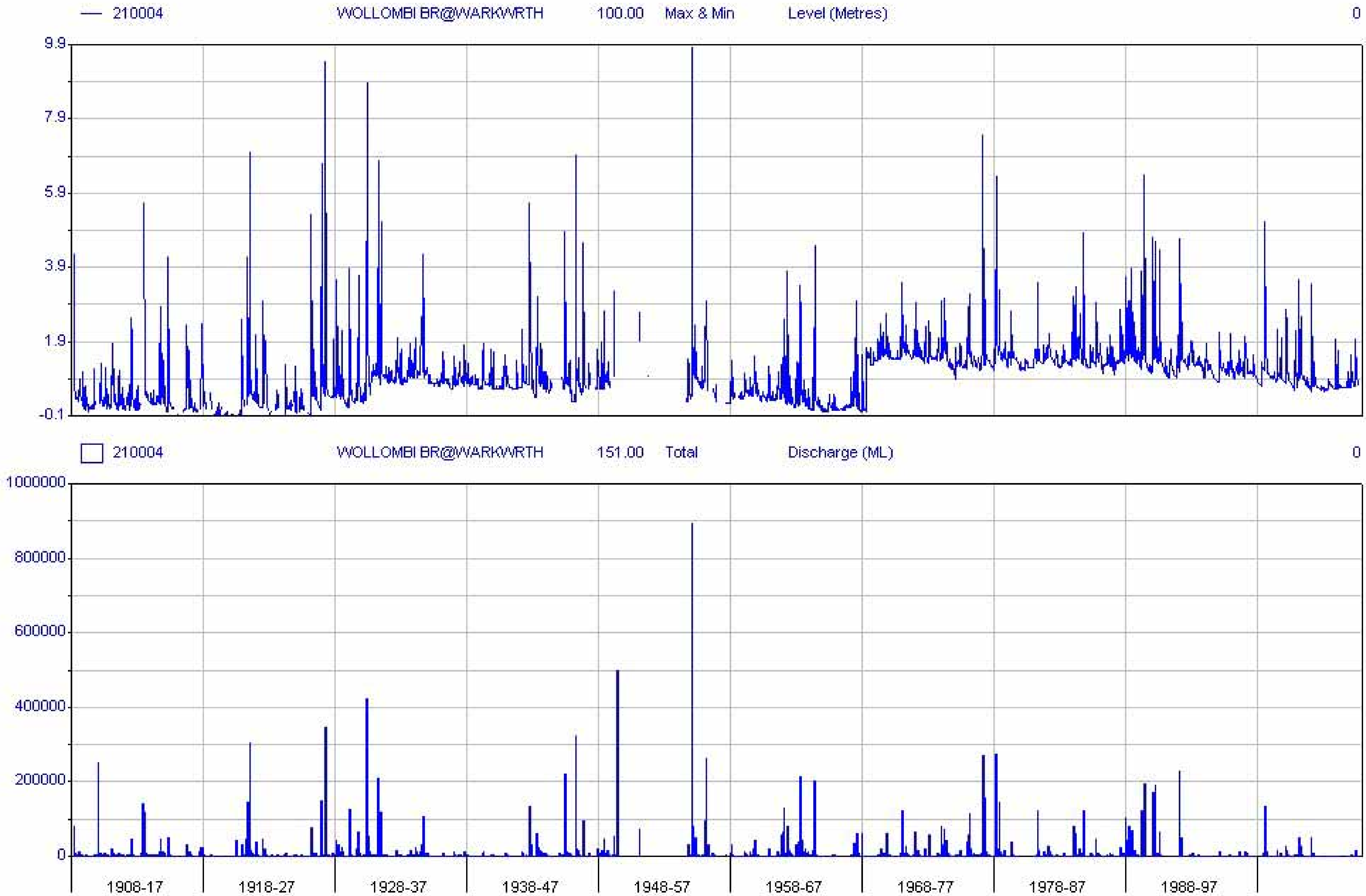
HYPLOT V129 Output 07/06/2006

Period	98 Year	Plot Start	00:00_01/01/1908	1908-06
Interval	1 Month	Plot End	00:00_01/01/2006	



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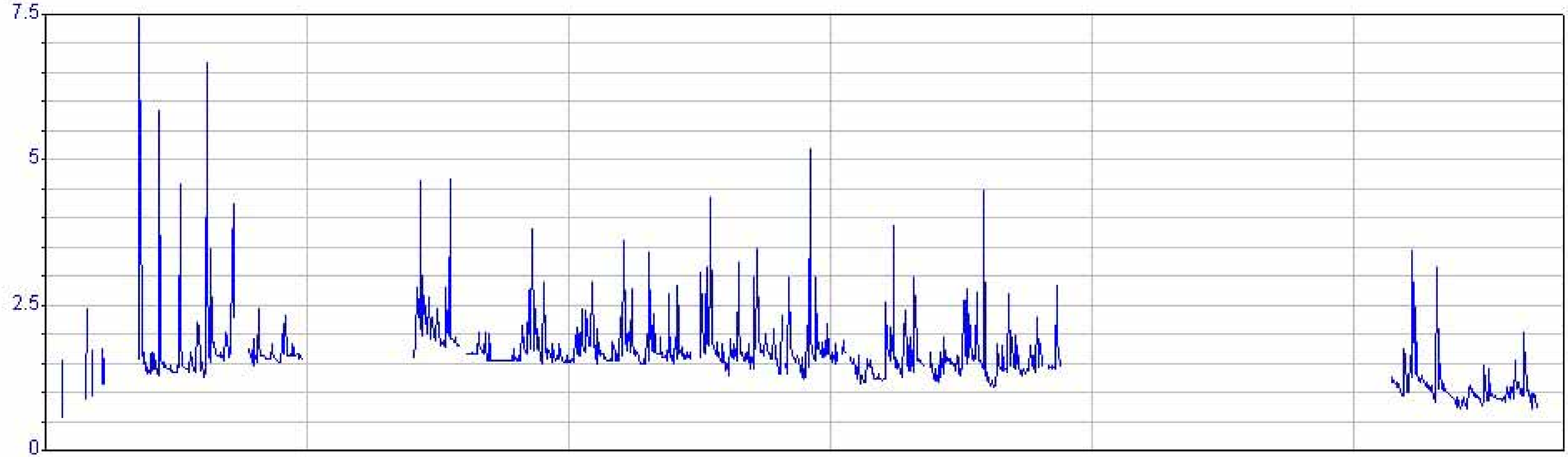
HYPLOT V129 Output 21/08/2006

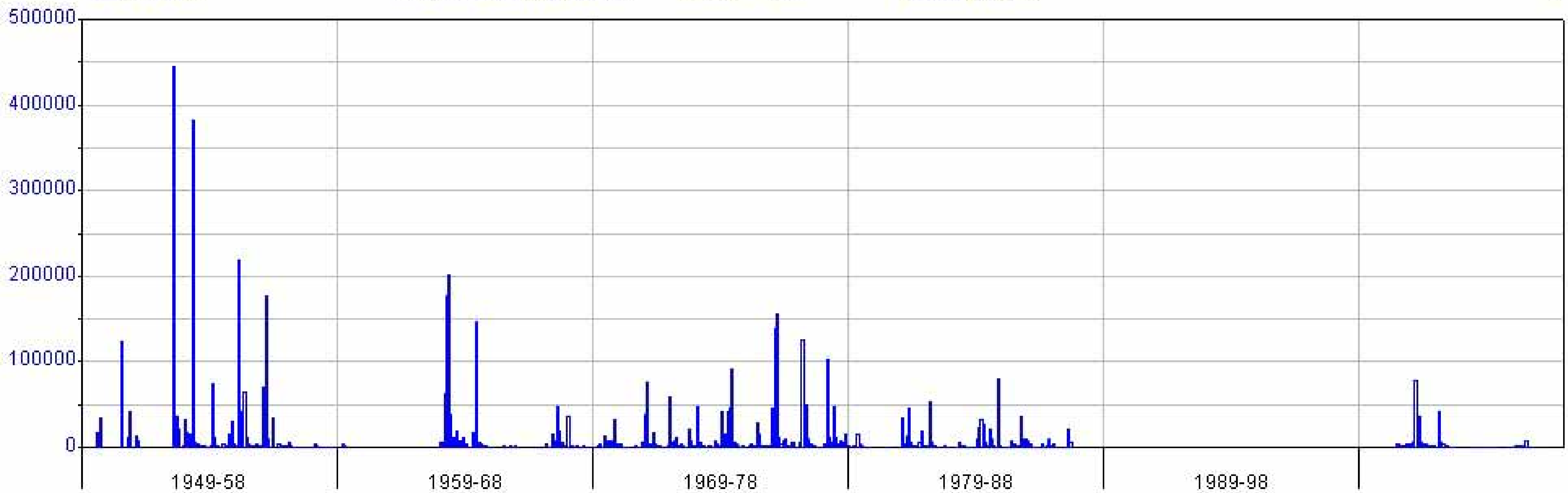
Period 58 Year Plot Start 00:00_01/01/1949 1949-07

Interval 1 Month Plot End 00:00_01/01/2007

— 210028 WOLLOMBI BRK @ BULGA 100.00 Max & Min Level (Metres) 0



□ 210028 WOLLOMBI BRK @ BULGA 151.00 Total Discharge (ML) 0



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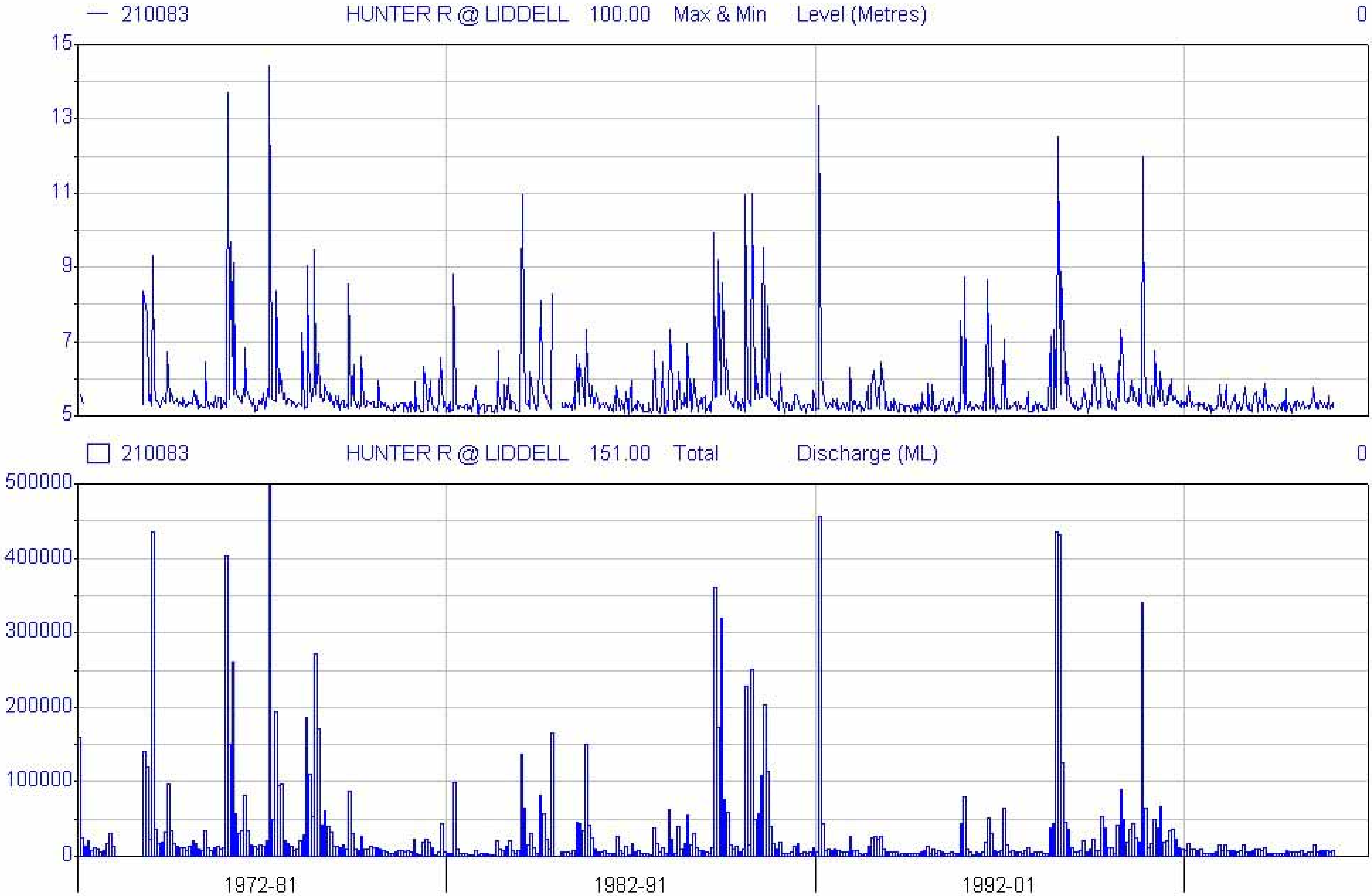
HYPLOT V129 Output 07/06/2006

Period 35 Year Plot Start 00:00_01/01/1972 1972-07

Interval 1 Month Plot End 00:00_01/01/2007



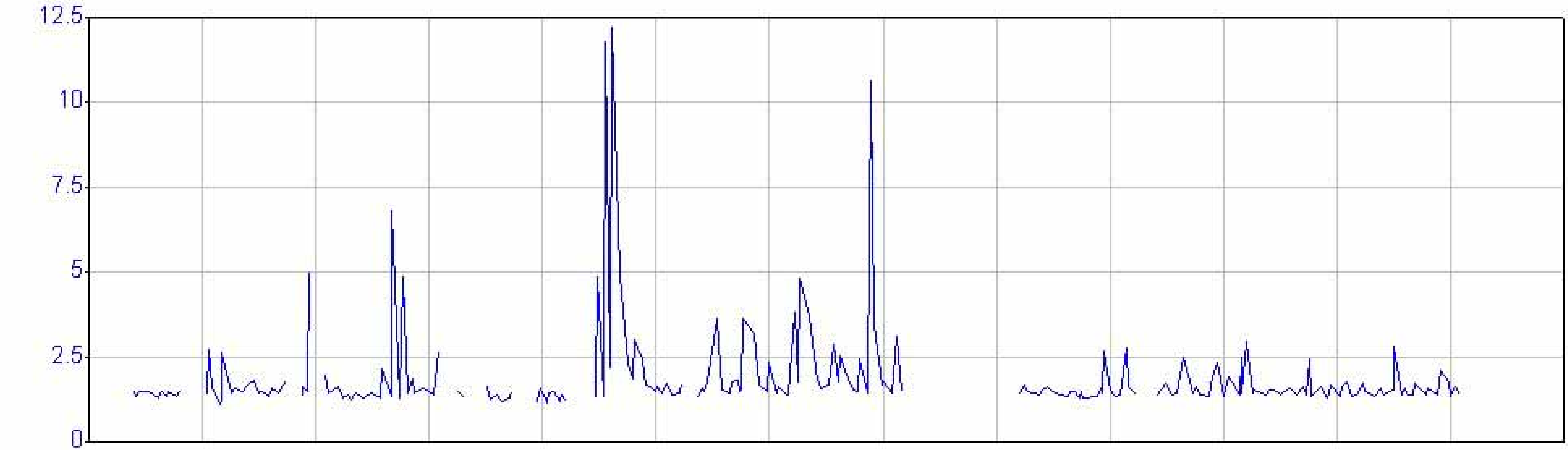
Department of Natural Resources PINNEENA 9

HYPLOT V129 Output 07/06/2006

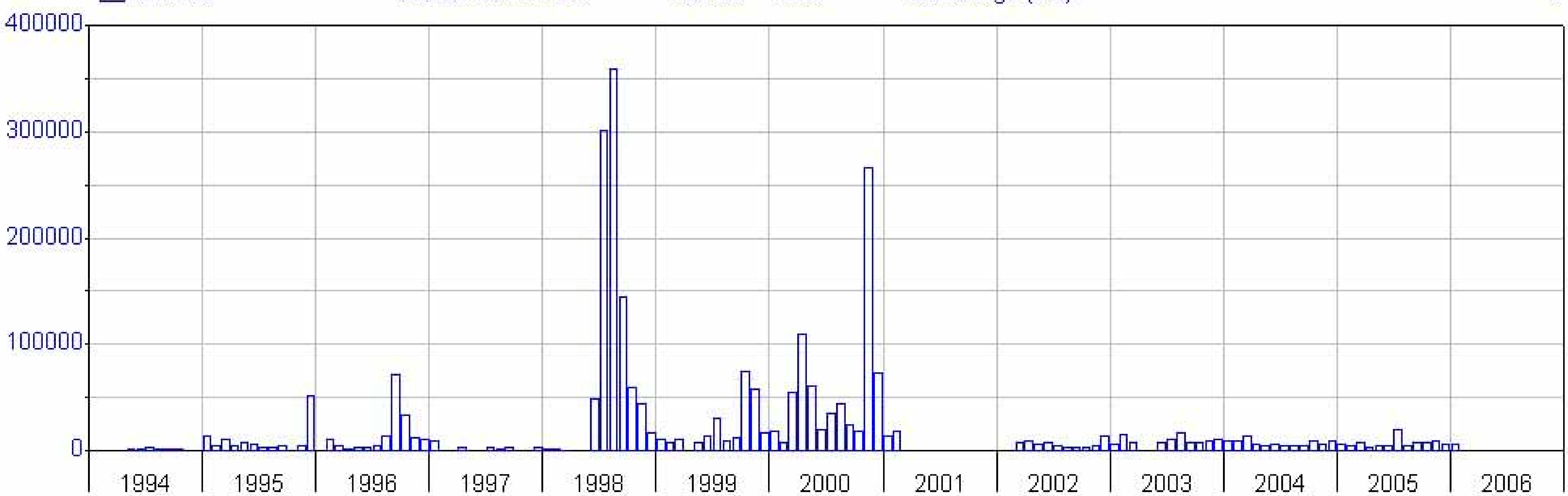
Period 13 Year Plot Start 00:00_01/01/1994 1994-07

Interval 1 Month Plot End 00:00_01/01/2007

— 210125 U/S BAYSWATER 100.00 Max & Min Level (Metres) 0



☐ 210125 U/S BAYSWATER 151.00 Total Discharge (ML) 0



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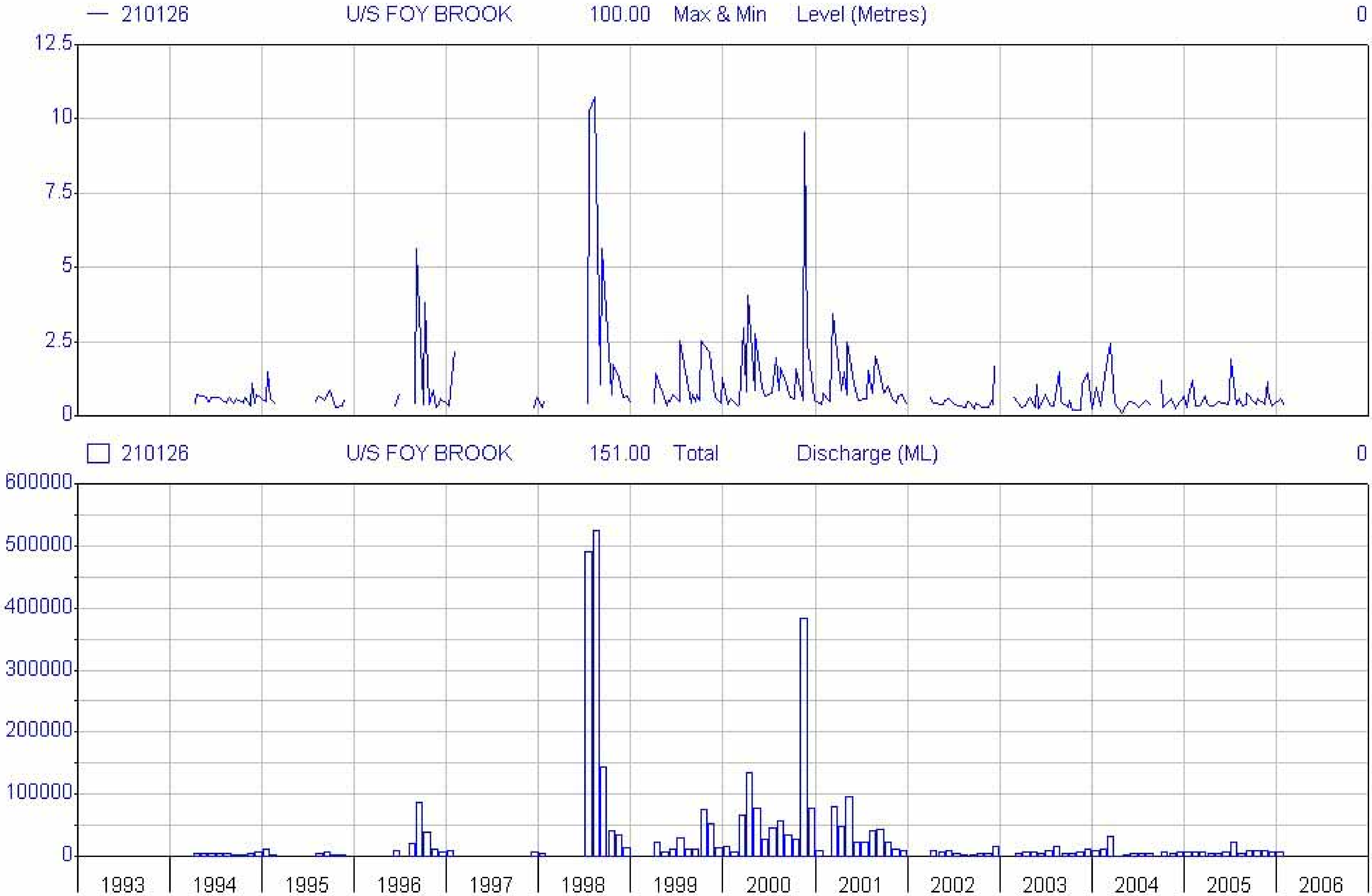
HYPLOT V129 Output 07/06/2006

Period 14 Year Plot Start 00:00_01/01/1993 1993-07

Interval 1 Month Plot End 00:00_01/01/2007

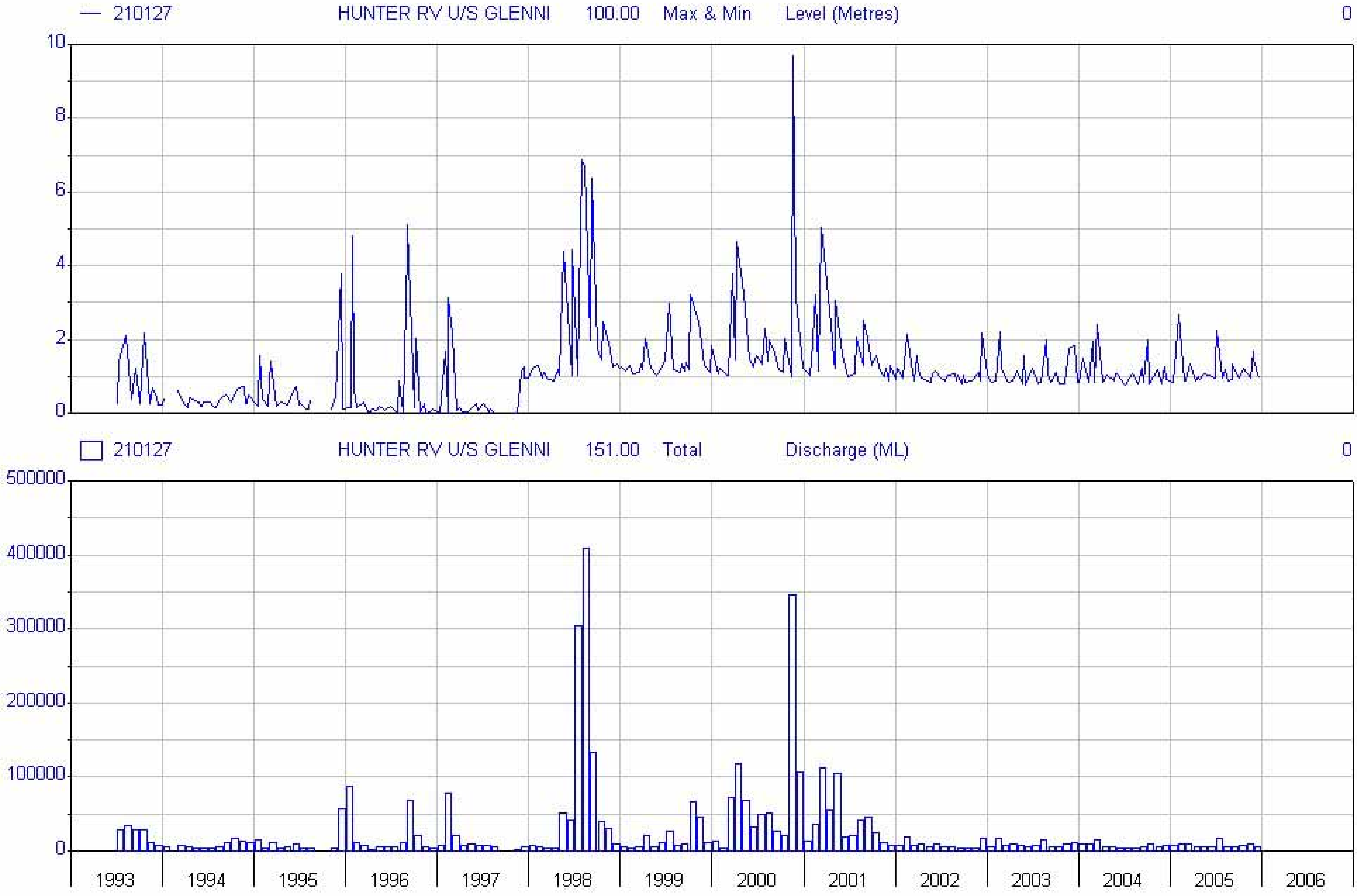


Department of Natural Resources PINNEENA 9

HYPLOT V129 Output 07/06/2006

Period 14 Year Plot Start 00:00_01/01/1993 1993-07

Interval 1 Month Plot End 00:00_01/01/2007

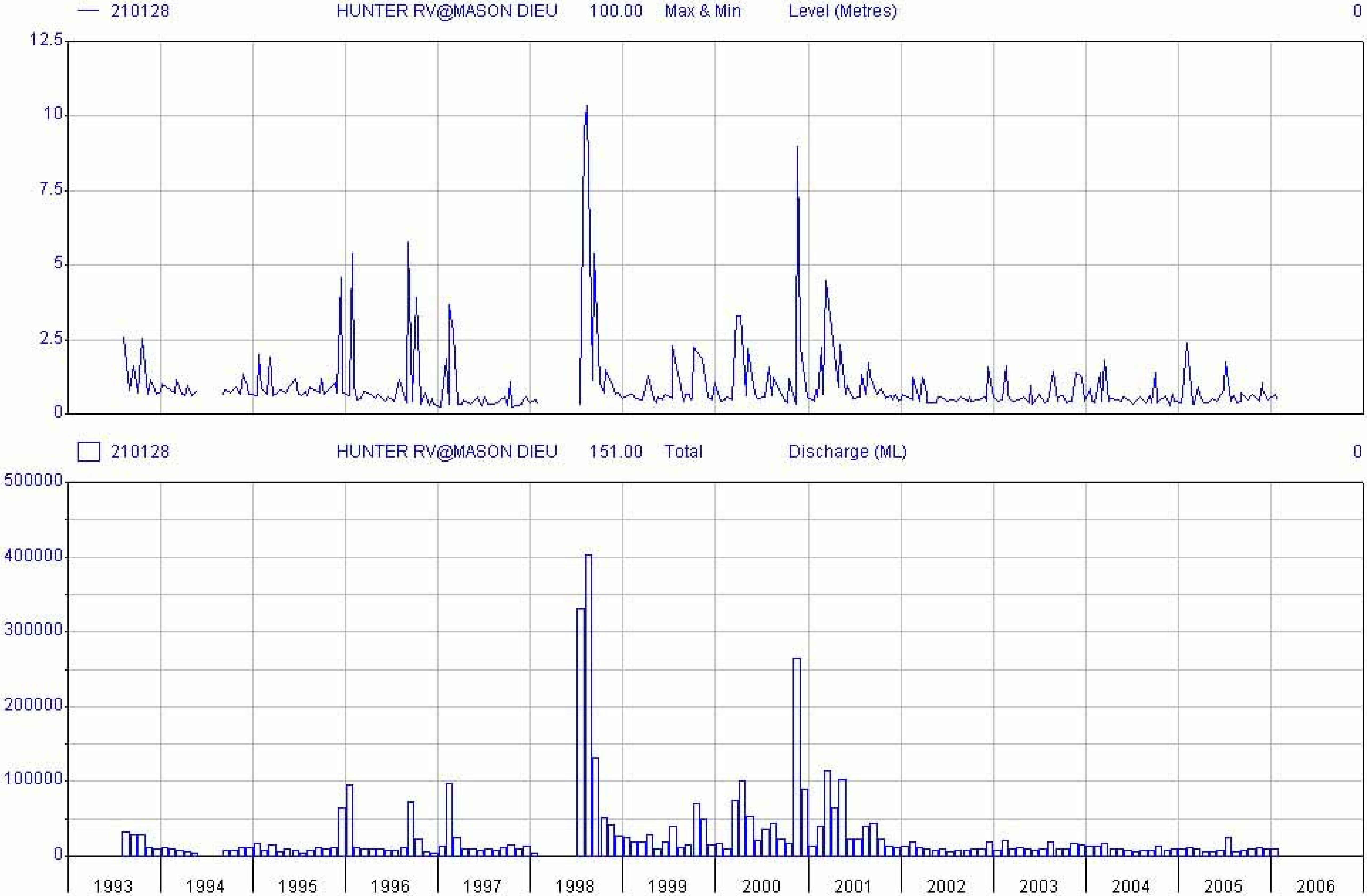


Department of Natural Resources PINNEENA 9

HYPLOT V129 Output 07/06/2006

Period 14 Year Plot Start 00:00_01/01/1993 1993-07

Interval 1 Month Plot End 00:00_01/01/2007



Department of Natural Resources PINNEENA 9

HYPLOT V129 Output 07/06/2006

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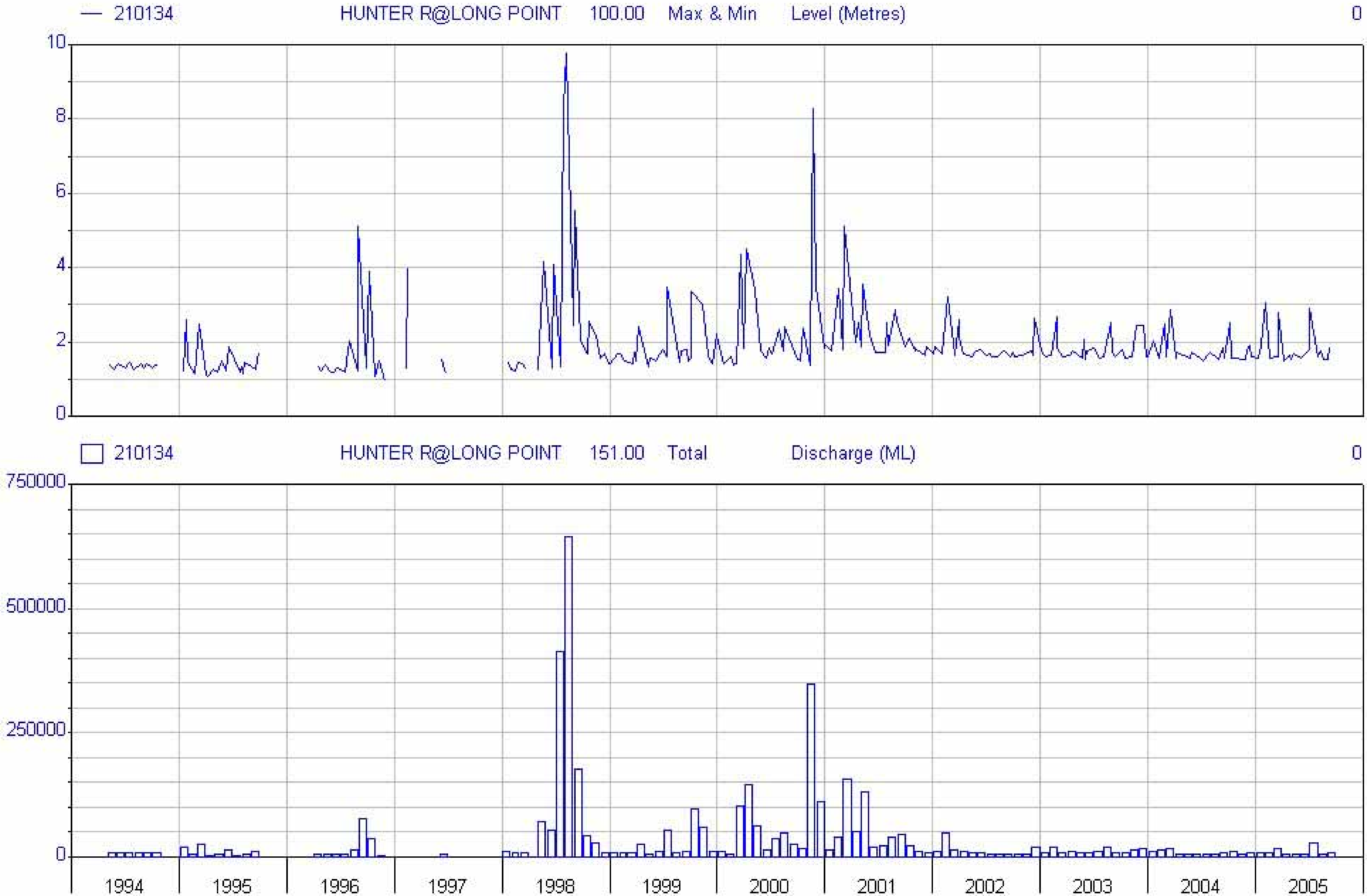
Interval 1 Month Plot End 00:00_01/01/2006



Appendix B

ANZECC Water Quality Guidelines

Parameter	ANZECC Guidelines[29]	HRC Objectives	EPA Interim Water Quality Objectives[30]								
	Ecosystem Protection		Aquatic Ecosystem Protection	Visual Amenity	Primary Contact Recreation	Secondary Contact Recreation	Livestock water supply	Irrigation Water Supply	Homestead Water Supply	Drinking Water	Aquatic Foods (cooked)
pH	*6.5 – 8.5*		6.5 – 9.0[1]	-	5.0 – 9.0	-	-	4.5 - 9.0	6.5 - 8.5	6.5- 8.5	-
Temperature	-		< 2°C increase in natural temp level	-	15-35°C for prolonged exposure	-	-	-	-	-	-
Turbidity (NTU)	*< 10*		< 5[2]	-	< 6 (approx)	-	-	-	5[19]	-	-
Dissolved Oxygen	*85 – 110 % saturation*		>6 mg/L[3]	-	-	-	-	-	-	> 6.5 mg/L[22]	-
Salinity (μS/cm)	-		300-900 [4]	-	-	-	<3000-9000 [13]	280-800 [16]	-	<1500	-
Clarity	-		< 10% change from seasonal norm	< 20% reduction	< 20% reduction	< 20% reduction	-	-	-	-	-
Surface films and debris	-		-	none visible or detectable by odour	none visible or detectable by odour	none visible or detectable by odour	-	-	-	-	-
Total phosphorus (μg/L)	*< 25*	*< 30*	20-50	-	-	-	-	-	-	-	-
Total nitrogen (μg/L)	*< 350*	*< 450*	100- 750	-	-	-	-	-	-	-	-
Nuisance organisms	-		-	not in unsightly amounts	not in unsightly amounts[6]	not in unsightly amounts[6]	-	-	-	-	-
Total Dissolved Soilds (mg/L)	-	-	-	-	-	-	-	-	<1000	-	-

Parameter	ANZECC Guidelines[29]	HRC Objectives	EPA Interim Water Quality Objectives[30]								
	Ecosystem Protection		Aquatic Ecosystem Protection	Visual Amenity	Primary Contact Recreation	Secondary Contact Recreation	Livestock water supply	Irrigation Water Supply	Homestead Water Supply	Drinking Water	Aquatic Foods (cooked)
Chlorophyll – a (µg/L)	*< 3*		-	-	-	-	-	-	-	-	
Algae			-	-	< 15 000 cells/mL	< 15 000 cells/mL	<10 000 cells/mL	none visible	In storages <2000 algal cells/mL	< 2000 algal cells/mL[23]	-[26]
Faecal coliforms	-		-	-	median[7] < 150 / 100 mL[8]	median < 1000 / 100 mL[11]	geometric mean <1000 / 100mL[14]	geometric mean <1000 / 100mL[17]	0 per 100mL[20,21]	0 per 100mL	<14 mpn /100mL[27]
Total coliforms	-	-	-	-	-	-	-	-	-	0 per 100mL[24]	-
Enterococci	-		-	-	median[7] < 35 / 100 mL[9]	median < 230 / 100 mL[12]	-	-	-	-	-
Chemical contaminants	*non-toxic levels*[5]		*non-toxic levels*[5]	*non-toxic levels*[10]	*non-toxic levels*[10]	*non-toxic levels*[10]	*non-toxic levels*[10, 15]	*non-toxic levels*[18]	*non-toxic levels*[21]	*non-toxic levels*[25]	*non-toxic levels*[28]

1. changes of more than 0.5 pH units from natural seasonal maximum or minimum should be investigated
2. additional guideline < 10% change in seasonal mean NTU
3. additional guideline: DO between 80-90% saturation; determined over at least 24 hours
4. additional guideline: non-degradation of current levels
5. refer ANZECC (2000) guidelines for protection of aquatic ecosystems – Table 3.4.1
6. large numbers of midges and aquatic worms are undesirable
7. based on data collected during bathing season
8. additional guideline: 4 out of 5 samples < 600 / 100 mL; minimum of 5 samples taken at regular intervals not exceeding one month
9. additional guideline: maximum number in any one sample 60 - 100 / 100 mL

Parameter	ANZECC Guidelines[29]	HRC Objectives	EPA Interim Water Quality Objectives[30]								
	Ecosystem Protection		Aquatic Ecosystem Protection	Visual Amenity	Primary Contact Recreation	Secondary Contact Recreation	Livestock water supply	Irrigation Water Supply	Homestead Water Supply	Drinking Water	Aquatic Foods (cooked)

10. refer guidelines for untreated drinking water
11. additional guideline: 4 out of 5 less than 4000 / 100 mL; minimum of 5 samples taken at regular intervals not exceeding one month
12. maximum number in anyone sample 450-700 organisms per 100ml
13. Dependant on type of livestock and other factors
14. Additional guideline: 20% of samples <5000/100 mL; minimum of 5 samples taken at regular intervals not exceeding one month
15. refer ANZECC (1992) guidelines, Sections 5.2.2 and 5.2.3
16. Medium salinity water threshold
17. Additional guideline: 20% of samples <4000/100 mL; minimum of 5 samples taken at regular intervals not exceeding one month
18. Refer ANZECC (1992) guidelines, section 5.1.4
19. < 1 NTU is desirable for effective disinfection
20. If micro organisms are detected in water seek advice from the relevant health authority
21. Refer Guidelines for inorganic chemicals in the *Australian Drinking Water Guidelines* (NHMRC & ARMCANZ 1996)
22. Additional guideline: > 80% saturation
23. For potable water supply, 2000 - 15 000 algal cells/mL may be used for potable supply if weekly toxicity test show no toxins, >15000 algal cells/mL water requires full treatment
24. for 95% samples throughout year; up to 10/100mL may be occasionally accepted; none detected in 100mL in any two consecutive samples
25. Refer to ANZECC (1992) guidelines, section 4.2.2
26. toxins present in blue-green algae may accumulate in other aquatic organisms.
27. < 10% of samples to be > 43 MPN/100ml
28. refer ANZECC (2000) guidelines for human consumption
29. ANZECC 2000, Location: South Eastern Australia, Ecosystem Type: Lowland River
30. NSW EPA, October 1999 – Catchment objectives for uncontrolled streams

Appendix C

Water Management System and Operating Protocols

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
1S	*Dam 1S:* ▪ West of Riverview Pit, opposite the Carrington Stud access road. ▪ Operated by Environmental Services – an inactive mining area.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	20	• Rainfall runoff from undisturbed catchment and regenerating natural catchment.	20.1	• Hunter River via spillway and natural drainage.
2S	*Dam 2S:* ▪ On the Carrington Stud access road at the toe of the WOOP dump. ▪ Operated by Environmental Services – an inactive mining area.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	10	• Rainfall runoff from rehabilitated catchment.	18.7	• Hunter River via spillway and natural drainage.
3S	*Dam 3S:* ▪ 1 km south of Barellan Homestead at the toe of the WOOP dump. ▪ Operated by Environmental Services – an inactive mining area.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	65	• Rainfall runoff from rehabilitated, regenerating and undisturbed natural catchments.	250	• Hunter River via spillway and natural drainage.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
4S	*Dam 4S* ▪ Approximately 900m west of the haul road bridge crossing the Hunter River, 40m from river bank. ▪ Operated by Mining.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site. • Do not construct earthworks on the embankment of this dam without approval from Environmental Services.	10	• Rainfall runoff from rehabilitated catchment and some disturbed areas.	44.3	• Hunter River via spillway and natural drainage.
5S	*Dam 5S:* ▪ SW corner of the haul road bridge crossing of the Hunter River, immediately adjacent to the Hunter River. ▪ Operated by Mining.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site. • Runoff south of the Cook's Road intersection is diverted into Dam 20S. • Do not divert additional catchments into this dam. • Located within 10m of river bank. Do not construct earthworks on the embankment of this dam without approval from Environmental Services.	5	• Rainfall runoff from haul roads and other disturbed areas.	24.9	• Direct to Hunter River via spillway.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
6S	*Dam 6S:* ▪ Approximately 700m east of haul road bridge over Hunter River and 100m south of the Cooks Road water cart fast fill station. ▪ Operated by Mining.	▪ Mine water management	• Regular inspections and de-silting to be done by Environmental Services. • Maintain minimum 300mm freeboard to spillway. • Stores saline water. Can't be permitted to overflow. • Protection against 100-year ARI storm overflows required.	30	• Spillages from the Cooks Road water cart fast fill station. • Runoff from Cooks Road and partially disturbed areas.	8.3	• Pumped to Cooks Road water cart fast fill station. • Overflow to Riverview East Void.
7S	*Dam 7S:* ▪ West side of Hobden Gully, SE of Dam 6S. ▪ Operated by Mining.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site via Hobden Gully.	10	• Rainfall runoff from Cooks Road and disturbed and undisturbed surfaces.	17.3	• Hunter River via spillway to Hobden Gully.
8S	*Elle's Dam:* ▪ North side of centre haul road, 500m west of South Bath House. ▪ Operated by Mining.	▪ Mine water management (Dust suppression)	• Regular inspections and de-silting to be done by Environmental Services. • Maintain minimum 300mm freeboard to spillway. • Stores saline water. Can't be permitted to overflow. • Turkeys nest dam - isolated from catchments. • Protection against 100-year ARI storm overflows required.	60	• Pumped from Cheshunt and Riverview Pits.	0	• Pumped to Elle's water cart fill station. • Emergency overflow to Dam 21S.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
9S	*Dam 9S:* ▪ North side of centre haul road, 200m west of South Bath House. ▪ Operated by Mining.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	60	• Rainfall runoff from EOOP dumps rehabilitated and disturbed areas.	133	• Overflow to Dam 21S via spillway.
10S	*Dam 10S:* ▪ West side of Hobden Gully, SE of Dam 7S. ▪ Operated by Mining.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site via Hobden Gully.	10	• Rainfall runoff from disturbed areas.	2.1	• Hunter River via spillway to Hobden Gully.
11S	*Dam 11S:* ▪ SE corner of Riverview Pit on land owned by United Colliery. ▪ Operated by Mining.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site. • Operate and maintain under letter of agreement with United.	25	• Rainfall runoff off from pre-strip and natural catchments.	49.3	• Via spillway to United Colliery 500 ML dam under “Lemington – United Water Supply Agreement”
12S	*Dam 12S:* ▪ North edge of Cheshunt Pit at toe of dumps. ▪ Operated by Mining.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	20	• Rainfall runoff from rehabilitated and disturbed areas.	60.0	• Hunter River via spillway and natural drainage.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
13S	*Dam 13S* ▪ North edge of Cheshunt Pit at toe of dumps SE of Dam 12S. ▪ Operated by Mining.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	20	• Rainfall runoff from rehabilitated and disturbed areas.	60.0	• Overflow to Dam 12S via spillway.
14S	*Dam 14S:* ▪ Between Cheshunt dumps and Barry residence. ▪ To be operated by Mining	• Sedimentation dam	• Constructed to suit maximum catchment. • Located outside final land form. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	30	• Rainfall runoff from rehabilitated and disturbed areas.	Eventually 96.3	• Hunter River via spillway and natural drainage.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
15S	*Lake James:* ▪ East side of Cheshunt Pit, adjacent to the Hunter River. ▪ Includes 2 U/S sed. dams ▪ Operated by Mining.	▪ Mine water storage and transfer ▪ HRSTS discharge point that can release 100 ML/day	• Mine water discharge off site only as permitted by the HRSTS Rules. • Discharge Point operated and maintained by Environmental Services as per CNA Discharge Procedure. • Maintain minimum 300mm freeboard to spillway. • Stores saline water. Can't be permitted to overflow. • Protection against 100-year ARI storm overflows required. • Regular inspections and de-silting to be done by Environmental Services.	313	• Pumped from Riverview East Void (Dam 20S). • Pumped from No.1 Dam (Dam 17S).	234 (incl. old TSF)	• Pumped to Dams 17S and 20S. • Releases by gravity to Hunter River via HRSTS discharge point. • Emergency Spillway to Hunter River only after 1:100 ARI 24 hour duration storm.
16S	*East Opencut:* ▪ East side of Cheshunt Pit, 1 km SSE of Lemington Workshop, approximately 170m from Hunter River. ▪ Operated by Mining.	▪ Mine water management	**Storage Level (mAHD):** > RL 54.2 **Status of Flood Protection.:** No protection – Dam 23S must be spilling. **Action Required to maintain 100-year ARI Flood Protection.:** Report incident to Environmental Services. Potential breach of EPL.	265	• Small undisturbed catchment. • Dam 23S by gravity.	9 (plus Dam 23S catchment)	• Pumped to Dam 17S. Water is stage pumped to Dam 15S or Dam 20S. • Pumped to Lemington workshop to maintain system

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters			Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
			RL 48 to RL 54.2	Limited – may become critical.	Monitor situation and take actions to reduce the water level below RL 48.				pressure. • Pumped to United Colliery under an agreement. • Overflow via Dam 23S spillway to Hunter River.
			< RL 48	Normal – able to contain full 100-year ARI flood.	Maintain water below RL 48. Regular inspections by ES. Maintain pump & water level warning system in good order.				

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
			• Minimum water level RL 38 – provides 3 m depth of water to protect the submersible pump. • Monitor levels using the gauge in the dam. • Regular inspections and de-silting done by Enviro. Services. • Piezometers are installed & monitored by ES to monitor seepage from the EOC to the Hunter River. Risk of seepage is assessed as low. • Stores saline water. Can't be permitted to overflow. • Water may also contain nutrients, hydrocarbon traces and may have elevated BOD and COD in addition to being saline. • Protection against 100-year ARI storm overflows required. Protection is achieved by maintaining a 124 ML storm buffer between RL 48 and RL 54.2 to contain runoff from the ARI 100 year 24 hour storm (108 ML).				

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
17S	*No. 1 Dam:* ▪ 900m SW of Lemington Workshop on haul road to Lemington South. ▪ Operated by Mining.	▪ Mine water management	• Regular inspections and de-silting to be done by Environmental Services. • Maintain minimum 500mm freeboard to spillway to contain the 10-year ARI 1 hour duration storm. • Stores saline water. Can't be permitted to overflow. • Part of EOC (Dam 16S) 100-year flood protected catchment.	64	• Rainfall runoff from rehabilitated catchment. • Saline water pumped from Dams 15S, 16S and 19S.	33.6	• Pumped to Dams 20S and 15S. • Can be pumped to Dam 16S (not recommended). • Emergency overflow to Dam 24S.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
18S	*No. 2 Dam:* ▪ 400m north of LCPP. ▪ Includes 2 U/S sed. dams ▪ Operated by HVCPP.	▪ Process water	• LCPP is under care and maintenance. Coal handling areas have been cleaned up and coal removed. Some areas have been revegetated. • Regular inspections and de-silting to be done by Environmental Services. • Keep empty. Drain water to Swan Pond (19S) after rain. • Do not pump mine water to this dam while LCPP is on care and maintenance. Use fresh water from river only if top up required. • Dam 18S should be monitored for water quality after heavy rainfall events that have filled the dam to 50% or more. • The dam has stored saline water over a long period. Can't be permitted to overflow until measured water quality improves to the acceptable levels.	165	• Rainfall runoff from rehabilitated catchment. • Saline water pumped from Dams 15S, 16S and 17S. • Fresh water from Hunter River offtake (26S).	47.3	• LCPP. • Can be pumped to Dams 15S. • Overflow to Road Dam then to Swan Pond (18S).

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
19S	*Swan Pond:* ▪ 500m SE of LCPP. ▪ Includes Coffer Dam ▪ Operated by HVCPP.	▪ Mine water management	• LCPP is not currently operational and on care and maintenance. Coal handling areas have been cleaned up and coal removed. Some areas have been revegetated. • Regular inspections and de-silting to be done by Environmental Services. • Stores saline water. Can't be permitted to overflow. • Some leakage detected – upgrade when LCPP becomes operational • Water can be made available to United Colliery under the terms of the agreement "Lemington – United Water Supply Agreement" from this dam.	52	• Rainfall runoff from coal handling areas. • Saline water pumped from Dams 15S, 16S and 17S. This does not happen while LCPP is not operational. • Saline water from Lemington South voids. This pipeline is temporarily removed, but pumping can occur under an agreement with Mount Thorley Warkworth Operations.	99.0	• Pumped to Dam 17S. • Emergency overflow to Dam 25S.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
20S	*Riverview East Void:* ▪ 800m SE of the haul road bridge crossing of the Hunter River. ▪ Operated by mining.	▪ Mine water management	• Regular inspections and de-silting to be done by Environmental Services. • Stores saline water. Can't be permitted to overflow. • ARI 100 protected dam. Internally draining and 1000 ML+ buffer above RL 50 (see stage storage curve).	4000+	• Rainfall runoff off spoil dumps. • Pumped from Dam 17S. • Dewatering from Cheshunt and Riverview Pits. • Pumped from Dam 9N and Dam 21N.	98.9	• Pumped to Dams 15S and 17S. • Pumped to HVO North (Dams 9N, 11N, 21N and North Void (30N)). • Overflow to Riverview Pit.
21S	*Dam 21S:* ▪ 1.6 km SSE of the haul road bridge crossing of the Hunter River. ▪ Operated by Mining	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	50	• Rainfall runoff off from disturbed and natural catchments.	64.2	• Overflows to Hunter River via spillway to Hobden Gully (Dam 28S).

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
22S	*No. 5 TSF:* ▪ Cheshunt Pit. Built in spoil at the south end of the old Lemington Pit. ▪ Operated by HVCPP.	▪ Fine tailings impoundment	• A "Prescribed Dam" that must be operated in accordance with NSW Dam Safety Committee requirements. • Must be operated in accordance with the Section 126 Approval from Department of Mineral Resources. • Regular inspections to be done by North CHPP. • Must inspect for, and monitor seepage at the toe (flows to Dam 24S). There is a risk of seepage leaving the premises via Dam 23S. • Maintenance and planning provided by Civils. • Operate in accordance with No. 5 TSF Operations Manual. • Do not store water in this dam. • Can't be permitted to overflow off site. • ARI 100 rainfall protected. • ARI 100 flood protected.	150+ "Nominal"	• Direct rainfall (21 ha). • HVCPP – regular tailings placement. When LCPP is operating (currently under care and maintenance).	23.5	• EOC overland via decant structure. • Emergency overflow to Dam 24S.

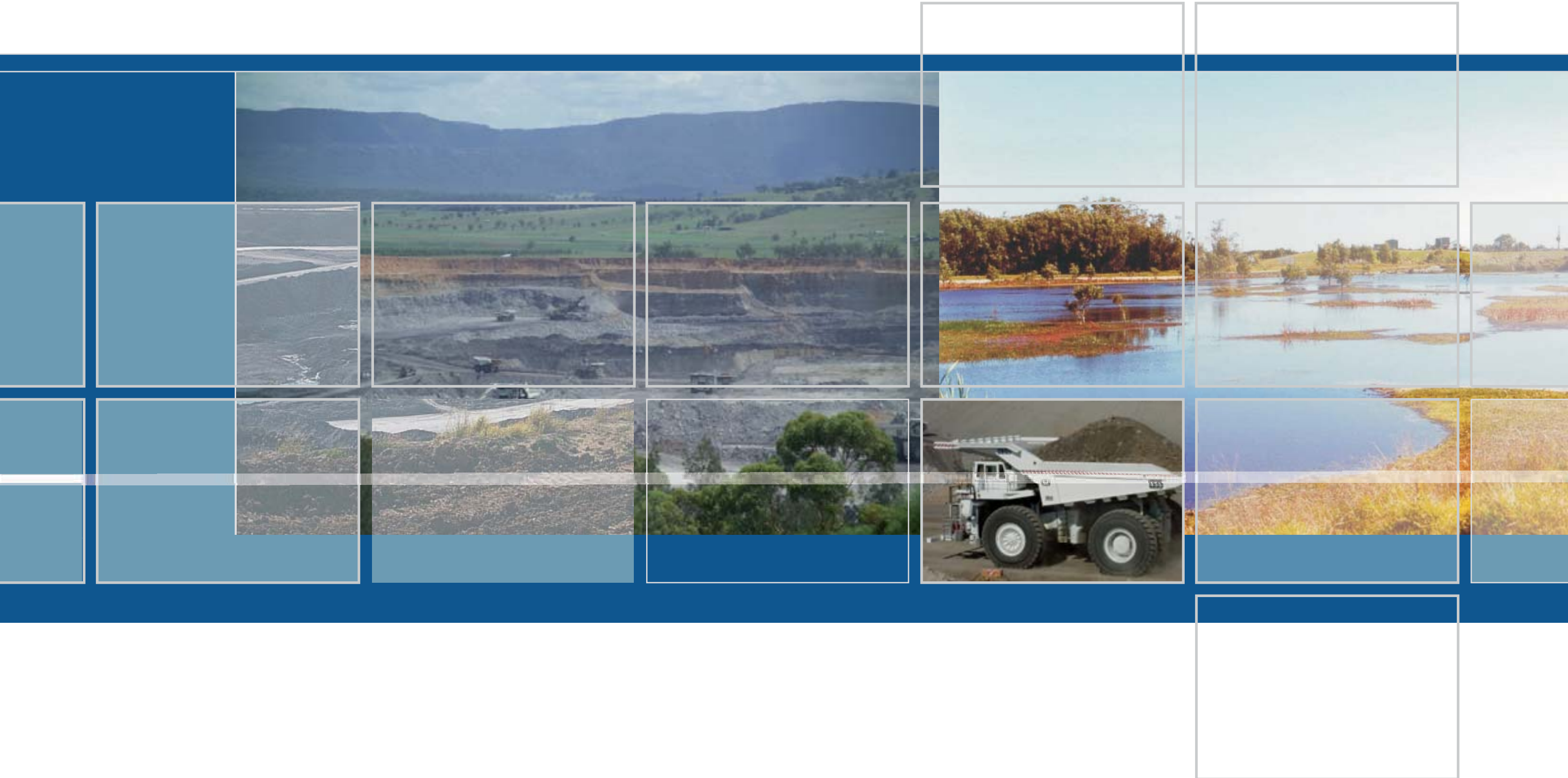
Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
23S	*Overflow Dam:* • Adjacent to Dam 16S and the Hunter River. • Operated by Mining.	▪ Mine water management ▪ Settles sediment ▪ Diverts runoff into Dam 16S	• Concrete weir spillway at RL 54.2 direct to Hunter River. The spillway also acts as spillway for Dam 16S (EOC). • Diversion channel at RL 53 to the East Opencut (16S) • Water quality is degraded and may contain nutrients, hydrocarbon traces and may have elevated BOD and COD in addition to being saline.	11	• All overflows from the Collector Dam (24S).	162 (incl. TD No.5)	• Diversion channel East Opencut (16S). • Concrete weir spillway direct to the Hunter River (only in 1:100 ARI storm.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
24S	*Collector Dam:* ▪ West side of Lemington access road & 200m upstream of the Overflow Dam (23S) access road. ▪ Operated by Mining.	▪ Mine water management ▪ Sedimentation	• Water quality is degraded and may contain nutrients, hydrocarbon traces and may have elevated BOD and COD in addition to being saline.	10	• Rainfall runoff from large catchments containing saline material including No. 5 TSFand Lemington Workshop. • Overflows from the Lemington workshop industrial water system. • Decant water from the Lemington No. 5 TSF (when in operation). • Spillages from the Dam 17S water tanker fill station (when in operation). • Saline water overflows from Dam 17S due to rainfall runoff.	122	• Overflow via spillway to Dam 23S.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
25S	*Road Dam:* ▪ West side of Lemington access road & 600m east of Swan Pond (19S).	▪ Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site. • Spillway RL 59.7.	8	• Undisturbed 52ha. • Rehabilitated 17ha. • Impervious 19	88	• Wollombi Brook via spillway and natural drainage.
26S	*Lemington River Pumps:* ▪ Hunter River adjacent to the EOC Dam (17S). ▪ Operated by Mining.	▪ Water Supply	• Consists of 4 submersible pump sites in the bed of the river. • Water is abstracted under State Water Licences 20SL035311, 20SL042662 and 20SL039176 each with a 500 ML high security allocation. • Pipeline to United Colliery & to Lemington Workshop. • Pipeline to Lemington CPP has been disconnected due to excessive leakage. Replacement of the pipeline will be required if reconnection to LCPP is required. • Water must be made available to United Colliery under the terms of the agreement <u>“Lemington – United Water Supply Agreement”</u> from these pumps. United Colliery holds a separate water licence and allocation to the Coal & Allied licence.	65 l/s	• Hunter River.	Not applicable.	• Lemington Workshop • LCPP • Dams 17S and 19S. • United Colliery

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
27S	*Dam 27S:* ▪ Small sediment dam near bridge over Wollombi Brook to South Lemington Pit 1. ▪ Operated by Mining.	• Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	10	• Rainfall runoff from undisturbed catchment. • Runoff from haul road.	4.4	• Wollombi Brook direct via spillway.
28S	*Dam 28S:* ▪ Series of 3 ponds in Hobden Gully approximately 1.2 km east of bridge over Hunter River. ▪ Operated by Mining.	▪ Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Water can overflow from this dam off site.	30	• Rainfall runoff from undisturbed catchment. • Overflow from Dams 7S, 10S & 21S.	15.0 (not incl. u/s dams)	• Hunter River via spillway, diversion channel and natural drainage.
29S	*Dam 29S:* ▪ East of Hobden Gully near south edge of Cheshunt void. ▪ Operated by Mining.	▪ Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam. • Overflows to void should be minimised.	15 (est)	• Rainfall runoff from disturbed & undisturbed catchments and haul road. • Overflow from Dam 30S.	31.0 (not incl. u/s dam)	• Overflow to Cheshunt void.
30S	*Dam 30S:* ▪ Approximately 350m south of Dam 29S. ▪ Operated by Mining.	▪ Sedimentation	• Regular inspections and de-silting to be done by Environmental Services. • Do not pump mine water into this dam.	15 (est)	• Rainfall runoff from disturbed & undisturbed catchments and rehabilitated area.	41.0	• Overflow via spillway to Dam 29S.

Structure No.	Name/Location/Owner	Purpose	Critical Operating Parameters	Capacity (ML)	Receives water From:	Catchment Area (ha)	Delivers Water to:
31S	*South Lemington Pit 1 Void* ▪ Operated by Mining.	▪ Mine Water Management	• Regular inspections and de-silting to be done by Environmental Services. Requires periodic pump-out. • Stores saline water. • Pond locations vary to suit mining operations.	Varies	• Rainfall directly into void. • Groundwater • Water pumped from adjacent sedimentation dams	108	• Pumped to Dam 17S.
32S	*Riverview Pit Void* ▪ Operated by Mining.	▪ Mine Water Management	• Regular inspections and de-silting to be done by Environmental Services. Requires periodic pump-out. • Stores saline water. • Pond locations vary to suit mining operations.	Varies	• Rainfall directly into void and undisturbed area north of Jerrys Plains Road. • Groundwater. • Overflow from Dams 6S & 20S.	511	• Pumped to Dam 20S.
33S	*Cheshunt Pit Void* ▪ Operated by Mining.	▪ Mine Water Management	• Regular inspections and de-silting to be done by Environmental Services. Requires periodic pump-out. • Stores saline water. • Pond locations vary to suit mining operations.	Varies	• Rainfall directly into void. • Groundwater. • Overflow from Dam 29S.	401 plus 94.5 in northern sector	• Pumped to Dams 17S & 20S.



Annex M

HVO South Coal Project, Cultural Heritage Community Consultation and Survey Results, RTCA 2008

CONTENTS

Public Notices for HVO South Cultural Heritage Community Consultation

The following meetings / agendas where placed in the Singleton Argus, Muswellbrook Chronicle, Scone Advocate and Hunter Valley News, two weeks prior to the meeting dates, inviting all interested indigenous people and representatives of community based Indigenous organisations to attend. A sample of a Public Notice is attached.

1. CNA and Indigenous Interests in the Upper Hunter Valley - meeting held at 10:30am on Thursday 5 October 2006 covering:
    a) Terms of Reference (Scope of Works) for Warkworth Bora Ring Cultural heritage study;
    b) Terms of Reference (Scope of Works) for cultural heritage investigations of infrastructure development areas at HVO (South);
    c) Terms of Reference (Scope of Works) for cultural heritage assessment of water monitoring bore drilling areas at HVO (South) Cheshunt Pit;
    d) Discussions are to be held in accordance with the Department of Environment and Conservation's January 2005 Interim Community Consultation Requirements for Applications.

2. CNA and Indigenous Interests in the Upper Hunter Valley - meeting held at 10:30am on Thursday 11 January 2007, continue discussions regarding:
    a) Terms of Reference (Scope of Works) for cultural heritage investigations of infrastructure development areas at HVO (South);
    b) Draft report on cultural heritage study (Stage 1) if the Mount Pleasant Coal Project Cultural Heritage Management Plan;
    c) The 2007 cultural heritage program for the Warkworth Coal Mine Operations
    d) The 2007 Coal & Allied cultural heritage program overview;
    e) Discussions are to be held in accordance with the Department of Environment and Conservation's January 2005 Interim Community Consultation Requirements for Applications.

3. CNA and Indigenous Interests in the Upper Hunter Valley - meeting held at 9:30am on Friday 23 February 2007, continue discussions regarding:
    a) Endorsement of the draft Hunter Valley Operations (HVO) South Environmental Assessment cultural heritage study report;
    b) Terms of Reference (Scope of Works) for HVO Carrington Extension scarred tree mitigation process;
    c) Warkworth Extension 2007 mitigation program;
    d) HVO West Pit 2007 mitigation program;
    e) Discussions are to be held in accordance with the Department of Environment and Conservation's January 2005 Interim Community Consultation Requirements for Applications.

Sample of Public Notice

Public Notice

Coal & Allied and Indigenous Interests in the Upper Hunter Valley

A meeting will be held at 10:30 am on Thursday 5 October 2006 at Coal & Allied's (CNA's) Hunter Valley Operations Mine office to continue discussions regarding:

- Terms of Reference (Scope of Works) for Warkworth Bora Ring cultural heritage study;
- Terms of Reference (Scope of Works) for cultural heritage investigations of infrastructure development areas at Hunter Valley Operations (South);
- Terms of Reference (Scope of Works) for cultural heritage assessment of water monitoring bore drilling areas at Hunter Valley Operations (South) - Cheshunt Pit;
- Discussions are to be held in accordance with the Department of Environment and Conservation's January 2005 Interim Community Consultation Requirements for Applicants.

All interested Indigenous people and representatives of community based Indigenous organisations are invited to attend.

People who intend participating in this meeting with CNA should register their interest by writing to:

Dr David Cameron
Cultural Heritage Systems Specialist
Rio Tinto Coal Australia Pty Limited
GPO Box 391, Brisbane QLD 4001

Registrations of interest must include current contact details and be received by close of business on Wednesday, 4 October 2006.

Sample of RTCA Upper Hunter Valley Cultural Heritage Working Group Community Letter

RIO TINTO

COAL AUSTRALIA

18 September 2006

NAME/ADDRESS

UPPER HUNTER VALLEY CULTURAL HERITAGE WORKING GROUP – COMMUNITY MEETING (5 OCTOBER 2006)

Dear NAME**,**

I am writing to invite you to attend a community meeting on Thursday 5 October 2006 at Coal & Allied's (CNA) Hunter Valley Operations Mine office (meeting room 4) to discuss further cultural heritage investigations at the Hunter Valley Operations Mine, a proposed study of the Warkworth Bora Ring, and other aspects of Rio Tinto Coal Australia's (RTCA) comprehensive cultural heritage management process for CNA Mining Leases and lands in the Upper Hunter Valley.

RTCA representatives will also provide a briefing on the cultural heritage surveys conducted at Hunter Valley Operations (South) during mid-September and seek feedback from the Aboriginal community on this project. Furthermore, RTCA will provide an up-date to community members on the Mount Pleasant cultural heritage surveys scheduled to commence on Monday 9 October.

RTCA will table at the meeting the following Terms of Reference for the consideration of the Aboriginal community:

- Terms of Reference for the Warkworth Bora Ring cultural heritage study;
- Terms of Reference for cultural heritage investigations of infrastructure development areas at Hunter Valley Operations (South);
- Terms of Reference for cultural heritage assessment of water monitoring bore drilling areas at Hunter Valley Operations (South) - Cheshunt Pit;

Discussions are to be held in accordance with the Department of Environment and Conservation's January 2005 Interim Community Consultation Requirements for Applicants.

Rio Tinto Coal Australia Pty Limited ABN 74 010 542 140
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All interested Indigenous people and representatives of community based Indigenous organisations are invited to attend.

The Upper Hunter Valley Cultural heritage Working Group community meeting details are as follows (see also attached public notice):

Date: Thursday 5 October 2006
Time: 10.30am to 2.00pm
Venue: Meeting Room 4, Hunter Valley Operations Mine Office, Lemington Road

- Morning tea and lunch will be provided.

NB: The Howick Training Centre where previous meetings have been held is not available, therefore, the meeting has been transferred to the Hunter Valley Operations Mine office. The office is located adjacent to the employee carpark and mine workshop. Attendees are asked to park in the employee carpark and to report to the mine office reception area. For more specific directions please call David Cameron (see contact details below)

Please advise me (ph 07 3361 4279) of your availability at your earliest convenience or if you have any queries about the community meeting.

Yours sincerely

Dr David Cameron
Cultural Heritage Systems Specialist

Contact details –

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Mail Merge for Upper Hunter Valley Cultural Heritage Working Group (UHVCHWG)

UHVCHWG Community Meetings Corporations Address List (June 2007)

Mrs Margaret Matthews
Aboriginal Native Title Elders Consultants
31 Mitchell Street
Muswellbrook NSW 2333

Mr Barry Anderson
Lower Wonnarua Tribal Consultancy Pty Ltd
156 Inlet Road
Via Bulga NSW 2330

Mrs Rhoda Perry
Upper Hunter Wonnarua Council
PO BOX 184
Singleton NSW 2330

Mrs Rhonda Ward
Ungooroo Aboriginal Corporation
PO BOX 3095
Singleton NSW 2330

Mrs Barbara Foot
Wanaruah Aboriginal Custodians Corporation
35 Acacia Circuit
Singleton NSW 2330

Mr Barry McTaggart
Wanaruah Local Aboriginal Land Council
19 Maitland Street
Muswellbrook NSW 2333

Mr Robert Lester
Wonnarua Nation Aboriginal Corporation
PO BOX 3066
Singleton Delivery Centre NSW 2330

Mr Des Hickey
Wattaka Wonnarua Cultural Consultants Service
4 Kennedy Street
Singleton NSW 2330

Mr Scott Franks
Yarrawalk Aboriginal Corporation
PO BOX 906
Muswellbrook NSW 2333

Mr Mick Matthews
Mingga Consultants
11 Coolibah Close
Muswellbrook NSW 2333

Mr John Matthews
Upper Hunter Heritage Consultants
160 Sydney Street
Muswellbrook NSW 2333

Mr Arthur Fletcher
Wonna Consultants
619 Main Road
Glendale NSW 2285

Mr Rodney Matthews
Giwiirr Consultants
8 Fitzgerald Avenue
Muswellbrook NSW 2333

Ms Colleen Stair
Upper Hunter Heritage Consultants
160 Sydney Street
Muswellbrook NSW 2333

Mr Larry Van Vliet
Valley Culture
140 Sydney Street
Muswellbrook NSW 2333

Ms Alison Howlett
Buda Mada Koori Women Aboriginal Corporation
PO BOX 3011
Singleton NSW 2330

Ms Julie Griffiths
Hunter Valley Aboriginal Corporation
PO BOX 579
Muswellbrook NSW 2333

Summary of UHVCHWG Minutes associated with the HVO South Project

UHVCHWG Meeting of 5 October 2006
The following is a summary of the minutes associated with the HVO South Project:

Agenda Item: Briefing on key element of the HVO South EIS ToR

The CNA Project Manager provided background information about the project. A large majority of the area has been surveyed in the past, although CNA is happy to undertake new survey using today's best practice management.

It was identified that an administration coordinator for the project had not yet been selected.

Q: How many corporations do we have?

A: Five potentially six. Only Ungooroo so far and the Land Council are next, followed by Yarrawalk and the Upper Hunter Valley.

The payment system was discussed. RTCA will provide information on how the Cultural Heritage Field Officer's (CHFO's) register is working.

The CNA Project Manager explained that the ToR is for a comprehensive survey of the area divided into various areas. The 100 metre transects were explained, and the expectation of covering approximately 10km per day was expressed. It was noted that once the work was complete for the day, they could go home. Any sites that already exist on the AIMS register would be avoided.

The dates for the field work were discussed, and it was noted that dates would be established prior to the end of the year. The need for a team of 6 CHFO's, along with the rest of the standard team was discussed.

Hard copies and CDs of the ToR to be provided.

Outcome: The Committee endorsed the ToR for HVO South EA.

UHVCHWG Meeting of 11 January 2007

The following is a summary of the minutes associated with the HVO South Project:

Agenda Item: Briefing on Draft Report on Cultural Heritage Study for HVO South EA

CNA Project Manager provided a background to the field survey undertaken at the end of 2006, and the draft report prepared by HLA-Envirosciences (HLA). The Project Manager outlined that RTCA had review the report and was hoping to discuss it with the Group, with the aim to finalise a review of the Cultural Heritage Management Plan (CHMP) from the report.

The following is a summary of the findings from the survey:

Overview of the results:
109 recorded – 11 artefact scatters, 97 isolated finds
HVO South area map shown
Rail easement assessed
Portion of land near Lemington
Archerfield only identified one site

Details
Study Area 2
24 places recorded
Large concentration of sites, no of site spread out in corner
New open cut pit constructed
Operations from North and East
Sites shown that may be impacted on

Study area 4 – Lemington South Pit
21 places – sites that may be impacted on were shown

LCHPP
Current Lemington plant not operating at the moment.
Will link to rail loop
Sites shown on map
Railway has been designed to avoid as much disturbance as possible

Archerfield Study area
1 place

Recommendations from the HLA draft report were extracted and were discussed with the Group. It was noted that if the Group agrees with the recommendations, they will be endorsed, if there are any questions we will discuss them. Information/feedback received at the meeting will be taken and helped to finalise the draft report and CHMP and then it will be sent out to the Group for review. Once the report and CHMP has been finalised it will be taken to DECC for their review.

The CNA Project Manager read the twenty three recommendations from the draft report and asked for comments / feedback from the Group. One by one the recommendations were read out and in many cases the Group asked questions, and they were answered by appropriate CNA personnel. If the Group members did not understand the recommendation further clarification was provided, and in some cases CNA personnel left the room (for 10 minutes at a time) to allow the Group to privately discuss the recommendation.

Twenty one of the twenty three recommendations were endorsed by the Committee, the further two recommendations (20 & 21), were left in order that Group could review and comment on the HLA final draft report, which would be sent out to Group members, in order that they could provide feedback to CNA prior to or at the next meeting.

UHVCHWG Meeting of 23 February 2007

The following is a summary of the minutes associated with the HVO South Project:

Agenda Item: Feedback and endorsement on Cultural Heritage Study for HVO South EA

The CNA Project Manager outlined that a report was sent out to Group to review in full and to more closely look at the endorsements. HLA reported that reports were sent out requesting feedback which was due back by the end of last week. HLA advised they have heard nothing from the Group. It was noted that HLA has acknowledged the endorsements from the Group's last meeting.

The CNA Project Manager invited the Group to provide comments / feedback on the report.

There was initially no response from the group and CNA personnel prompted the group to provide feedback, which was then followed by Group Members requesting a map of the survey area to refresh their memories, and the re-reading of the HLA recommendations (twenty one of the twenty three) which were endorsed at the previous group meeting on 11th January 2007.

After a series of general questions asked and answered. CNA personnel left the room to allow the Group to discuss the recommendations by themselves. On the return to the room, CNA asked the following question:

CNA Q: Is there anything you would like to discuss?

Group A: The group came to a consensus on Part 3A and before they were to make an informed decision, they wanted more information or an update on Part 3A process. Could someone from DECC come and provide the information maybe Brad Morrissey? Part 3A is a mystery! If you want us to sign off on something they have to make an informed decision.

CNA representatives provided a summary of what Part 3A is about, and outlined that they probably could get someone from DECC to provide information, although this would constitute a third meeting to discuss the recommendations. After a number of questions and answers, the Group developed a new recommendation (#24) / motion, in order to endorse the recommendations from the HLA report.

"The Aboriginal Stakeholders (Individuals and Group Representatives) and RTCA Representatives present at the Cultural Heritage Community Meeting held pursuant to issue of notices for this purpose at the Howick Training Centre on this twenty third day of February 2007 agree that the recommendations tabled by RTCA and subsequently amended at this meeting (and attached to this motion) constitute the basis for the management of Aboriginal Cultural Heritage at Hunter Valley Operations South Project".

The CNA representatives then left the room once again so that the Group could discuss the motion. The meeting resumed and the motion was then seconded by a Group member and carried unanimously by the Group.

Generic Terms of Reference Cultural Heritage Investigations HVO

GENERAL
TERMS OF REFERENCE
CULTURAL HERITAGE INVESTIGATIONS
HUNTER VALLEY OPERATIONS – SOUTH PROJECT

1. Background

Coal & Allied Operations Pty Ltd manage the Hunter Valley Operations (HVO) mining complex located in the Hunter Valley. Coal & Allied Operations Pty Ltd is a wholly owned subsidiary of Coal & Allied Industries Pty Limited (CNA). Rio Tinto is the major share holder of CNA. Rio Tinto Coal Australia Pty Ltd (RTCA) provides management services to all CNA operations.

The development of HVO has occurred through a process of expansion and acquisition and as a result there are a number of separate development approvals that apply to the operation. The mining and processing activities at HVO are geographically divided by the Hunter River, with movements of coal, overburden, equipment, materials and personnel between two operational areas, HVO North and HVO South.

HVO South comprises the Cheshunt Pit, Riverview Pit and Lemington Pits and the Lemington coal preparation plant. There is now an opportunity to undertake a consolidation of the consents and associated modifications that apply to HVO South. This process will also allow for government approval for some minor modifications and the associated continuation of mining. The proposed consolidation of development consents and the cultural heritage assessment and management plan are to be developed under Part 3A of the *Environmental Planning and Assessment Act* 1979.

The purpose of the project is to prepare a single Environmental Assessment Report that CNA can use to support a Project Application covering the consolidation, minor modifications and continuation of mining operations at HVO South, and also the relocation and/or reconfiguration of the Hunter Valley Gliding Club (HVGC) airstrip and associated facilities. In addition, an application may be made to the Department of Primary Industries – Mineral Resources for a mining lease that encompasses the entire HVO South project application area. This will improve and simplify the mining tenure currently in place for HVO South.

These Terms of Reference (ToR) have been developed through a collaborative process between CNA and various Aboriginal Parties in the Upper Hunter Valley. CNA and these parties established a working group who drafted, refined and endorsed these ToR. The Upper Hunter Valley Aboriginal Working Group was established September 2005 in response to a public notice published by CNA in accordance with consultation requirements of DECC for cultural heritage issues.

These ToR were presented, discussed and endorsed at an Aboriginal community meeting held on 5 October 2006 at the HVO office in response to public notices published by CNA during September 2006 in accordance with consultation requirements of DECC.

2. Predicates

The proposed consolidation of the HVO South approvals, and the cultural heritage assessment and management plan, are to be developed under Part 3A of the *Environmental Planning and Assessment Act 1979*. These ToR have been designed to be consistent with draft guidelines prepared for Part 3A, and are intended to ensure compliance with this Part.

Various cultural heritage investigations have been undertaken across the majority of the HVO South mining area beginning in the 1981, with the last occurring in 1999. Nevertheless, CNA is of the view that there is a need to undertake a range of supplementary investigations in the areas described within these ToR before the CHMP can be finalised for the HVO South project application.

3. Definition of Aboriginal Cultural Heritage

A broad definition of Aboriginal cultural heritage will be adopted. All places and values of archaeological, traditional, spiritual, historical or contemporary significance are deemed to constitute cultural heritage. This definition is wide and certainly covers the notion of cultural heritage as set in both state and federal legislation. In practical terms, this definition will allow, for instance, recording of places which are archaeological sites (such as shell middens, stone arrangements, scarred trees and the like), any places which have traditional stories associated with them, places which are historically important (such as old camps) and places which are important today (such as good food-getting places or places used for recreational purposes). All cultural places and values identified will be accorded equal importance in deliberations.

4. Scale of Activities and Methodology

4.1 HVO South Environmental Assessment development extension area

4.1.1 A comprehensive and systematic survey of the all areas identified in Table 1 will be undertaken, excluding those areas that have been subject to significant ground disturbance.

Table 1 Survey Areas

Survey Area ID	Total Area (Approx ha)	Disturbed Area (Approx ha)	Area to be surveyed (Approx ha)
Cheshunt (Survey Area 1)	650	650	0
Riverview south west (Survey Area 2)	105	5	100
Riverview south east (Survey Area 3)	58	5	53
South Lemington Pit 1 (Survey Area 4)	69	20	49
Proposed Glider Airstrip (Survey Area 5)	50	N/A	50
Proposed Rail Easement (Survey Area 6)	20	N/A	20
South Lemington south east (Survey area 7)	80	N/A	80
South Lemington south west (Survey Area 8)	150	N/A	150
Lemington CHPP & rail line easement	194	14	180
Archerfield area	220	N/A	220
Total	**1596**	**694**	**902**

4.1.2 The study methodology will involve completion of a series of 100 m wide transects across the areas listed in Table 1 aimed at ensuring that a comprehensive survey of the areas is completed.

4.1.6 All cultural material identified in this area will be recorded using GPS and entered on a GIS to be established as part of the project. In addition, a program of consultation with knowledgeable Aboriginal people will be undertaken regarding the significance of the places identified in the development area, and the presence of any other cultural places known to those people in the development area;

4.1.7 The results will be included in a report to be prepared documenting the outcomes of the investigations which will inform preparation of the CHMP for inclusion in the HVO South environmental assessment.

5. Dates and Timing

5.1 HVO South.

The investigations will be conducted at a time and date to be determined by agreement between the RTCA project coordinator, technical advisor, data management officer and the administrative coordinator appointed for the project.

It is expected that a report will be completed by DAY MONTH YEAR.

It is expected that the parties will settle the CHMP by DAY MONTH YEAR.

6. Management and Mitigation

6.1 HVO South Environmental Assessment

No mitigation is to be undertaken during the cultural heritage field surveys. Mitigation measures will only be implemented after places or objects have been reported to the parties and management measures agreed to in the CHMP. The agreed mitigation measures and CHMP are to be developed under Part 3A of the *Environmental Planning and Assessment Act 1979*.

7. Outcomes of the Investigations

7.1 HVO South Environmental Assessment development extension area & Lemington CHPP & Rail line

A report documenting the outcomes of the investigations countenanced in this ToR will be prepared. Using this report, the parties will convene and develop a CHMP for inclusion in the HVO South environmental assessment.

8. Personnel Required

8.1 HVO South Environmental Assessment

The field teams for both the HVO South environmental assessment proposed extension areas and 'Archerfield' property will consist of six cultural heritage field officer representatives of the Aboriginal parties, one technical adviser, and one or more CNA representative authorised to escort the field team on site. CNA may appoint a data management officer to the field team. This person will assist in recording the location of cultural places identified in the course of the investigations.

To be eligible to work as a cultural heritage field officer a person must be an Aboriginal person either recognised by the Wonnarua Aboriginal community as a Wonnarua person, or an Aboriginal person living within the Singleton, Muswellbrook or Upper Hunter local government areas.

9. Selection of Technical Adviser/s

The selection of the technical adviser shall be as follows:

1. The parties shall settle criteria that the technical advisers are required to meet;
2. CNA, at its expense, shall advertise in suitable media for persons (or corporations) are to provide the services contemplated in this ToR;
3. Interested parties will be required to respond in writing;
4. Representatives of CNA and the Aboriginal parties shall convene to review the written responses and select a technical adviser acceptable to both parties;
5. In circumstances where the parties are unable to agree on person willing to accept the brief to the set schedule, CNA reserves the right to appoint a person to fill the role of technical adviser.
6. Where no expressions of interest are received, CNA reserves the right to appoint a technical adviser.

10. Inductions

All persons working at CNA operations and project areas are required to hold the NSW Coal Surface Induction certificate. A CNA site induction will also be required for all cultural survey team members prior to undertaking any aspect of the investigation fieldwork contemplated in this ToR.

11 Field Team ToR Briefing

Prior to the commencement of the work program, the Technical Advisor will provide a briefing on the ToR to the field officers. The briefing will involve communicating the terms and conditions and scope and scale of the activities to be conducted under the ToR so that all participating field officers have a clear understanding of the nature of work program and their roles and responsibilities.

12 Workday Team Meetings

Prior to the commencement of each day's work program, the Technical Advisor will conduct a field team toolbox work day planning session. The toolbox meeting will involve discussing safety issues and conducting a risk assessment of the day's work activities, logistical arrangements, work hours, and other routine project management issues.

13 End of Work Program De-briefing Meeting

On the final day of each block of the work program, the Technical Advisor will hold a de-briefing meeting with the field team. The de-briefing session is a forum for all to discuss the positive and any negative aspects of the work program, suggested improvements for future work programs and other feedback and recommendations relating to the cultural heritage program.

14. Administrative Arrangements

CNA will advertise for a contractor for the provision of administrative coordination and project support services and the contractor will be responsible for meeting all administrative, payment and tax (as well as all additional on-costs) arrangements for the Cultural Heritage Field Officers selected by the Aboriginal Parties. The Cultural Heritage Field Officers will be the employees of this contractor.

15. Work Day

Notionally, the work day for field work is to commence at 7.00am and finish at 4.00pm; however, this period includes travel time (30 minutes each way), morning tea break, lunch break and afternoon tea break. Allowance will be made for extreme or unsafe weather conditions. Time allowances will be made for early/late starts/finishes.

16. Accommodation and Meals

No accommodation or meals are supplied.

17. Vehicle and Transport

CNA will arrange suitable vehicles to transport personnel around the study area and for use during the CHMP and drilling investigations. The vehicles will be pick up personnel from a pre-arranged location and return them to this location at the end of each day. Cultural Heritage Field Officers will be responsible for arranging their own travel to and from the pre-arranged pick up point.

18. Communications

The following communications protocol will be adopted and strictly adhered to:

1. All negotiations of budgets, work programs, agreement to mitigation measures, and overall administrative arrangements will be undertaken on CNA's project coordinator;
2. The administrative contractor, appointed under section 11 of these Terms of Reference will assume the role of administrative coordinator on the behalf of the Aboriginal parties.
3. Day to day fieldwork arrangements will be agreed between the technical adviser, CNA data management officer and the CNA site representative. They will advise each party's project coordinator of any particular issues that emerge in the course of any particular day.

19. Data Management and Information

The following information is defined as confidential information:

(a) information provided by, or on behalf of any Party during negotiation of the ToR or its associated schedule;

(b) any Aboriginal Cultural Heritage, Significant Objects or Significant Areas.

Neither party will disclose any such information to any third party without the express and prior written consent of the other party, other than to satisfy statutory or regulatory obligations.

All information and data pertaining to Aboriginal cultural heritage, significant areas and significant objects collated in the course of the cultural heritage investigations will remain the property of the Aboriginal parties. No party may make use of this information and data for any purpose other than as required for meeting the outcomes of the investigations, or to satisfy statutory or regulatory obligations, and in line with preceding clauses of this ToR regarding confidentiality and disclosure of information.

Consistent with statutory obligations, where previously unrecorded sites, or additional information is recorded in relation to sites listed on the AHIMS register, CNA, through the technical advisor, will complete AHIMS site recording cards for these sites and submit them to the DECC.

20. Equipment and Assistance

Technical advisor will provide all necessary recording equipment and materials.

21. Access

CNA is responsible for securing access to all sections of the study area.

22. Permits

A section 87 permit under the NPW Act is not required as there are no Aboriginal cultural heritage sites listed in the Department of Environment and Conservation's AHIMS database located within the proposed study areas.

23. Occupational Health and Safety

There is a strict no drugs and no alcohol policy on all CNA mines, leases and lands, and personnel may be tested. Smoking is prohibited in CNA-supplied vehicles. Firearms and dogs are strictly prohibited. No open fires may be lit. No knives allowed.

Personnel undertaking the investigations will be required to wear the following Personal Protective Equipment (PPE):

- Steel capped ankle lace up safety boots
- hi-viz vest (CNA to supply)
- long sleeved collared shirt
- long pants
- hard hat (CNA to supply)
- safety glasses and gloves (CNA to supply)

Additional measures and PPE as specified in the induction may also be required.

24. Project Budget

Refer to Schedule 1 for rates and fees.

Contact Details:

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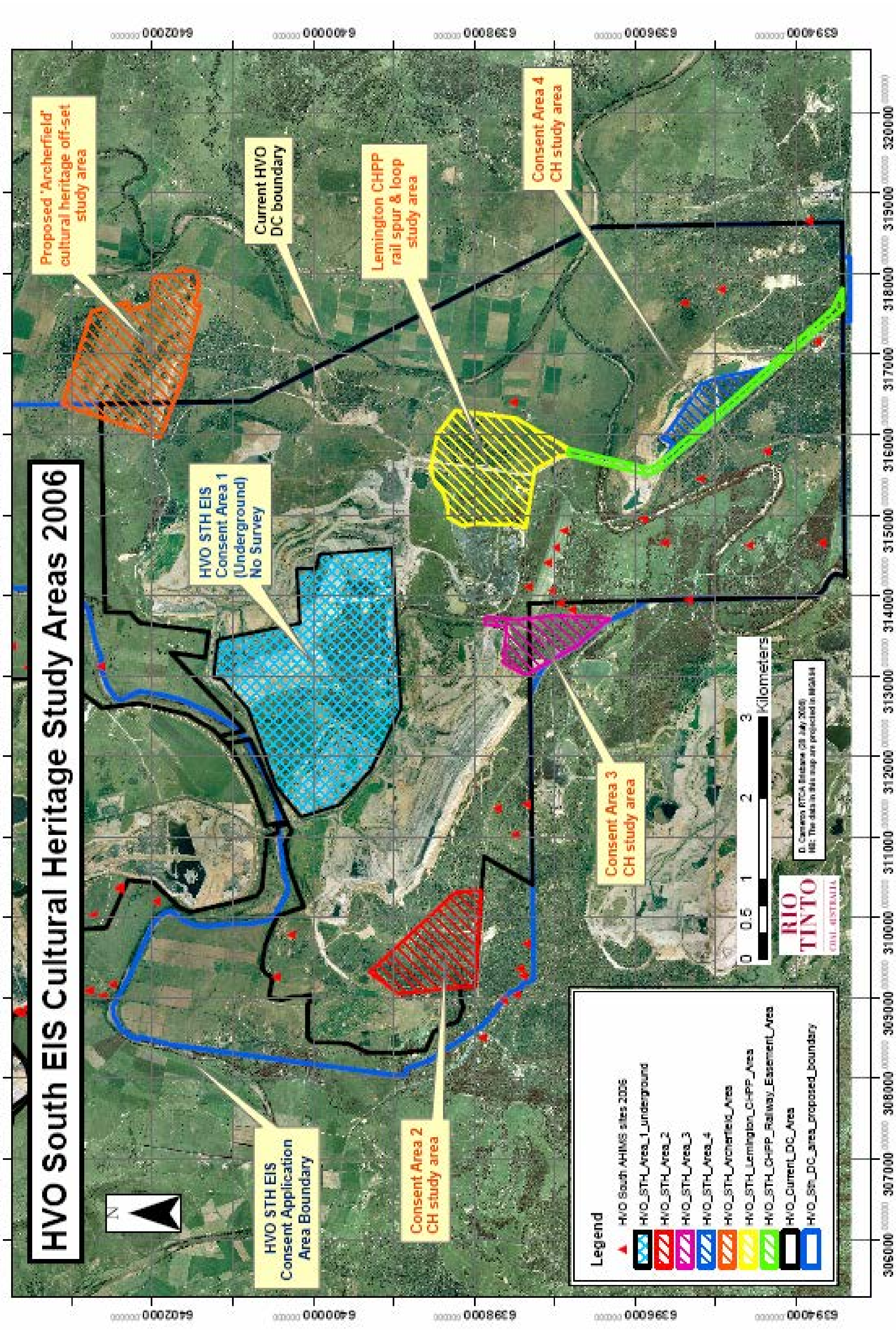
Appendix 1: Map of HVO South EIS Study Areas



HVO South Cultural Heritage Assessment References

HLA Envirosciences Pty Limited (November 2006) Aboriginal Heritage Assessment: Area 2, Area 4, Railway Easement, LCHPP, and Archerfield, Hunter Valley Operations South, NSW 10 November 2006, prepared for RTCA.

McCardle Cultural Heritage Pty Ltd (July 2007) RTCA Hunter Valley Operations: Stage 2 Indigenous Archaeological Assessment Stage 2 (Draft) July 2007

RIO TINTO

COAL AUSTRALIA

Hunter Valley South Environmental Assessment

Stage 1 Cultural Heritage Report – Management Recommendations for HVO South Cultural Heritage Management Plan

(23 February 2007)

Rio Tinto Coal Australia (RTCA) is undertaking extensive Aboriginal heritage assessments at Hunter Valley Operations South (HVO). These investigations form part of wider environmental investigations being undertaken for an extension of mining operations at HVO. This report presents the Aboriginal heritage findings of site investigations of HVO Areas 2, 4, Lemington CHPP (LCHPP), Railway Easement, and Archerfield.

The outcome of the assessment will be to develop an Aboriginal Cultural Heritage Management Plan for HVO, which will outline all of the specific processes surrounding Aboriginal heritage management in HVO, including communications, methods, personnel, timeframes, emergency activities, etc. HLA-Envirosciences Pty Limited (HLA) involvement in this project was to act as a technical advisor for the Aboriginal communities, assisting in the identification and recording of Aboriginal sites located during the site inspection.

The field investigations were undertaken between 18 to 24 September and on 6 October 2006. HLA were then required to prepare sections of the Aboriginal Cultural Heritage Management Plan for HVO. HLA prepared a report on the survey findings, potential impacts, limited interpretation, scientific significance, and suggested management options. These have been integrated into this report, along with sections detailing the consultation with Aboriginal parties, and the management strategy agreed between RTCA and the Aboriginal parties in conformance with the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979*.

The following recommendation were discussed and endorsed unanimously at a public community meeting held at the CNA Howick Training Centre on Friday 23 February 2007.

Recommendations:

1. The management of the Stage 1 areas is to be the subject of a Cultural Heritage Management Plan agreed between RTCA and the Aboriginal Parties. Where agreed, the CHMP will make provision for the following recommendations.

2. The CHMP is to provide for the Stage 1 area to be subject of an agreed zoning scheme. This zoning scheme is to control mine-related land use activities in the Stage 1 area. These controls will include:
   - areas zoned as Restricted Access Areas;
   - areas zoned as cleared for development;
   - areas zoned as available for development subject to implementation of agreed management measures; and
   - areas zoned as Environmental Management Offset areas where cultural heritage issues will be factored into the general plan for such areas.

   Additional subsets of each of these zones may be created as needed.

3. Provision needs to be made for the management of collected cultural heritage material. Currently, this is subject to the existing Care and Control Plan (CCP) for Hunter Valley Operations. It is proposed that the CCP be reviewed and amended in the following manner. Firstly, the existing facility currently situated at Howick Mine (a sea container) is to be relocated to the Hunter Valley Services facility on Lemington Road. Secondly, the CCP should be revised to make provision that, at the discretion of the Aboriginal parties, collected material from the area subject of the CHMP may either be placed in the existing facility once relocated or may be placed in the Restricted Access Area. If there is agreement to review and amend the CCP, RTCA will take all steps necessary for this, including negotiation with DEC.

4. A program for the induction of personnel and contractors in relation to the cultural heritage management strategy will be developed in collaboration with the Aboriginal Parties. The induction program will explain the CHMP and the management program contained therein. The Aboriginal Parties will be specifically requested to develop a short module on the nature and significance of their cultural heritage. They will also be requested to assist with the presentation of the induction program where face to face presentation is envisaged.

5. Human skeletal remains – Implement NPWS sanctioned process.

6. Sites 1 – 24 lie in Area 2, currently planned to be developed as an open cut mine pit. Consequently, it would be necessary to implement a mitigation program, consistent with the recommendations of HLA for these sites, prior to mining taking place. HLA has recommended controlled collection of these sites. However, RTCA will review its mine development plan for this area with a view to determining whether it is possible to conserve sites 13 – 23, situated in the northern tip of this area, and will advise on the outcomes of this review. Irrespective of the outcome of the review, mitigation of sites 1 – 12 and 24 will be undertaken in accordance with recommendations made by HLA for these places: controlled collection. Until such time as the review of the mine development plan is completed, and the necessary mitigation program is implemented (which may include 13 – 23), RTCA will take all reasonable steps to ensure all these sites are not affected by any mine-related activity.

7. Site 25 lies within the Archerfield Environmental Offset area. RTCA will ensure that any management activity in this area is designed in such a way as to avoid any impact on this site.

8. The alignment of the rail loop to LCHPP is to be amended such that the alignment further to the north and east than originally proposed. Any areas to be affected by the revised alignment that have not previously been subject to cultural heritage assessment ($0.2km^2$) will be comprehensively and systematically inspected in a manner consistent with the methodology adopted in stage 1.

9. Provision has been made in stage 2 investigations for this area to be surveyed. Management measures for any identified cultural material will be settled in a manner consistent with that applying to stage 1.

10. Realignment of the rail loop as now planned will avoid the vast majority of cultural places identified in the area that would have been affected by the original alignment. Thus, sites 26 – 44, 47 – 58, 107 - 109 inclusive will be avoided by the proposed realignment. Consequently, sites 44 (scarred tree), 51 and 52 (where test pitting was proposed), for which there are specific recommendations will not be affected.

11. Sites 84 – 100 and 102 - 104, all of which lie to the west of the existing haul road and Comleroi Road, will not be impacted by any proposed development activity.

12. RTCA proposes that the areas containing sites 26 – 44, 47 – 58, 84 – 100, 102 – 104, and 107 – 109 (i.e. that either will not be affected either by revision of the rail loop or which lie in an area to the west of the existing haul road and Comleroi Road) will be formally zoned as Restricted Access Areas, with access subject to authorisation by Aboriginal Relations, Brisbane office, RTCA.

13. Proposed conditions of access will include: no ground disturbing activities to be approved without the proposed activity being first being referred to the Aboriginal Parties for their consideration, and review of the proposed management recommendations, and subsequent implementation of agreed measures. The decision making process for this will be undertaken in a manner consistent with that used for the initial assessment. Ground disturbing activities are defined as any action to be undertaken by RTCA or RT-related company in the areas zoned as Restricted Access Areas. This recommendation is, however, qualified by conditions of schedule A pertaining to existing non-mine related land use activities.

14. RTCA will initiate discussions with the current property owner regarding their existing non-mine related activities with a view to ameliorating impacts on cultural sites and values.

15. Sites possibly to be affected by the revised rail loop alignment are sites 45 and 46. These sites consist of two isolated finds: a chert flake and a chert retouched flake. If revised plans will result in any impact, this impact will be mitigated by controlled collection of the items.

16. Sites to be possibly affected by the expansion of the preparation plant (sites 101, 105 – 106) consist of a broken chert flake, a broken chert flake and a possible basalt axe respectively. These will be mitigated by controlled collection of the items.

17. Sites 59 – 79 are situated in Area 4, known as the South Lemington Pit, currently planned to be developed as an open cut mine pit. Consequently, it would be necessary to implement a mitigation program, consistent with the recommendations of HLA for these sites, prior to mining taking place. HLA has recommended controlled collection of these sites. Until such time as the necessary mitigation program is implemented, RTCA will take all reasonable steps to ensure all these sites are not affected by any mine-related activity.

18. Sites 80 – 83 are situated within the proposed railway easement. These sites will be mitigated in line with the recommendations of HLA pertaining to these sites: controlled collection.

19. If at a later date it is found necessary to undertake an action that would impact sites described by HLA as requiring additional and specific management recommendations be implemented (with these including sites 44, 51-52, 55, 85-87, 97-100) then RTCA will consult with the Aboriginal Parties with a view to settling and implementing agreed management measures, with such measures to be informed by advice provided by HLA in their report on Stage 1 investigations.

20. RTCA will ensure that its Ground Disturbing Permit (GDP) process is applied in all areas. Any GDP that is issued will be compliant with the zoning scheme and any specific management requirements set for any area or sites. Where sites have been identified in an area, an arbitrary buffer of 50m will be applied beyond the identified extent of each site, and no ground disturbing activities will be permitted to take place within that area until such time as all agreed management measures have been implemented in full.

21. Where any mitigation is required it will be undertaken by representatives of the Aboriginal Parties and suitably qualified technical advisers. Any mitigation will be undertaken in advance of development. Analysis will be undertaken of the collected material as per HLA recommendations. The mitigation program and analysis will be appropriately reported.

22. It is agreed that all mitigation measures should be undertaken in a manner conforming to the recommendations contained in the HLA report.

23. The boundary of any Restricted Access Zone and the Limit of Disturbance Boundary defining where mining or mine-related activities are authorised to take place will be suitably identified on the ground and the zoning scheme will be regularly revised to ensure its currency for planning purposes.

24. Provision will be made in the CHMP for the Aboriginal Parties to undertake an independent compliance audit of the management program on a six monthly basis, commencing six months after settlement of the CHMP. In the event that any non-compliant activities are identified, the Aboriginal Parties shall be entitled to undertake a compliance audit as part of the investigation process.

25. RTCA and the Aboriginal Parties agree that the above recommendations are acceptable to both parties and may form the basis for a submission under Part 3A of the Environmental Planning and Assessment Act 1979. The parties further agree that there shall be a formal briefing provided to the Aboriginal Parties by 30 March 2007. If as a consequence of this briefing either party determines a need to revise, amend or add any recommendation, then the parties shall include such revisions, amendments or additions in the CHMP to be settled as a condition of the above recommendations.

HLA Recommendations	Proposed CHMP
4.3, page 88, para 4; 4.3.1, page 89, para 6 (in situ management)	Rec 6, 8, 9, 10, 11, 12, 13
4.3, page 88, para 4 (mitigation prior to development	Rec 20
4.3, page 88, para 4 (collection by Aboriginal Party)	Rec 20
4.3, page 88, para 5 (mitigation requirements)	Rec 21
4.3, page 88, para 6; 4.3.1, page 89, para 7 (specific requirements)	Rec 9, 10, 11, 12, 13, 18, 19
4.3 page 88, para 6; 4.3.1, page 89, para 9 (analysis)	Rec 20
4.3, page 88, para 7; 4.3.1, page 89, para 5 (management of collected material)	Rec 3
4.3, page 88, para 8 (reporting)	Rec 20
4.3, page 88, para 9; 4.3.1, page 89, para 6 (defining site locations and boundaries)	Rec 2, 6, 7, 11, 12, 19, 22
4.3, page 88, para 9; 4.3.1, page 89, para 6; 4.3.1, page 90, para 3 (inductions)	Rec 4
4.3, page 89, para 1; 4.3.1, page 90, para 2 (human remains)	Rec 5
4.3.1, page 89, para 4 (mitigation of certain sites)	Rec 6, 14, 16, 20, 21
4.3.1, page 89, para 7 (mitigation requirements)	Rec 6, 14, 15, 16, 17, 18, 20, 21
4.3.1, page 89, para 7 & 8 (mitigation of sites 51 and 52)	Rec 9, 11, 12, 13, 18
4.3.1, page 89, para 10 (scarred tree)	Rec 9, 11, 12, 13, 18

Schedule A

Existing non-mine related activities will continue in these areas until such time as these areas are vacated by the current property owner. These existing non-mine related activities will include:

- traversing the area using the existing roads and tracks;
- maintaining existing fences;
- depasturing stock;
- implementation of any existing weed and fire management regimes;
- general stock management measures; and
- other authorised activities as required.

Stage 1 Survey
September – October 2006

Table M1: Summary of the cultural heritage sites identified and recorded throughout the Stage 1 survey areas

Survey Area	**Site Number**	**Isolated Stone Artefact/s**	**Stone Artefact Scatter**	**Possible Scarred Tree**	**Total**
Stage 1 Survey					
Riverview south west (survey area 2)	1-24	24	-	-	24
South Lemington Pit 1 (survey area 4)	59-79	21	-	-	21
LCPP	26-58 and 84-109	49	9	1	59
Proposed rail spur and loop easement	80-83	2	2	-	4
Archerfield	25	1	-	-	1
Sub Total		**97**	**11**	**1**	**109**

Table M2: Summary of the archaeological significance of cultural heritage sites identified and recorded throughout the Stage 1 study areas

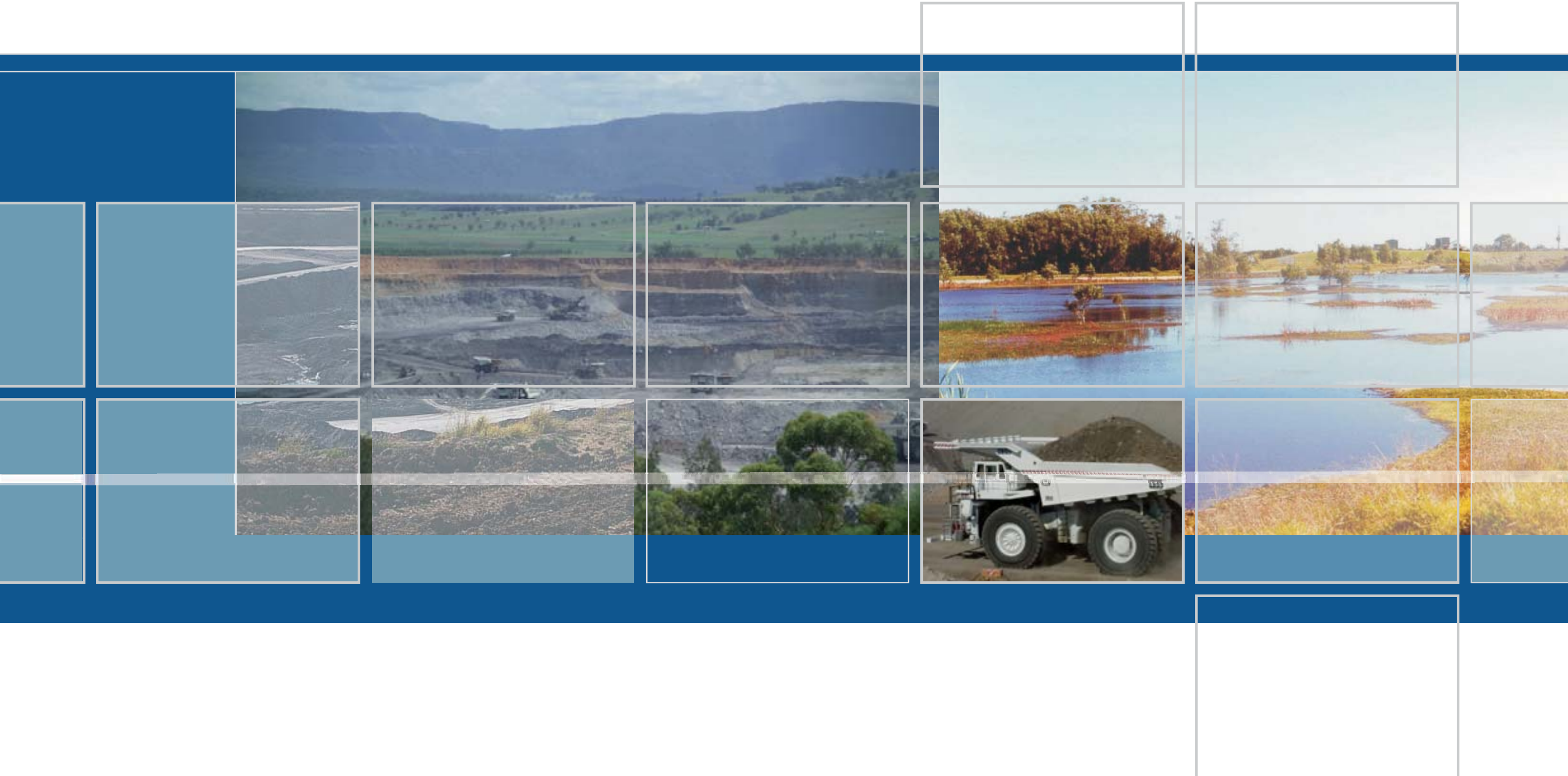
Significance Assessment	**Site Number**
High	51, 52, 86, 97-99
Moderate/High	44
Moderate	55, 85, 87, 100
Low/Moderate	7, 13-19, 26-30, 36, 38, 39, 46, 50, 74, 80-83, 107-109
Low	1-6, 8-12, 20-25, 31-35, 37, 40-43, 45, 47-49, 53, 54, 56-73, 75-79, 84, 88-96, 101-106

Table M3: Summary of the cultural heritage sites identified and recorded throughout the Stage 2 survey areas

Survey Area	Site Number	Isolated Stone Artefact/s	Stone Artefact Scatter	Possible Scarred Tree	Total
Stage 2 Survey					
Cheshunt (survey area 1)	-	-	-	-	0
Riverview south east (survey area 3)	137-138	1	1	-	2
Proposed Gliding Airstrip (survey area 5)	110-118	8	1	-	9
Proposed rail easement (survey area 6)	133-136	1	3	-	4
South Lemington south east (survey area 7)	119-124	4	2	-	6
South Lemington south west (survey area 8)	125-132	5	3	-	8
Sub Total		**19**	**10**	**0**	**29**
Total					

Table M4: Summary of the archaeological significance of cultural heritage sites identified and recorded throughout the Stage 2 study areas

Significance Assessment	Site Number
High	-
Moderate/High	-
Moderate	118, 120
Low/Moderate	-
Low	110-117, 119, 121-138



Annex N

Heritage Impact Assessment Warkworth Aerodrome,
Weir and Phillips 2007

HERITAGE IMPACT STATEMENT

Warkworth Aerodrome Warkworth

New South Wales

WEIR + PHILLIPS
Architects & Heritage Consultants

Studio 4 Level 2
134 Broadway
Broadway, NSW, 2007
Phone 9212 5458

May 2007

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1.0 INTRODUCTION

1.1 Preamble

This Heritage Impact Statement for Warkworth Aerodrome was prepared at the request of Coal & Allied Industries Ltd.

Warkworth Aerodrome is located about 20 kilometres (by road) to the west of Singleton in the Hunter Valley Region of New South Wales.

Warkworth Aerodrome was constructed during World War II. Upon the entry of Japan into the Second World War in December 1941, the Australian Government sought to make the most of their limited resources for air defence. A system of parent and satellite aerodromes was proposed for areas throughout New South Wales and Queensland. Warkworth was one of three satellite aerodromes, the others being located at Broke and Singleton, created to support RAAF Base Bulga. Warkworth Aerodrome is currently used by the Newcastle Gliding Club.

1.2 Authorship

This report was prepared by James Phillips, B.Sc. (Arch), B. Arch., M.Hert.Cons. (Hons), of Weir + Phillips Architects and Heritage Consultants.

1.3 Limitations

A detailed site history was not provided for. No historical archaeological work was carried out.

The history contained in this statement was prepared from material obtained during research into the Former RAAF Base Bulga (see under Section 1.6).

1.4 Methodology

This statement was prepared with an understanding of the guidelines provided by the NSW Heritage Office's *NSW Heritage Manual* update *Statements of Heritage Impact* (www.heritage.nsw.gov.au *Publications S-Z*) and with reference to the Council documents listed in Section 1.6.

1.5 Physical Evidence

A site visit was conducted on 24 January, 2007. The photographs contained in this statement were taken on this occasion.

1.6 Documentary Evidence

The following resources and references were used to prepare *Weir + Phillips, Former RAAF Base Bulga, Heritage Assessment, May 2007* and were thus relied upon for the preparation of the history contained in this statement.

1.6.1 Resources Accessed

- Most information regarding the site is located in the National Archives of Australia. Canberra, Melbourne and Sydney Repositories were accessed for the preparation of this assessment.

- New South Wales Department of Lands (Aerial Photographs).

- State Library of New South Wales.

1.6.2 References

General References

- Gillison, Douglas, *Australia in the War of 1939-1945: Royal Australian Air Force, 1939-1942*, Canberra, Australian War Memorial, 1962.
- Scholes, J., 'Bulga/Milbrodale History', *Hunter Valley News*, 20 March 1985.

National Archives of Australia (Sydney)

- *Bulga Drome- Disposal of Building*. Box 1317. SP857/11, PS/219.
- *Bulga.* Box No. 787. SP857/6, PH/1291.
- *Bulga: Specification for erection and completion of 4 groups of timber framed and concrete buildings, 31 July, 1942*. Box 7. SP155/1, DEF31481C.
- *Bulga*. Box 907. SP857/6, PH3048.
- *Bulga.* Box 1273. SP857/10, PR2029.
- *Bulga.* Box 907. SP857/6, PH 3052, 53 and 3054.
- *Bulga.* Box 1331. SP 857/12, PX/71PART1 and PART2.
- *Bulga*. Box 907. SP857/6, PH3050 and PH3051.
- *Bulga Post Office (History File)*. Box 439. C3629, BULGA.
- *Bulga*. Box 907. SP857/6, PH3049.

National Archives of Australia (Canberra)

- *DWB (Director of Works and Buildings)-Bulga NSW-Aerodrome-Disposal of surplus assets*. A705, 171/106/778.
- *Selection of site and erection of transmitting building-Bulga NSW.* A705, 171/106/778.

- *Bulga RAAF Station.* A649, 168/600/158.
- *DWB (Director of Works and Buildings)- Bulga NSW-Aerodrome-Hiring of Site.* A705, 171/93/109PART1.
- *DWB (Director of Works and Buildings)-Property-Bulga NSW-Aerodrome-Acquisition of site*. A705, 171/94/105.
- *Settlement-Land-NSW-Bulga Subdivision Proposition*. CP211/2, 73/34.
- *DWB (Director of Works and Buildings)-Property-Bulga NSW-Aerodrome-Hiring of site*. A705, 171/93/109PART2.
- *DWB (Director of Works and Buildings)-Property-Bulga NSW-Dispersal aerodrome-Utilisation and guarding of property*. A705, 171/105/51.
- *Selection of site and erection of VHF DF Building-Bulga NSW*. A705, 171/87/47.
- *RAAF Bulga (NSW)-Aerodrome works*. A705, 7/1/1376.

National Archives of Australia (Melbourne)

- *Bulga and satellites-Broke, Strowan, Warkworth*. MP535/5, NN.
- *Bulga-Post Office and Related history*. B5846, NN.
- *Bulga Aerodrome Site*. B985, N/4/281.

1.7 Site Location

Warkworth Aerodrome is located within the Lower Hunter Valley, New South Wales, about 20 kilometres (by road) to the west of Singleton (Figure 1). The Aerodrome is located parallel to Comleroi Road as it runs east–west after intersecting with Jerrys Plains Road (Golden Highway), about 200 metres after it crosses the Wollombi Brook (Figures 2).

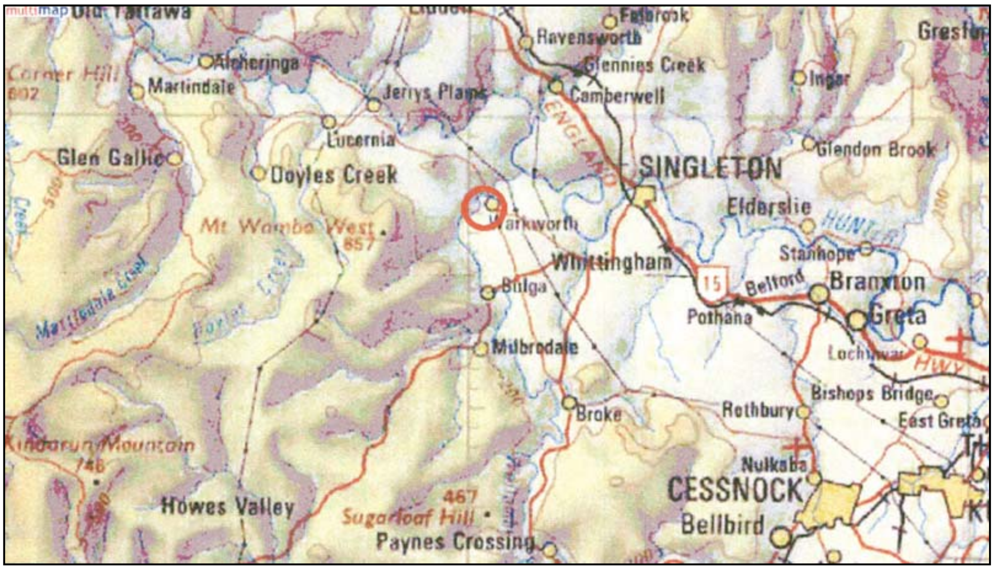


Figure 1: Regional Map
http://www.multi-map.com.

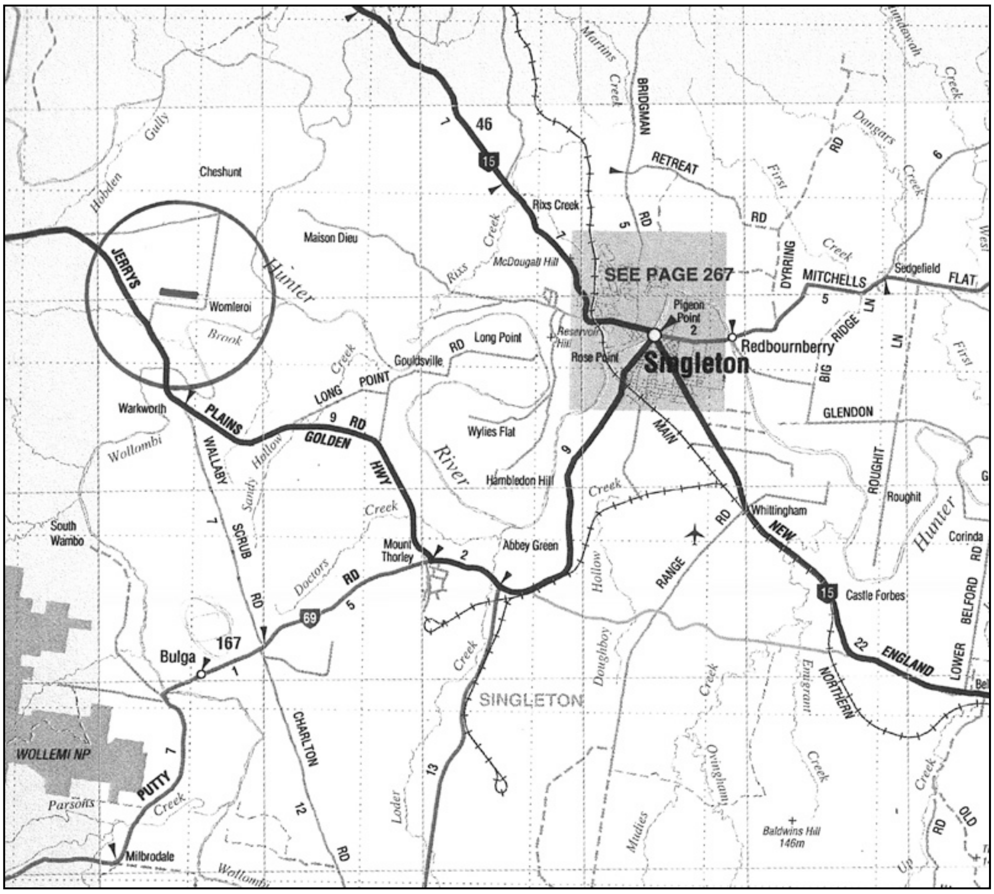


Figure 2: Locality Map, Warkworth.

http://www.multi-map.com.

Note the orientation of the air strip as shown by Figure 2.

2.0 BRIEF OUTLINE OF THE HISTORICAL DEVELOPMENT OF THE SITE

2.1 European History Before World War II

European settlement of the surrounding area began in the late 1820s. Land was initially apportioned into large freehold leases by crown grants. This land was predominantly used as grazing land for cattle stock, or simply held and traded for their financial value. Few holdings were ‘improved’ by the construction of significant works.

Following the passing of the *Land Act* in 1863, many of the larger leases were divided into smaller lots. A significant number of these were used as dairies, as grazing for dairy dry stock, or as orchards. Development of the dairy industry did not reach its full potential until the 1890s, following the completion of the Hawkesbury River Railway Bridge in 1888. This bridge allowed an expansion of the Sydney Metropolitan Milk Board Zone to incorporate the Hunter Valley region, thereby giving dairy farmers in this region access to more lucrative markets than was previously possible. Dairying, timber felling for firewood and milling, and grazing remained the dominant industries practiced in the immediately surrounding area until the outbreak of World War II.

2.2 World War II

Australia formerly declared war on Japan on 9 December, 1941, two days after the bombing of Pearl Harbour. As part of their defence strategy, the Australian Government approved plans for the expansion of the Royal Australian Airforce (RAAF), from 45 to 73 flying squadrons, in what became known as the '73 Squadron Plan'. Warkworth Aerodrome was constructed as part of this plan.

The expansion of the RAAF under the 73 Squadron Plan entailed the construction of a number of new aerodromes, dispersal fields and associated buildings and services throughout both New South Wales and Queensland. The principal intention of these sites was to provide a flexible base for a range of aircraft to defend Australian civilian, military and industrial sites – of which many were concentrated around the Hunter Valley and Newcastle region – and to allow ranging attacks against enemy units. The forces deployed across these aerodromes and dispersal fields would also augment a number of major military assets in the Hunter Valley including the Army base at Singleton, the RAAF base at Williamtown, Rathmines, a major seaplane base on Lake Macquarie, and the sophisticated radar unit operating on the headland to the north of Catherine Hill Bay. As surmised by a Ministerial Minute some eight months after planning began, the proposed aerodromes were intended

> '…to accommodate in each area a balanced air force capable of meeting the threat of attack from seawards. While the risk of attack is high, squadrons will be in occupation of these bases, but when the threat subsides to reappear against another area the air forces will be redisposed accordingly. It is only by the provision now of bases suitably located can the flexibility of air forces be exploited to yield a high degree of security with the minimum of forces.[1]'

The preparation and readiness of the proposed aerodromes was considered 'essential for the defence of Australia', and was thus recommended for approval as an 'urgent war measure', that is, a work of the highest priority. In 1942, three parent aerodromes in the Newcastle

[1] Ministerial Minute, Enc.No.36A. Cited (and dated) in Air Board Meeting Agenda 4484/1942, Supplement No.1, 21 December 1942. Enc.No.34A.

and Singleton region- at Williamtown, Pokolbin and Bulga- were identified.

The Williamtown aerodrome serviced disposal fields at Hexham, Ringwood, and Dungog (also a maintenance strip). Pokolbin supported dispersal fields at Weston, Rothbury, and Glendon, (also a maintenance strip). Bulga, had satellites disposal fields at Warkworth, Broke and Strowan (also a maintenance strip).[2] The location of these fields with respect to one and other is demonstrated by Figure 3.

Figure 2: Location of the Former RAAF Base Bulga with respect to its satellite aerodromes.
Adapted from http://www.multi-map.com.

Bulga is identified by the circle with a thick line. The location of the satellite aerodromes at Strowan, Warkworth and Broke are indicated by circles with a dotted line.

The necessary land was resumed under the National Security (General) Regulations. A plan for the 'RAAF Landing Ground Warkworth', produced in October 1942, can be found in Appendix 1.

While individual sites were chosen according to the suitability of their immediate terrain, the general siting of the aerodromes in remote regions lessened the likelihood of their discovery and collateral damage to civilian locations in the event of an enemy attack. All sites were also within short flying range of critical industrial assets throughout the Newcastle and Hunter Valley region, including shipping, iron and steel fabrication, and mining. The location and design of aerodromes was

[2] Progress Report for Works in the Newcastle and Singleton Area, dated 7 August 1942. Enc.No.21A.

also determined by concerns of minimising the possibility of detection by enemy aircraft and, in case of detection, to reduce damage to aircraft and personnel. The proximity of the sites was such that alternative landings and transfers could be made between each.

In January 1943, the state of progress at Bulga and its satellite sites, including Warkworth, was given as:

Bulga:	One runway useable. Dispersal works in progress.
Broke:	Works nearing completion.
Warkworth:	Runway useable, but dispersal services not complete.
Strowan:	Works nearing completion.

After the battle of the Coral Sea in May 1942, the threat of Japanese attack receded. The Chief of the Air Staff noted that although the 'threat to the mainland had apparently decreased since the start of the project, until we reach the stage where we can abandon work in connection with the defence of the mainland the planned development must go on.' With that in mind, it was proposed to 'limit buildings and engineering services to the minimum facilities essential for operations.'[3]

By mid-1943, the threat of invasion had waned to such an extent that the use of Bulga and its satellite grounds at Strowan, Broke and Warkworth was no longer envisaged. Once the airstrips had been completed to the minimum serviceable standard, little was done. When calculations were done at the end of 1943, over £50,000 had been expended on the airstrip at Warkworth, including, fencing and drainage; over £2,500 had been spent on minimal messing and sanitary facilities for 50 personnel, comprising a general purpose hut and kitchen, latrine (all ranks) and ablutions (all ranks).

As with a great many war works, the effort expended in the construction of Warworth and related sites served only in the purposes of effective preparation and readiness for certain eventualities; it appears no use of the site was made for any war-related activities.

Towards the end of 1944, the Newcastle Aero Club made a request to the RAAF HQ at Stern for permission to land on 'RAAF strips in the vicinity of Newcastle' for practice in forced landings. Request was also made to establish a training centre at Singleton which would make occasional use of 'the local RAAF strip.'[4] Internal communications at the RAAF show that the strips at Bulga, Broke and Warkworth, on which grazing rights had already been established, were to be made available to the Aero Club. The RAAF documents note that the strips were not used by the local RAAF unit (HQ

[3] Air Board Meeting Agenda 4484/1942, Supplement No.1, 21 December 1942. Enc.No.34A.
[4] Letter, from Sgt Rushbrooke, Manager Newcastle Aero Club, to HQ, Stern Area, RAAF, 27 April 1945, Enc.No.72B.

Eastern Area or HQ No.2 Training Group), save for emergency landings.[5] Consent was granted on 11 June 1945 for the Aero Club's use of the site.[6]

During the mid 1960s, the newly formed Hunter Valley Gliding Club Co-operative Limited, (The Gliding Club), began using Warkworth Aerodrome. Initially, the club operated out of Glendon, east of Singleton, moving soon after to Broke:

> 'I remember that we used to park our glider on its trailer and we also used to camp over night in the old hay shed that is still standing near the top of the hill beyond the eastern end of the aerodrome. I can remember building the hangar and club house but I have no idea when that was except that it was in the late 60's.
>
> Originally we rented the land from the dairy farmer who owned it. The whole area was inhabited by dairy properties before the mines arrived and some point when the land was being subdivided we had the opportunity to purchase the land that we now own.'[7]

Warkworth Aerodrome is still used by the Hunter Valley Gliding Club.

3.0 SITE ASSESSMENT

3.1 The Surrounding Area

The area surrounding Warkworth Aerodrome to the east, west and north is dominated by open cut coal mining. The area to the south the site consists of partially cleared dry sclerophyll forest.

3.2 The Site

The site consists of a 5,000' x 150' (1,524m x 46m) airstrip running east-west between a mining area to the west and the continuation of Comleroi Road to the east. The eastern end of the runway lies on the southern part of a piece of land formed by the confluence of the Wollambi Brook and the Hunter River.

Adjacent and to the south of the airstrip are a number of buildings, sheds and caravans forming the facilities of the Gliding Club and its members.

Refer to Photographs 1 and 2.

[5] Memorandum from Air Officer Commanding Eastern Area, RAAF, to Secretary, Air Board, 11 May 1945, Enc. No. unknown.
[6] Memorandum from Director of Works and Buildings, RAAF, to HQ, Eastern Area, RAAF, 11 June 1945, Enc.No.73A.
[7] Information provided by the Hunter Valley Gliding Club Co-operative Limited in an email to Jennifer Anderson (RTCA), dated 30 January, 2007.

Use of the aerodrome by the Gliding Club extends to almost fifty years. Changes to the site by them have been minimal with the exception of the construction of a number of simple buildings to house their facilities. These buildings have social significance to the Gliding Club and its members.

Photograph 1: Warkworth, the end of the strip showing Comleroi Road.

Photograph 2: Warkworth, looking across the air strip towards the Gliding Club buildings.

3.3 Integrity

Little evidence remains of the World War II aerodrome and facilities with the exception of the airstrip itself. Paths to and locations of hideaways are not evident.

3.4 Citations and Listings

The aerodrome and surrounds have no statutory heritage listing. (www.heritage.nsw.gov.au).

3.5 Brief Summary Statement of Significance

The Warkworth Aerodrome has historic significance as one of three dispersal grounds attached to Bulga Aerodrome, the others being located at Strowan and Broke. Bulga was one of three 'parent aerodromes' in the Newcastle- Singleton region identified by the 73 Squadron Plan of 1942. Collectively, this system of aerodromes and dispersal grounds demonstrate the Australian response to the threat of Japanese attack during the early stages of the Pacific War when the attack on Pearl Harbour, the fall of Singapore and the bombing of Darwin made the prospect of Japanese attack on the industrial areas of the east coast of Australia imminent.

The difference between the initial plans and the work realised on the site demonstrates a range of aspects of the prosecution of the war including; the difficulties encountered by a massive increase in public works placing a strain on a wide range of resources; the time taken by a bureaucracy to plan and activate works even when deemed to be of the utmost urgency; and the rapidity with which priorities change as war progresses.

This significance lies solely in records. With the exception of the airstrip, there are no remaining World War II period structures at Warkworth.

Arising out of this significance, Warkworth Aerodrome does not warrant listing as an item of cultural significance.

4.0 HERITAGE IMPACT ASSESSMENT

The following should be read in conjunction with the plans in Appendix 1.

4.1 Description of the Proposal

It is proposed to remove a portion of the western end of the runway to facilitate mining and to extend the runway by an equivalent distance to the east. In the process, Comleroi Road would be diverted to the east.

4.2 Effect of Work

The site has no statutory heritage listing. Concurrent research into the Former RAAF Base Bulga, it was noted that Warkworth Aerodrome was one of three dispersal areas (the others being located at Broke and Strowan) associated with Bulga during World War II.

The historical understanding of the place is derived from records rather than the physical manifestation of the airstrip on the site. There appears to be no artefacts on the site associated with its use during World War II.

In general, World War II sites have strong associative significance, particularly for those who served there. In the case of Warkworth however, there is no evidence that RAAF personnel ever served on the site.

Alterations to the airstrip will have no adverse heritage impact on the site.

5.0 SUMMARY

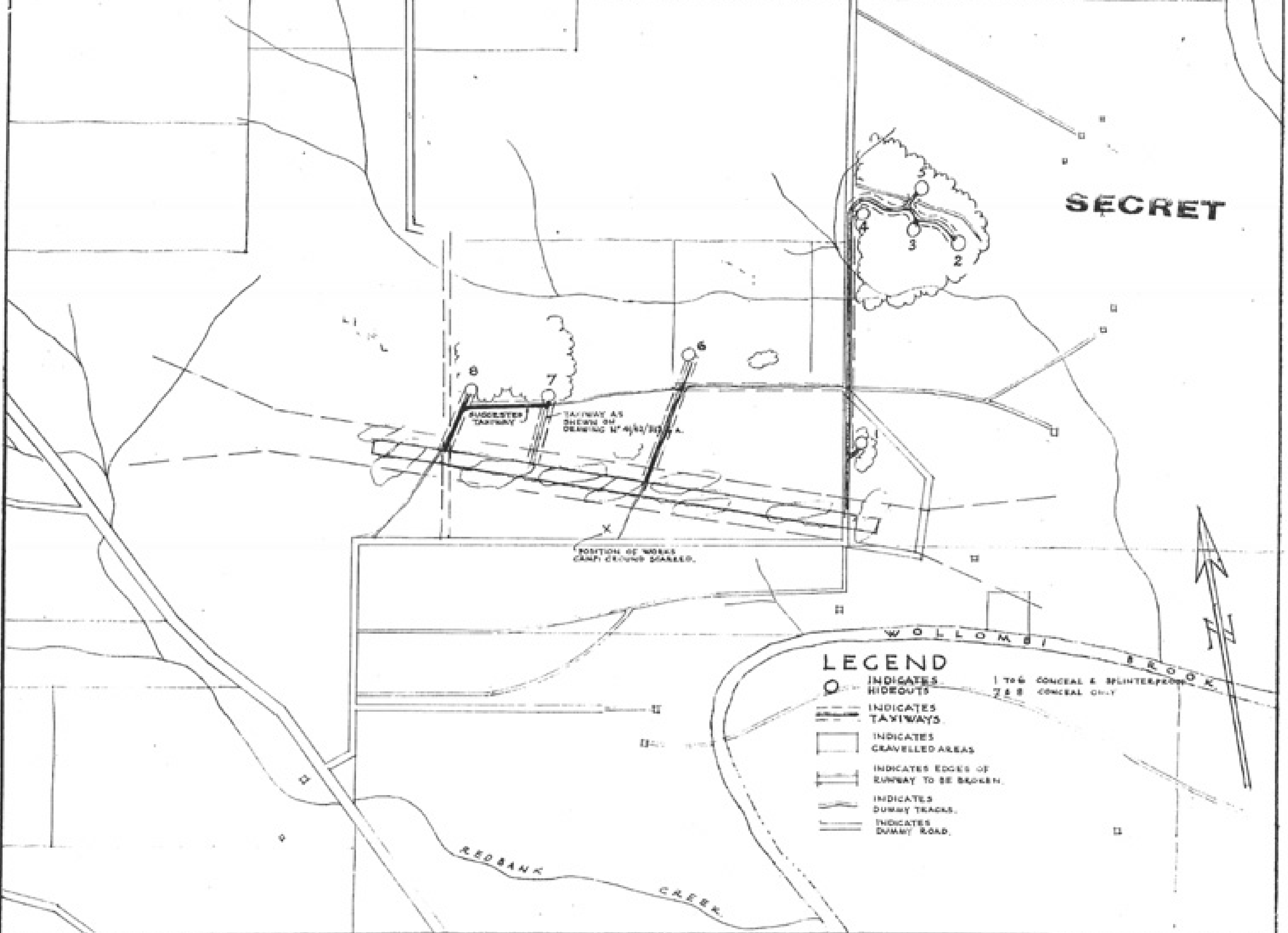
The Warkworth Aerodrome was constructed as part of a group of aerodromes during World War II. It has historic significance arising out of its association with the more elaborate facilities at its parent aerodrome, the Former RAAF Base Bulga. This significance is limited and is not readily reflected in the physical place.

The proposed alterations to the runway will have no effect on the heritage significance of the place.

6.0 APPENDIX 1

Plan of RAAF Landing Ground, 1942

RAAF Landing Ground Warkworth, New South Wales.
Project No. 140. Compiled by the Department of Home Security, Camouflage Section, Sydney University. Dated 03.10.1942.
National Archives of Australia.



DEPT of HOME SECURITY
CAMOUFLAGE BRANCH
SYDNEY UNIVERSITY
F. H. MOLONY DEL
3. 10. 1942.

· R · A · A · F LANDING GROUND ·
· WARKWORTH · N · S · W ·
PROJECT Nº 140

DEPT DIRECTOR
CAMOUFLAGE
N. S. W.

SCALE
ONE INCH = 600'0"

Annex O

HVO South Coal Project, Greenhouse and Energy Assessment, Rio Tinto 2007

RIO
TINTO

Project Code: 11945 **Document Reference:** 2007/152 **Version:** FINAL

HVO South Coal Project Greenhouse and Energy Assessment

Part 3A proposal

Report for Environmental Assessment submission

Prepared For:	Ruth Kinal
Author/s:	Rhys Jenkins
Distribution:	Anna McMullen Technology and Innovation file
Issue Date:	1 October 2007
Project Manager:	Mick O'Keeffe
Reviewer	Crosbie Baulch

SECTION 1 - EXECUTIVE SUMMARY

Project purpose

The purpose of this project is to provide a quantitative assessment of the potential impact of the additional greenhouse gas emissions that will result from the approval of the Hunter Valley Operations South Coal Project.

Focusing question

> ***"What are the potential impacts to the environment due to greenhouse gas emissions from the Hunter Valley South expansion project?"***

Major findings

CNA has applied to expand its mining operations at the existing HVO coal mine. The expansion, called the HVO South Coal Project (the Project) involves the extraction of 16Mt of ROM coal from four mining areas over a period of approximately 20 years. If approved, the Project will require 14.6PJ of direct on-site energy and result in 155Mt CO_2-e[1] being emitted over the life of mine. This equates to approximately a 20 per cent increase in equivalent energy use and greenhouse gas emissions at HVO.

The potential global impact of the Project has been assessed using internationally recognised data and methodologies. Between project inception to peak-production the impact of the Project will range from 0.01 per cent (2010), to 0.04 per cent (2020) of global energy related emissions. An assessment was also carried out to determine the potential impact on global surface temperatures resulting from the additional emissions. It was determined that over the life of mine the Project will raise the global surface temperature by an estimated 0.000078ºC.

On a global scale the greenhouse impact of the Project is minimal and is unlikely to have any significant influence on global temperatures. Nevertheless, the cumulative effect of greenhouse emissions does impact global warming and climate change. In this context, Rio Tinto and CNA will continue to focus on improving energy efficiency and reducing the greenhouse gas emissions associated with mining, processing and using its coal product. CNA remains committed to reducing the impact of on-site activities and will continue to implement energy efficiency improvement projects, while Rio Tinto will continue to seek global solutions through adoption of new technologies and continued support of greenhouse abatement solutions such as clean coal technologies.

[1] Scope 1, Scope 2 and relevant Scope 3 emissions (see Section 2 for definitions)

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SECTION 2 - MAJOR FINDINGS & ACTIONS

1 CONTEXT

CNA owns and operates HVO, which currently operates in two mining areas divided by the Hunter River, known as HVO North and HVO South. HVO South comprises three pits, identified as Riverview, Cheshunt and South Lemington pits. HVO is seeking to expand its mining operations in HVO South as part of the HVO South Coal Project (the Project). The Project proposes to extend mining operations in the following four areas:

- Deep Cheshunt;
- Riverview Pit South West;
- Riverview Pit South East; and
- South Lemington Pit 1.

These areas are currently covered by 25 separate development consents and 11 modifications (ie 36 approvals), which have previously been issued by both the Singleton Shire Council and the New South Wales Department of Planning (DoP). Approval for the Project is being sought by an application (06_0261) under Part 3A of the *Environment Planning and Assessment Act 1979* (EP&A Act). The application seeks to consolidate the existing consents under a single project approval to allow production and processing of up to 16 million tonnes of run-of-mine coal to continue. An environmental assessment has been prepared to support this application. The Director General has advised that under Section 75F of the EP&A Act, the environmental assessment must address the following aspects:

- Greenhouse gases – a greenhouse gas assessment (including a quantitative analysis of the greenhouse gas emissions associated with the combustion of product coal, and a quantitative assessment of the impacts of these emissions on the environment); and
- A description of the measures that would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the impacts of the Project, and how existing environmental monitoring and management programmes/plans at HVO North and HVO South would be revised to accommodate the changes.

This report addresses these requirements by presenting the following information:

- Details of the greenhouse gas estimation methodologies applied (including calorific values and emission factors);
- Energy and greenhouse inventory data for 2006, for existing HVO North and HVO South mining operations;
- Projected energy use and greenhouse emissions for both business as usual and Project case scenarios;
- Quantitative assessment of potential impact of the Project, in relation to global greenhouse gas emissions and global temperature rise; and

- Existing and proposed energy use and greenhouse gas emissions management practices.

2 GREENHOUSE GAS INVENTORY REPORTING METHODOLOGY

The methodologies used to estimate the greenhouse emissions are consistent with Rio Tinto's greenhouse inventory methodology. Rio Tinto's inventory and methodologies have been externally verified by third parties, and endorsed as being consistent with World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) Greenhouse Gas Protocol[2] approaches. The Rio Tinto methodology is also aligned with the ISO 14064 series of Standards which are specific to the measurement, monitoring and reporting of greenhouse gases.

The Rio Tinto methodology reports emissions based on the classification included in the WBCSD/WRI Greenhouse Gas Protocol. The nomenclature used is as follows:

- *Scope 1* – direct greenhouse gas emissions from sources that are owned or controlled by the company and include fuel use, on-site electricity generation, anode and reductant use, process emissions and land management. In the case of the Project, this includes emissions from the use of diesel fuel for mining equipment, coal seam gas, land clearing and explosives used within the boundary of the site;
- *Scope 2* – emissions from the imports of electricity, heat or steam from third parties (energy related indirect emissions); and
- *Scope 3* – other indirect greenhouse gas emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation. Third party transport and the combustion of CNA's coal by its customers are examples of Scope 3 emissions considered in this report.

A recent judicial decision in New South Wales found that major coal proponents need to fully consider the impact of greenhouse gas emissions from coal combustion when assessing the environmental effects of projects. This decision has set a precedent for decision makers in New South Wales to request the assessment of the Scope 1, Scope 2 and relevant Scope 3 greenhouse gas emissions of projects.

2.1 Greenhouse gases

The WBCSD/WRI Greenhouse Gas Protocol and other international bodies such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) recognise six main greenhouse gases:

- Carbon dioxide (CO_2);
- Methane (CH_4);

[2] World Business Council for Sustainable Development / World Resources Institute (2004) *Greenhouse Gas Protocol*. WBCSD: Washington

- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur hexafluoride (SF_6).

Carbon dioxide is formed and released during the combustion of gaseous, liquid and solid fuels (ie when fuels are burnt in diesel-powered equipment, when explosives are used, and in the generation of the electrical energy that will be used by the project). In addition, there will be emissions of CH_4 and CO_2 which are liberated as coal is uncovered, mined and processed. Emissions from the remaining greenhouse gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) are not expected from the Project.

2.2 Emission factors

Inventories of greenhouse gas emissions can be calculated using published emission factors. The following emission factors, as published in the National Greenhouse Gas Inventory Workbooks (NGGI 2006) and AGO Factors and Methods Workbook 2006 (AGO 2006), have been used for this report:

- *Diesel used on-site* – 3.0t CO_2-e per kilolitre of diesel used. This is based on a full fuel cycle analysis (Table 3, AGO 2006), which includes 2.7t CO_2-e/kL and 0.3t CO_2-e/kL required to produce the fuel;
- *B2 Biodiesel for transport* – as advised by Caltex via Caltex Australia. Diesel factors have been used allowing for a two per cent reduction in greenhouse gas emissions;
- *Petrol used for transport* – 2.6t CO_2-e per kilolitre of petrol used. This is based on a full fuel cycle analysis (Table 3, AGO 2006), which includes 2.3t CO_2-e/kL and 0.3t CO_2-e/kL required to produce the fuel;
- *Purchased electricity* – 1.068kg CO_2-e per kilowatt hour of electrical energy used in NSW. This is based on a full fuel cycle analysis (Table 5, AGO 2006), which includes 0.893kg CO_2-e/kWh from the fuel burnt in the power station and 0.176kg CO_2-e/kWh for the provision of the fuel used in the power station and losses in the distribution system that delivers the power to the mine;
- *Explosives* - 0.167t CO_2-e per tonne of ANFO used, 0.178t CO_2-e per tonne of heavy ANFO and 0.166t CO2-e per tonne of emulsion used. These are point source emission factors (Table 12, AGO 2006); and
- *Coal seam gas* – 45.5kg CO_2-e (or 2.17kg CH_4) per tonne of raw coal extracted from opencut mines in NSW. This is a point source emission factor (Table 6, AGO 2006), which is based on the liberation of both CO_2 and CH_4 as the coal seam is broken up.

2.3 Global Warming Potential

Different gases have different greenhouse warming effects (potentials) and emission factors take into account the global warming potentials of the gases created during combustion. The global warming potentials of the greenhouse gases (Appendix 3, AGO 2006) are as follows:

- CO_2 – 1;
- CH_4 – 21; and
- N_2O – 310.

When the global warming potentials are applied to the estimated emissions then the resulting estimate is referred to as CO_2-equivalent emissions (CO_2-e).

Table 1 - Summary of energy and emission factors used

Source	Unit	Calorific value	Scope 1 emission factor	Scope 2 emission factor	Scope 3 emission factor
		GJ/unit	tCO_2-e/unit	tCO_2-e/unit	tCO_2-e/unit
B2 Biodiesel	kL	38.6	2.64		0.3
Diesel	kL	38.6	2.70		0.3
Petrol	kL	34.2	2.31		0.3
Purchased electricity	MWh	3.6		0.893	0.176
Anfo	tonnes		0.167		
Heavy Anfo	tonnes		0.178		
Emulsion	tonnes		0.166		
Coal seam gas	tonnes		0.0455		
			tC/ha		
Land clearance[3] - woodland/scrub	hectares		45		
Land clearance - grass	hectares		13.5		
			tC/ha/yr		
Revegetation[4] - trees	hectares		1.8		
Revegetation - grass	hectares		1.1		

2.4 Projected greenhouse gas emissions and energy use

The year-to-year energy required by the operation is governed by mine plans. These plans are created for the short and long term, and dictate the development of a mine, the equipment utilised and the resource to be extracted. These plans are used as the basis for reporting on projected resource recovery and energy consumption during operation.

The predicted amount of energy used each year has been based on:

- Use of mining equipment and ancillary plant;
- Amount of explosives used; and

[3] Land clearance data assumes 100 per cent clearance
[4] Trees are considered to be in active re-growth for 15-30 years and grass for two years.

- Operation of coal handling and preparation plant.

For each year of the mine plan this information is collated and the appropriate energy values applied to each activity/item. These values are totalled and a prediction of the energy consumed for each year of the mining scenario is produced.

Production projections are derived from Life of Mine (LOM) plans using the September 2006 mine plan. This is the same mine plan data that all other assessments for the EA are based on. It is important to note that the September 2006 mine plan was developed prior to the negative impacts of port and rail restrictions, therefore emissions projections presented in this report are considered as a worst case scenario, as the projections are based on maximum production and maximum sales.

2.5 Assumptions and limitations

The following assumptions and limitations were considered during the preparation of this report:

- Data supplied by CNA is accurate;
- LOM planning data is considered accurate as at September 2006;
- LOM period for the entire HVO operation is from 2007 to 2038, with the Project coming on line in 2009 and ceasing operations and sales in 2027. Extraction of coal will be preceded by two years of land clearance and pit development activities;
- From 2007 onwards, 100 per cent of diesel used on-site will be B2 Biodiesel;
- That the coal extracted from the Project has the same carbon content (70 per cent) and the same energy content (23.9 GJ/t ROM coal) as NSW unwashed black coal used for electricity generation (Table 1, AGO 2006). This is consistent with the coal from the existing HVO North and South pits;
- The vegetation type to be cleared and revegetated is the same as previously cleared and planted for existing HVO North and HVO South operations. Data presented by HVO is for net land management activities (ie assumes CO_2-e sinks through revegetation);
- ROM coal data has been provided by mine planners for both the Project and HVO North + HVO South. The percentage difference between ROM coal for the Project and existing operations has been applied to projections for saleable coal for the Project – as this data was not provided by CNA;
- HVO sells approximately one per cent of its coal to power stations in Australia (including New South Wales). The combustion of coal for electricity generation is included in the Scope 3 data as well as the Scope 2 emissions for the electricity purchased back from the New South Wales grid. Therefore the total emissions (Scope 1, 2 and 3) for the Project will be overestimated slightly (ie less than one per cent), due to double accounting;
- For the combustion of fuels, a direct conversion of carbon to CO_2 (emissions) has been applied using the multiplier 3.667 (44/12). This assumes 100 per cent combustion of carbon and that incidental CH_4 and N_2O emissions are negligible. For the evaluation of emissions from fuel combustion then NGGI CO_2 emission factors have been used;

- All projection data is based on the calculated 2006 data and projected saleable and ROM coal estimates;
- Restricted ability to access to timely and accurate global emissions data. This uncertainty reduces the ability to confidently estimate CNA's potential contribution to global greenhouse gas inventories;
- The data presented in Sections 3.3 and 3.4 of this report compares 2004 global *energy related* emissions to emissions from all of HVO's activities (not just energy related emissions). Because the Project data is being compared to a subset of what the total global emissions would be, the actual potential contribution to global greenhouse gas emissions and potential influence on global temperature rise, will be overstated; and
- Emissions data for third party transport (port to port) has been included in Sections 3.2 and 3.4. Access to information on the locations of all customers beyond major ports is not possible. Therefore, it is not possible to provide a precise estimate of the emissions associated with the delivery of coal to final destinations.

3 ENERGY USE AND GREENHOUSE GAS INVENTORIES

3.1 Current energy usage - 2006

HVO used 2.9 peta joules of energy during 2006[5] through the consumption of electricity and fuel (Table 2). Electricity usage is divided into mining (electricity expended on the extraction of resources) and processing (electricity expended on the preparation of coal for sale). Diesel is used in equipment across the operation, and in association with the preparation and detonation of explosives.

Table 2 - 2006 energy usage for HVO

Source	End use	Amount[6]	Unit	TJ
B2 Biodiesel	Mining	16,000	kL	620
Diesel	Mining	47,000	kL	1,800
Petrol	Mining	150	kL	5
Purchased electricity	Mining	63,000	MWh	230
Purchased electricity	Milling	62,000	MWh	220
Total				**2,875**

3.2 Current greenhouse gas emissions - 2006

HVO emitted approximately one million tonnes[7] of CO_2-e during 2006 and were indirectly responsible for a further 31 million tonnes CO_2-e (Table 3). Greenhouse gas emissions at the site are related to purchased electricity and fuel, the preparation and detonation of explosives, gases liberated from mined coal seams and net vegetation lost during land clearance activities. Third-party emissions have also been included in this report, and they relate to third party transport and combustion of saleable coal.

3.3 Projected energy use

If the Project is approved, an additional 14.6PJ of energy will be required over the life of mine. This equates to a 20 per cent increase in energy required compared to a business as usual scenario over the same period. Figure 1 shows the annual energy projections for both the existing mining operations as well as the additional energy required for the Project (between 2009 and 2027). This figure also highlights the decrease in annual energy use as the mine approaches closure in 2038.

[5] This includes HVO North and the two active HVO South pits.
[6] Data has been rounded for confidentially purposes.
[7] Scope 1 and Scope 2 emissions.

Table 3 - 2006 greenhouse gas emissions for HVO

Source	Amount[8]	Unit	Scope 1 emissions t CO_2-e	Scope 2 emissions t CO_2-e	Scope 3 emissions t CO_2-e
B2 Biodiesel	16,000	kL	42,000		4,800
Diesel	47,000	kL	127,000		14,000
Petrol	146	kL	350		40
Purchased electricity	63,000	MWh		56,000	11,000
Purchased electricity	62,000	MWh		55,000	11,000
Anfo	10,000	tonnes	1,600		
Heavy Anfo	17,000	tonnes	2,800		
Emulsion	11,000	tonnes	2,000		
Coal seam methane	33,000	tonnes CH_4	700,000		
Land clearance	149	hectares	15,000		
Land revegetation	573	hectares	-4,000		
Third party transport					250,000
Combustion from saleable coal	12,000,000	tonnes			31,000,000
Total			**886,750**	**111,000**	**31,290,840**

A negative indicates amount sequestered.

3.4 Projected emissions

If the Project is approved, an additional 155Mt CO_2-e of greenhouse gases will be emitted over the life of mine. This equates to a 21 per cent increase in greenhouse gas emissions compared to a business as usual scenario over the same period. Figure 2 shows that the percentage contribution of the Project to overall emissions varies from year to year. This contribution ranges from 3.6 per cent in 2012 to as much as 45 per cent in 2021. Figure 2 also shows the annual greenhouse gas emissions (Scope 1, 2 and relevant Scope 3) projections for both the existing mining operations as well as the additional emissions resulting from the Project. This figure also highlights the decrease in emissions as the mine approaches closure.

[8] Data has been rounded for confidentially purposes.

Figure 1 – Projected energy use for existing mining operations and the additional of the Project

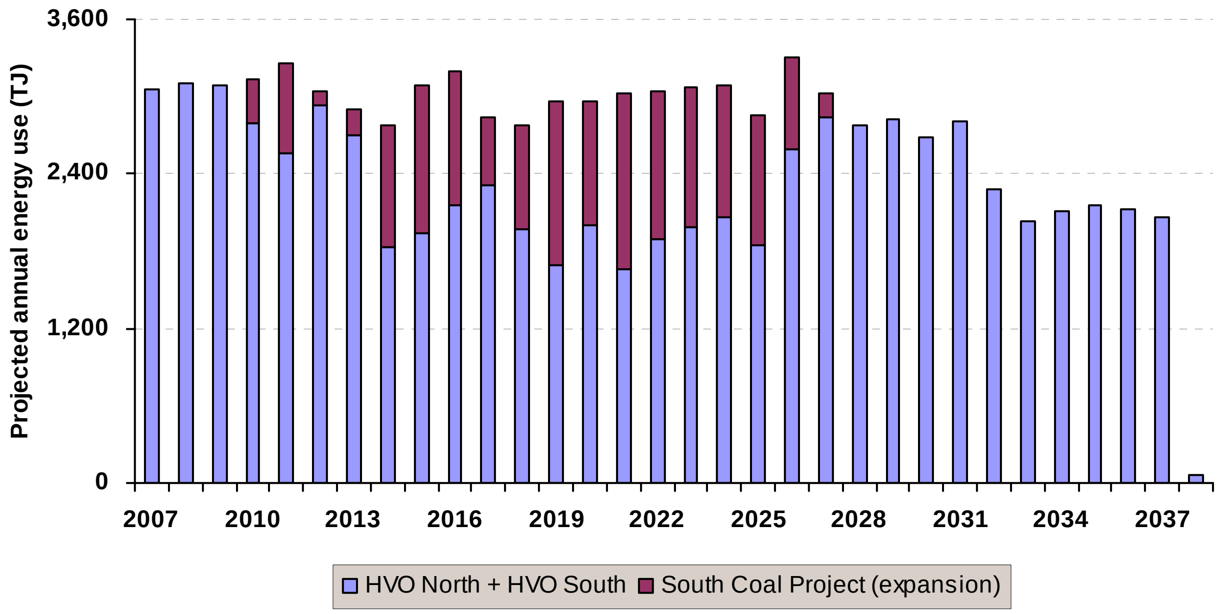
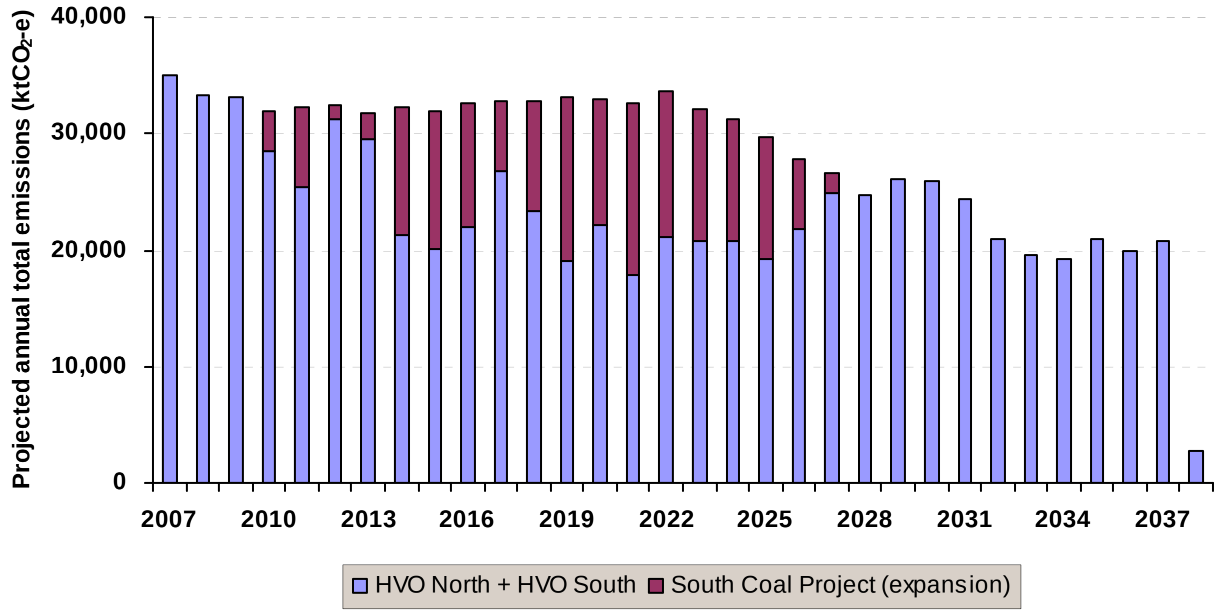


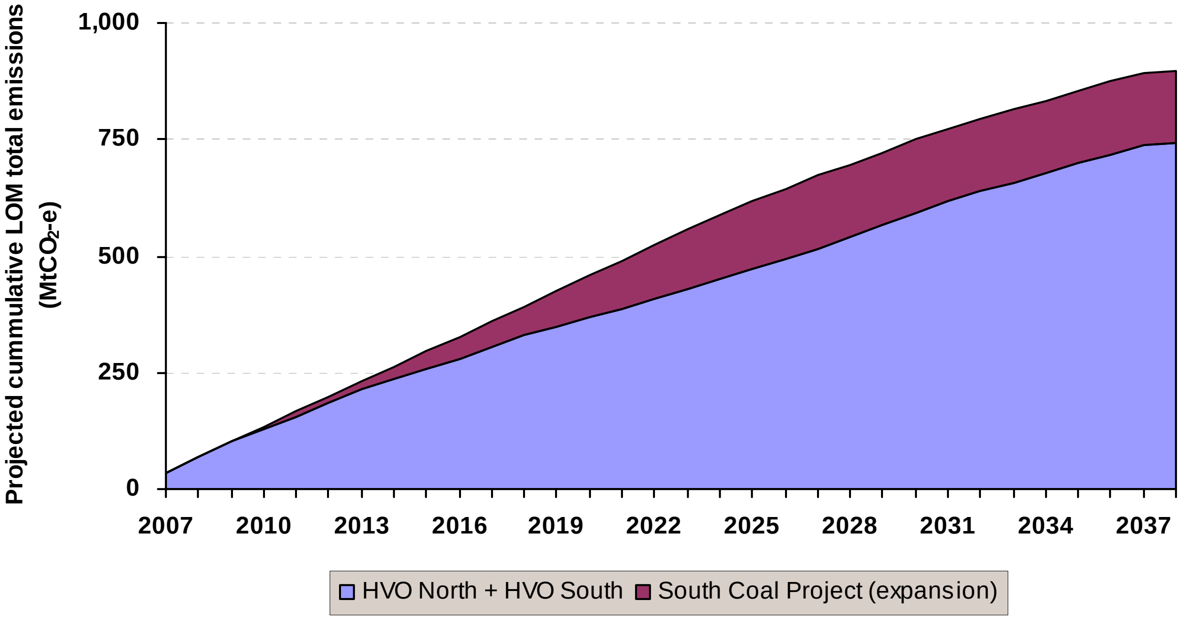
Figure 2 - Projected greenhouse gas emissions for existing mining operations and the addition of Project maximum



Data includes Scope 1 + Scope 2 + Scope 3 emissions

Figure 3 shows the cumulative effect of the Project on LOM greenhouse gas emissions.

Figure 3 – Projected cumulative greenhouse gas emissions for existing mining operations and the addition of the Project



Data includes Scope 1, Scope 2 and relevant Scope 3 emissions

3.4.1 Quantitative assessment of the environmental impact of additional greenhouse gas emissions

A key issue to be addressed is what contribution the additional emissions from the Project might make to global CO_2 levels, and potentially global warming. The relationship between global warming and greenhouse gas concentrations is not linear. Thus there is no widely accepted method to determine the contribution that a given addition of greenhouse gas emissions might make to global warming.

However, it would be reasonable to draw a conclusion relating to the estimated CO_2-e emissions from the Project and the projected global emission data for a point in time. This has been done below to determine what impact the additional emissions resulting from the Project might have on global warming.

The 2006 Energy Information Administration (EIA)[9] reference document was used for the basis of emissions comparisons. The 2006 International Energy Agency (IEA)[10] document was also reviewed, however the EIA reference was used in preference of the IEA reference simply because it provides more recent data. The EIA reference was published 2006, however it contains retrospective data from 2004. This is the most current data available, and therefore HVO data for 2006 has been compared to global data from 2004.

[9] Energy Information Administration (2006) *International Energy Outlook June 2006*. US Department of Energy: Washington (DOE/EIA-0484(2006).
[10] International Energy Agency (2006) *World Energy Outlook – Summary and Conclusions*. IEA: Paris.

Table 4 presents the EIA global *energy related* greenhouse gas emissions data for 2003, as well as projected emissions for 2010, 2020 and 2030. These years have been chosen to demonstrate the potential impact of the Project; is in its infancy (2010), when the Project is peaking in production (around 2020) and when the project has ceased production (2030). Also presented in the table are the approximate 2006 greenhouse gas emissions for the existing HVO mining operation as well as the potential impact of the Project on global emissions.

Table 4 – HVO's present and projected contribution to global CO_2-e emissions

Region	Units	2006	2010	2020	2030
EIA data[a]	Gt CO_2-e	27.0	30.4	33.7	43.7[c]
HVO North + HVO South[b]	Mt CO_2-e	32.2	28.5	22.2	25.9
HVO North + HVO South + Project	Mt CO_2-e	32.2	32.0	33.0	25.9
HVO North + HVO South[b]	%	0.12	0.09	0.06	0.06
Project only	%	0	0.01	0.04	0
HVO North + HVO South + Project	%	0.12	0.11	0.10	0.06

[a] Energy Information Administration (2006) *International Energy Outlook 2006*, which includes 2004 data. Forecast global data is *energy related* carbon dioxide emissions only
[b] Existing mining operations in 2006. Forecast emissions does not include the expansion Project
[c] EIA 2006 published a figure of 43,676 million tonnes for 2030
Greenhouse emissions data presented is Scope 1, Scope 2 and relevant Scope 3

The data in Table 4 shows that if the Project was approved, its contribution to global energy related greenhouse gas emissions would be 0.01 per cent in 2010 when production had recently begun and 0.04 per cent in 2020 when production is at near-capacity. Overall the contribution of HVO to global greenhouse gas emissions is projected to decrease from 0.12 per cent (2006) to 0.06 per cent (2030). This demonstrates that HVO's potential impact on global emissions will decrease over time, with or without the additional emissions from the Project. This indicates that emissions from sources outside HVO operations are anticipated to increase at a greater rate than emissions from HVO mining operations.

A second evaluation was carried out to determine whether the additional greenhouse gas emissions resulting from the Project might have an impact on global temperature rise. The methodology suggested by the Intergovernmental Panel on Climate[11] (IPCC) has been used for the following evaluation.

Based on the IPPC estimate, a doubling of the CO_2-e concentration in the atmosphere would lead to a 3.0°C increase in global average temperature. Applying this estimate to the 2006 atmospheric CO_2 concentration of 381 parts per million by volume of air[12] (ppmv) this would result in a 3.0°C rise in the global average temperature as atmospheric CO_2 concentrations approach 762ppmv. A CO_2 concentration of 762ppmv is equivalent to 3.4 trillion tonnes[13] of CO_2 in the atmosphere. Therefore by applying a direct proportional relationship between the additional emissions resulting from the Project (155Mt CO_2-e) and global concentrations (3.4 trillion tonnes CO_2-e) it is possible to estimate that the emissions from the Project would lead to an estimated increase in global temperature of 0.00007827°C over the life of mine.

[11] Intergovernmental Panel on Climate (April 2007) Fourth Assessment Report *"The Physical Science Basis".* Summary for Policy Makers (pg 12).
[12] US Department of Commerce, National Oceanic & Atmospheric Administration Research (2006), Earth System Research Laboratory, Global Monitoring Division
[13] Carbon dioxide information analysis centre. http://cdiac.esd.ornl.gov/pns/faq.html . One ppmv CO_2 = 7.81Gt CO_2.

This calculated increase in global temperature can be considered as a maximum estimate since the comparison has been made against the EIA's world projection data which is based on *energy related* emissions only. The Project data includes all emissions sources (not just energy related). If the EIA data included emissions from all sources, the global projections would increase, and the calculated proportional contribution of the Project would be further diminished. This suggests that from a global perspective there will be no significant environmental effect due to the additional emissions of greenhouse gases from the Project, even when the customer's combustion of product coal is taken into account.

In practice, the effects of global warming and associated climate change are the cumulative effect of numerous sources of greenhouse gas emissions (such as HVO) and it is the cumulative effects of all of these sources that pose a threat to the global climate. This analysis highlights the problematic approach to dealing with climate change on a mine-by-mine, or project-by-project basis.

In summary, the greenhouse gas emissions from the Project are not expected to have any significant effect on global CO_2-e concentrations or global warming. Rio Tinto recognises that global warming and climate change are largely attributable to the cumulative effects of burning coal and other fossil fuels. It should however be acknowledged that global demand for coal is increasing. If the Project was not to proceed, HVO's customers demand for coal will simply be sourced from another mine, which may be operated in a less efficient manner, therefore potentially increasing the amount of emissions created.

4 MANAGEMENT OF ENERGY USE AND GREENHOUSE GAS EFFICIENCY

The control of global greenhouse gas emissions will be achieved through the efficient management of energy use, implementation of abatement solution and reasonable economic restraints. Such instruments set at appropriate levels, would encourage increases in efficiencies in the way that carbon-based fuels (including coal) are used.

The efficient use of energy during operations is important to CNA. The majority of HVO's greenhouse gas emissions are energy related and CNA also acknowledges that it makes good business sense to reduce energy use (ie energy costs money). In addition Rio Tinto has publicly committed its businesses (including CNA) to improve energy and greenhouse performance, and has set targets to reduce both energy use and greenhouse gas emissions.

CNA is committed to operating the Project in the most efficient method practicable to reduce energy use and emissions of greenhouse gases and is an active contributor to research programmes to develop clean coal technologies.

Prior to discussing the management of energy use and greenhouse gas emissions in more detail it is worth noting that the energy efficiency of coal mining can fluctuate from year to year. Fluctuations in this efficiency can be the result of a number of factors including:

- Depth of the pit;
- Distance of the active mining area from the processing plant;

- Pit development and rehabilitation activity;
- Thickness of the overburden; and
- Tonnes of coal produced.

To minimise emissions of greenhouse gases during mining, CNA's mine plan will seek to:

- Minimise the movement of overburden and coal;
- Minimise rehandle;
- Maintain vehicle fleets to maximise operational efficiency;
- Uses the most fuel efficient equipment available;
- Minimises the length of haul roads consistent with the development of an acceptable final landform; and
- Maximise resource extraction.

Application of these principles is consistent with minimising dust generation as well as minimising fuel usage and greenhouse gas emissions. The following sections of this report detail the actions and initiatives that are being undertaken by RTCA to minimise energy use and greenhouse gas emissions.

4.1 Management initiatives

There are a number of energy management and greenhouse gas abatement initiatives currently being undertaken by HVO at an operational level, by RTCA Corporate at a business unit level and by Rio Tinto at a global level. The following section outlines the commitment to these initiatives.

4.1.1 Rio Tinto management initiatives

Energy underpins economic development, and coal is, and will continue to be, an essential component of the global energy supply that powers that development. That said, the world is transitioning towards energy technologies with lower carbon intensity. Rio Tinto is actively involved with a number of initiatives to further develop these technologies, some of which involve coal. Rio Tinto invests significantly in the initiatives listed below, and continued business prosperity is a key element in ensuring this ongoing commitment.

- *Hydrogen Energy* – is the company jointly owned by Rio Tinto and BP to develop hydrogen fuelled power generation, using fossil fuels and carbon capture and storage technology to produce new large scale supplies of clean energy;
- *Clean coal* - actively researching and promoting technologies that reduce CO_2 emissions from the use of coal. Programmes include COAL21, an initiative of the Australian Coal Association aimed at reducing greenhouse gas emissions arising from the use of coal in electricity generation in Australia. Current actions include payment of a levy per tonne of coal to fund clean coal demonstration ($A12-15 million per year based on 2005 production rates), inclusion of a minimum of five energy improvement projects per site in the 2007 plan, and measurement and reporting to capture energy use and savings;

- *Energy management* - improving energy use at both the operations, and along the supply chain. The first step was undertaking energy reviews at each operation and identifying a range of energy projects for further development and implementation;
- *Designing for the future* - designing projects, recognising risks from a changing climate and opportunities in a changing policy environment. Programmes in this area include investigating new options to capture coal seam methane from underground and opencut mines; and
- *Raising awareness* - raising awareness with employees, the communities where we operate, our customers, governments, suppliers and industry, that this is an issue that requires us all to change how we currently operate.

One medium which will be used to achieve CNA's contribution to these tasks is the RTCA Climate Change Action Plan (CCAP). The CCAP has been developed as a requirement of the Rio Tinto Climate Change Plan, and seeks to manage the risks and opportunities that arise in relation to a changing climate.

The Rio Tinto Environment Standard E4 Greenhouse Gas Emissions aims to ensure the minimisation of greenhouse gas emissions in Rio Tinto. This will be accomplished by identifying greenhouse gas emissions sources, evaluating and prioritising them according to significance, then designing and implementing appropriate control, reduction and mitigation measures of greenhouse gas emissions to the environment.

4.1.2 RTCA Corporate initiatives

Cost effective projects being investigated or undertaken by RTCA Corporate with an intention to implement these projects across all RTCA operations including HVO, include:

- *Diesel Fuel Management* - HVO currently uses implied burn rates and run hours from the 'Modular' system to allocate diesel fuel usage. This system is not currently utilised by HVO to measure efficiency or highlight individual users. HVO also issues diesel from a number of points and the potential exists for significant spillage and errors in allocation. RTCA Corporate is currently undertaking a review of the potential inefficiencies listed above and is using this to develop a best practice diesel metering, monitoring and reporting system for use at HVO with the aim to use this data to drive efficiency of diesel use and to assess a number of projects that have the potential to save significant amounts of diesel;
- *Electricity monitoring and management (SCADA)* – data from electricity meters should report to the plant management systems through the local SCADA (Supervisory Control and Data Acquisition) system. The data should be used for calculation and tracking of efficiency KPI's for major electricity-consuming plant. The aim of this project (together with other online systems) is to develop a best practice electricity metering, monitoring and reporting system to provide operators with electricity KPI's in real time to facilitate timely intervention to correct variances in efficiency; and

- *Project Centre* – all RTCA operations are proposed to use the Project Centre system as a tool to manage greenhouse and energy projects.

4.1.3 HVO operational initiatives

As a designated energy user under the NSW *Energy Savings Order 2005*, HVO is required to submit an Energy Savings Action Plan (ESAP) to the NSW Department of Energy, Utilities and Sustainability (DEUS). The most recent plan lists 13 energy saving activities. These projects, which are shown in Table 5, and outlined below, represent a potential annual savings of 22kt CO_2-e and could improve (ie reduce) HVO's annual energy use by 2.2 per cent. These emissions and energy use savings will contribute to HVO's targets of a 0.7 per cent improvement in greenhouse gas efficiency and 3.0 per cent improvement in energy use efficiency between 2003 and 2008.

Details of specific HVO projects listed in Table 5 are discussed below:

- *Haul truck engine replacement / repower* - this project involves a minimum trial size of eight haul trucks being repowered with alternative engines that are estimated to provide six per cent fuel savings compared to current engines. Actual fuel burn rates of the engines will be recorded to obtain energy savings in litres of fuel;

- *Improve control of lighting plants* - automatic switches (on and off) are to be installed on all lighting plants across site (approximately 50 plants). Observations will be made during project implementation to ensure that the switches are effective. The fuel usage of operation for each of lighting plant will be recorded prior to and after project implementation to determine savings in litres of fuel;

- *Reduce idle load on conveyors and plant* - the ROM conveyors and associated equipment at HVCPP will be automated to stop when operating idle. Energy savings will be determined by measuring the hours that relevant plant is stopped with the new automated system rather than operating idle as would be the case prior to project implementation;

- *In-pit fuelling* – in the first quarter of 2007, HVO will implement in-pit fuelling. A mobile fuel tanker will be stationed in-pit so additional fuel is not needed to travel to re-fuel; and

- Potential cost effective projects that will continue to be reviewed by HVO during project pre-feasibility and feasibility to determine if cost effective energy savings can be obtained from implementation of these projects.

Table 5 – HVO greenhouse and energy saving projects

Project	Potential annual energy savings (GJ)	Potential emissions savings t CO_2-e	Project start date
HVO – cost effective projects			
Haul truck engine replacement / repower with higher efficiency engines	14,822	1,025	01 May 2006
Improve control of lighting plants	3,860	270	01 Jul 2006
Reduce idle load on conveyors and plant	9,010	2,640	01 Oct 2006
High efficiency motors	2,700	790	01 Jul 2006
HVO – Potential cost effective projects			
Dragline digital drive and Titronics installation and optimisation of operating efficiency	4,510	1,320	01 Sep 2005
VSD for process pumps	2,880	840	01 Jul 2006
Spiral upgrade	NYE	NYE	01 Jul 2006
Develop truck replacement strategy, incorporating energy efficiency potential	NYE	NYE	31 Dec 2007
In pit fuel tankers	1,274	94	01 Jan 2006
Hydrocarbon cleanliness	22,840	1,679	01 Jan 2006
Total HVO savings	**61,896**	8,658	
RTCA corporate – Cost effective projects			
Monitoring and management SCADA - Electricity	9,010	2,640	01 Oct 2006
Diesel fuel management	44,710	3,120	01 Jul 2006
Investigate use of diesel fuel additives	111,780	7,790	01 Jul 2006
Total RTCA corporate savings	**165,500**	13,550	
Total savings	**227,396**	22,208	

NYE – Not yet evaluated
Energy savings figures based on 2006 actual energy use data
Energy Savings to be determined as project enters pre-feasibility stage

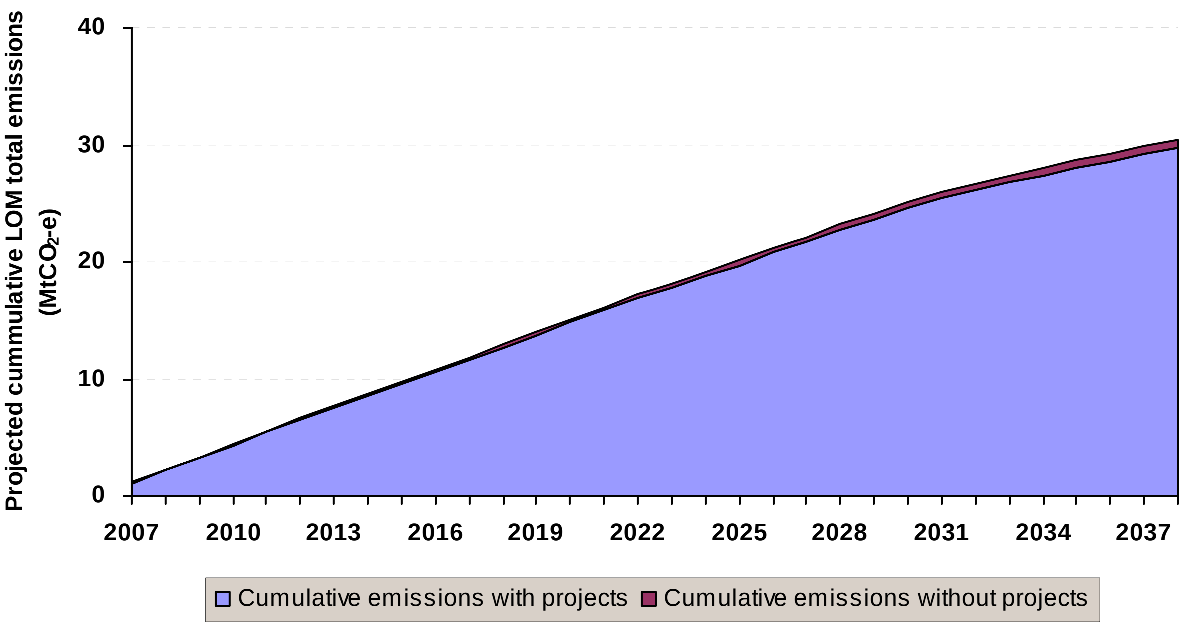
Figure 4 shows the potential impact of completion of the greenhouse and energy savings projects listed in Table 5. The data represented is Scope 1 and Scope 2 data, as this is where CNA is in a position to be able to influence possible change. Scope 3 data has not been presented as CNA does not currently have direct operational influence over the emissions from third party transport and coal combustion. It is anticipated that more opportunities will be identified through the life of mine, and savings from these opportunities will further reduce the overall energy and greenhouse impact of the Project.

4.1.4 Energy audits

During 2006 Rio Tinto carried out an Excellence in Energy Management Diagnostic at HVO. Thirteen projects were identified specifically for HVO and three others are being managed by CNA Corporate, as they are relevant to all CNA sites.

Rio Tinto has registered with the Energy Efficiency Opportunities programme (EEO), which lists HVO within this registration. HVO is scheduled to undergo its EEO assessment in the second half of 2009. The scope of work for the EEO assessment will include the Project, to ensure that energy use at existing and proposed mining operations is assessed.

Figure 4 - Potential impact of greenhouse and energy savings projects on Scope 1 and Scope 2 emissions



4.1.5 Reporting

Reports generated on a bi-annual basis contain a summary of all energy used at HVO, and the corresponding CO_2-e emissions associated with each energy type and from other sources such as coal seam methane and land management. The reports also detail greenhouse emissions from the road, rail and ship transport of product coal, and the carbon content of the coal which can be used to determine the emissions from burning (assuming 100% of product coal is burnt).

Among other uses, the bi-annual reports are used to assess progress against Rio Tinto's global greenhouse and energy targets. The Group targets are based on site specific contributions. For HVO the targets are to achieve a three per cent reduction in energy use and 0.7 per cent reduction in greenhouse gas emissions (over the five year period 2003 – 2008).

HVO's greenhouse and energy performance is reported across a range of fora, which include:

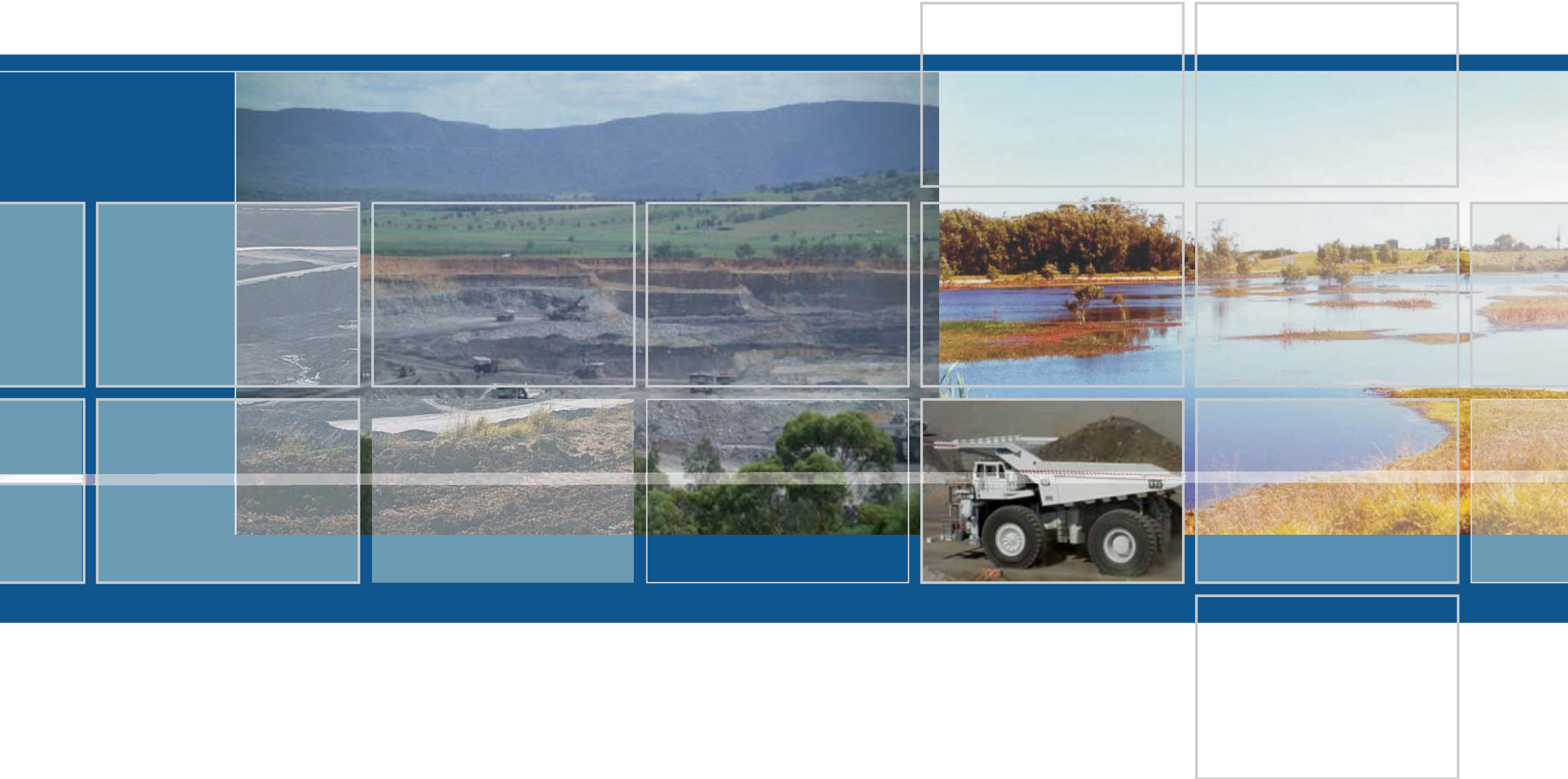
- *Rio Tinto Sustainable Development report and webpages* – Rio Tinto reports Group performance via its annual SD report. This report is typically a high level document and its content is not directed towards specific operational references. The main points of the report are paraphrased directly onto the Rio Tinto website;

- *Rio Tinto Greenhouse Challenge Plus progress reports* – Rio Tinto reports greenhouse and energy performance to the government on behalf of RTCA, CNA and HVO. For the last two years the report has been publicly available. The report provides detailed site-specific information on energy use, greenhouse gas emissions and GH&E abatement projects; and
- *RTCA Sustainable Development Reports* – the 2006 public report presented information on greenhouse and energy performance and detailed the RTCA Climate Change Action Plan.

5 CONCLUSION

CNA has applied for approval to extent its mining activities at HVO, located in New South Wales. The expansion, called the HVO South Coal Project (the Project) involves the extraction of up to 16Mt of ROM coal from four mining areas over a period of approximately 20 years. If approved, the Project will require 14.6PJ of energy and result in 155Mt CO_2-e being emitted over the life of mine. This approximately equates to a 20 per cent increase in energy use and greenhouse gas emissions at HVO. Globally the potential impact of the Project has been assessed using internationally recognised data and methodologies. Between project inception to peak-production the impact of the Project will range from 0.01 per cent (2010), to 0.04 per cent (2020) of global energy related emissions. For HVO the impact of the operation will decline over time from 0.12 per cent (2006) to 0.06 per cent (2030). An assessment was also carried out to determine the potential impact on global surface temperatures resulting from the additional emissions. It was determined that over the life of mine the Project will raise the global surface temperature by an estimated 0.000078ºC.

On a global scale the greenhouse impact of the Project will be minimal and is unlikely to have any significant influence on global temperatures. Nevertheless, the cumulative effect of greenhouse emissions does impact global warming and climate change. In this context, Rio Tinto and CNA will continue to focus on improving energy efficiency and reducing the greenhouse gas emissions associated with mining, processing and using its coal product. CNA remains committed to reducing the impact of on-site activities and will continue to implement energy efficiency improvement projects, while Rio Tinto will continue to seek global solutions through adoption of new technologies and continued support of greenhouse abatement solutions such as clean coal technologies.



Annex P

Soil Survey and Land Resource Assessment, GSSE 2007

REPORT

Hunter Valley Operations

South Coal Project:

Soil Survey and Land Resource Assessment Report

Prepared for:
Environmental Resources Management Australia
Building C, 33 Saunders St,
PYRMONT NSW 2009

GSS Environmental Project No: ERM1-06-HVO Sth Soils
Issue No. 1
Copy No. 1

Hunter Valley Operations South Coal Project:

Soil Survey and Land Resource Assessment Report

Prepared for **Environmental Resources Management Australia**

Luke Stewart

Project Manager

Building C, 33 Saunders St,

PYRMONT NSW 2009

Prepared by **GSS Environmental**

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WAMBERAL NSW 2260

Issue Date 01 November 2007

GSSE Ref ERM1-06-HVO Sth Soils

ISSUE AND AMENDMENT CONTROL HISTORY

Issue	Date	Description	Author	QA/QC
1	19 October 2006	Draft	Lachlan Crawford	Rod Masters
2	31 October 2007	Draft	Lachlan Crawford	Rod Masters
3	01 November 2007	Final	Lachlan Crawford	Rod Masters

Distribution List

Master: GSS Environmental

Copy 1: Luke Stewart (ERM)

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1.0 INTRODUCTION

1.1 Objectives

GSS Environmental (GSSE) was commissioned by Environmental Resources Australia (ERM) on behalf of Coal & Allied Operations Pty Limited (CNA) to undertake a land resource assessment, with respect to soils, rural land capability and agricultural suitability classification, for the Hunter Valley Operations (HVO) South Coal Project. This land resource assessment is being undertaken as part of a larger Environmental Assessment. The Environmental Assessment is being prepared by ERM to accompany a Project Application to the NSW Department of Planning (DoP) for the proposal. As part of the proposal, the area will be subject to some ground disturbance resulting from extended operations, such as topsoil stripping, drilling and blasting, and highwall advancement.

The proposed disturbance is located in four separate opencut extension areas. Minor disturbance may also be associated with the construction of rail loop and spur line. The five areas are:

- Area 1: Deep Cheshunt Extension Area (Broonie and Bayswater seams, with mining to the Vaux seam currently consented);
- Area 2: Riverview Pit South West Extension Area;
- Area 3: Riverview Pit South East Extension Area ;
- Area 4: South Lemington Pit 1 Extension Area; and
- Area 5: Area adjacent to Lemington Coal Preparation Plant (LCPP) and south of South Lemington Pit 1.

For the remainder of this report these areas will be referred to as Areas 1 to 5, and collectively as the 'study areas'. The surface disturbance in Area 1 has previously been consented, and this proposal is seeking approval to access deeper seams. The soils and land resources in this area were reassessed to capture any new aspects resulting from the proposal. The study areas are described further in *Section 1.2* and *1.3* of this report. A location plan is presented as *Figure 1*. To assist with management of topsoil reserves and planning for post-mining rural land capability, a field survey of soil material in the study area and classification of pre-mining rural land capability was undertaken by GSSE. The major objectives of this assessment include:

1. to describe and classify soils within the study areas;
2. analyse the identified soil units to assess their suitability for salvage and re-use as topsoil/growth media in future land rehabilitation projects;
3. identify pre-mining rural land capability and agricultural suitability classes to assist with post-mining rehabilitation planning; and
4. identify any potentially adverse soil materials requiring special management during rehabilitation of post-disturbance areas.

The following report presents the results of the field survey undertaken by GSSE and the assessment of soil resources within the survey areas. A glossary of commonly used soils terms is presented in *Appendix 1*.

1.2 Location

HVO South is located in the Upper Hunter Valley, 18 km west of Singleton. The proposed area of disturbance is comprised of four separate study areas.

Area 1 is located immediately south of the Hunter River and is bounded to the east, south and west by land disturbed by existing HVO South opencut operations. The area is approximately 3 km east to west and 2.5 km north to south, and encompasses approximately 450ha.

Area 2 is located in the south-western section of the Mine Lease. It is bounded to the north by HVO mining disturbed land, and to the east and west by disturbed native vegetation. Jerrys Plains Road traverses the southern boundary of the area. The area is approximately 1.1 km east to west and 1.2 km north to south, and encompasses approximately 120ha.

Area 3 is located on the southern boundary of the Mine Lease, adjacent to the Hunter Valley Glider Club. It is bounded to the north by HVO mining operations, to the east by glider club land, to the west by United Collieries (Xstrata Coal Australia) Mine Leases and to the south by grazing land and Jerrys Plains Road. The study area is approximately 1.5 km east to west and 1.1 km north to south, and encompasses approximately 100ha.

Area 4 is located in the south-eastern boundary of the Mine Lease. It is bounded to the north and west by land disturbed by HVO mining operations, and to the south and east by a mixture of native vegetation and grazing land. The study area is approximately 1.3 km east to west and 1.2 km north to south, and encompasses approximately 30ha.

Study area locations 1 to 4 are shown in *Figure 2*.

Area 5 is located in the central eastern and southern areas of the Mine Lease, adjacent to and south of the existing LCPP. It is bounded to the north, west and south by land disturbed by HVO mining operations, and to the east by grazing land. This area has previously been assessed as part of the Jerrys Plains Coal Terminal Statement of Environmental Effects (HLA, 2000) and was not re-assessed for the purpose of this report.

The Hunter Valley region contains extensive coal resources at depth. Other coal operations in the district include United Collieries (Xstrata Coal Australia) and Wambo Mine (Excel Coal) to the south, and Mt Thorley Warkworth (CNA) to the south-east. Other major surface land uses in the region include beef and dairy cattle grazing, vineyards, as well as small areas of cropping along the Hunter River alluvial plains to the east and west.

1.3 Topography, Land Use and Vegetation

As the study areas are proposed extensions of an existing opencut mining operation, the topography and drainage in all four areas have been impacted by mining activities. Well over 50% of the natural landform within Area 1 has been altered through mining. Areas 2, 3 and 4 are less impacted by previous mining and a greater proportion of the natural landform remains relatively undisturbed. A section of Area 3 has been modified to provide a suitably flat surface for the glider club airstrip. Much of the native vegetation within the study areas has been cleared for grazing or has been fragmented by mining related infrastructure such as powerlines and dams.

Area 1

Area 1 consists mainly of mining disturbed ground and less than 50% of the natural topography remains undisturbed. The topography within the southern central section of the study area is relatively undisturbed (although heavily fragmented) and is comprised of a small area of land that gently slopes towards the north west. Surface run-off from this undisturbed landform drains towards the advancing mine disturbed land, before being diverted by mine drains. Although most of the native vegetation has been cleared, the relatively undisturbed section consists of moderately dense woodland consisting predominantly of *Casuarina* and *Acacia* species.

Area 2

Area 2 consists of low undulating hills and ridges, with areas of sandstone outcropping on upper slopes and crests. Although the landform in the northern corner of the area has been substantially modified by mining, the topography in the remainder of the area has not been significantly disturbed. Localised areas of vegetation and ground surface within the area have been impacted by the construction of mining related infrastructure such as roads, drains, dams and topsoil stockpiles. Many minor drainage lines drain the area towards the north-east. These drainage lines are intercepted by contour drains that divert the surface run-off away from the active mining area. Most of the remaining vegetation consists of scattered open eucalypt woodland with a ground cover of native grass species. Vegetation communities within the upper slopes in the south west corner of the area are dominated by moderately dense *Casuarina* woodland.

Area 3

The landform within Area 3 consists of low, gently rolling slopes, grading to an area of relatively flat land in the east. This area of flat land is utilised by the Hunter Valley Gliding Club as an airstrip (1600 m length by two 50 m widths), following establishment of the airstrip during WWII. The main access road to the Cheshunt facilities bisects Area 2. The western half of the area has been impacted by the construction of a dam, which drains the western half of Area 2. The eastern half of the area drains into Wollombi Brook via a series of minor drainage lines. The area has historically been used as low density grazing land and most of the vegetation has been cleared or thinned out. The remaining vegetation consists of scattered native trees, dominated by *Casuarinas*, *Eucalypts* and *Acacias*, with a ground cover of native pasture species.

Area 4

Area 4 is a long narrow area that slopes gently to the south west. The topography in the area is largely undisturbed by mining activities; however, the vegetation has been heavily fragmented by the construction of drains, roads and stublines. Surface run-off from this area drains towards Wollombi Brook via table drains. The remaining vegetation consists of moderately dense woodland dominated by *Casuarina* species.

Area 5

The northern section of Area 5 is characterised by low slopes and Ironbark woodland with simplistic structure and low diversity. The area is subject to grazing.

The area south of South Lemington Pit 1 is characterised by flat terrain to low slopes with regenerating Box-Ironbark woodland. The area in between (proposed for either the rail spur, haul route or conveyor route) has been cleared for an existing haul road and a transmission line easement.

As Area 5 has been previously assessed, it was not subject to detailed soil analysis as part of this study.

Legend

Project Application Area

Current Development Consent Boundary (HVO North only)

Figure 1

HVO South in its Local Setting

Client:	Coal & Allied Operations Pty Limited
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_F_02 Suffix No: R1
Date:	19.09.2006 Drawing Size: A3
Drawn By:	DH Reviewed By: LS
Source:	-
Scale:	Refer to Scale Bar

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0 1 2km

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ERM

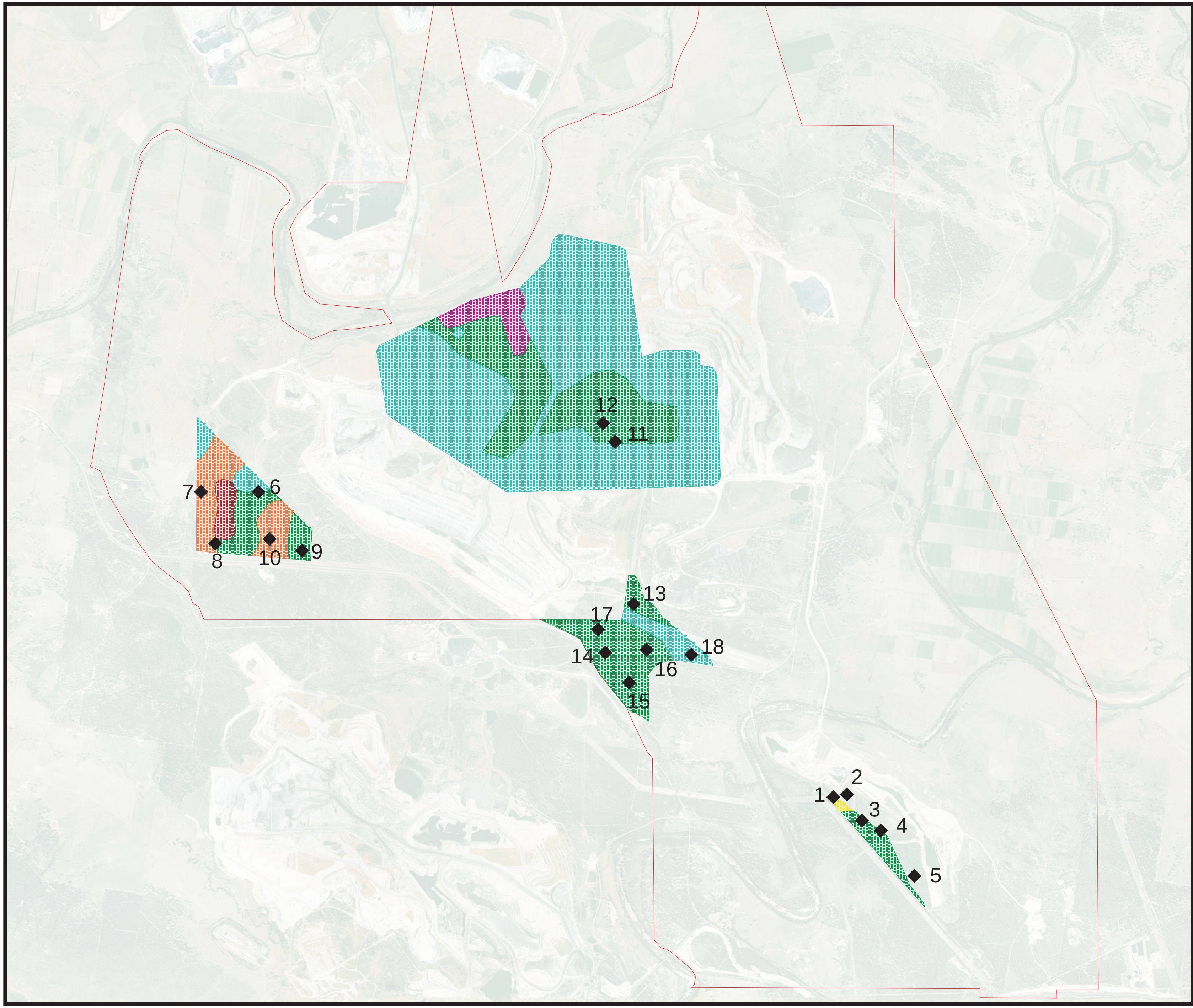

Figure 2

HVO South Soil Types and Profile Sites

Client:	Coal & Allied Operations Pty Ltd
Project:	Hunter Valley Operations South Coal Project
Drawing No:	0047820_ANXQ_01
Date:	04/10/2007 Drawing size: A4
Drawn by:	GC Reviewed by: -
Source:	GSS Environmental
Scale:	Refer to Scale Bar

N 0 0.75 1.5km

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ERM

2.0 LAND RESOURCE SURVEY METHODOLOGY

2.1 Introduction

A soil survey and land capability assessment was undertaken to identify and characterise land resources within the HVO South study areas. The field component of the survey was conducted during July and August 2006.

2.2 Mapping

An initial soil map was developed using the following resources and techniques:

1) Aerial photographs and topographic maps

Aerial photo and topographic map interpretation was used as a remote sensing technique, allowing detailed analysis of the landscape and mapping of features related to the distribution of soils within the survey areas.

2) Previous soil survey results

A survey of the region (including the areas surveyed in this assessment) was undertaken by Kovac and Lawrie (1991) at a scale of 1:250,000. The survey map and report present a broadscale guide to the soil and landscape unit distribution in the upper Hunter Valley Region, and provides a framework for more detailed surveys.

Several soil surveys have previously been conducted on a more detailed scale for sections of the study areas. These surveys were referenced as a background source of information on the geology and soil units likely to be encountered within these study areas.

ERM Mitchell McCotter (1998) conducted a survey that covered the majority of the Areas 1 and 2. This survey categorised soils broadly into Clay Soils, Gravelly Soils, Alluvial Soils and Sandy Soils. Clay Soils were identified as the dominant soil unit within Areas 1 and 2.

A soil survey was produced for the South Lemington EIS (Sinclair Knight Merz, 1997) (SKM) based on field investigations conducted in 1987. The SKM survey covered Area 4 and the eastern half of Area 3 of the current soil survey. This survey identified Duplex soils as the dominant soil units within Areas 3 and 4, with Siliceous Sands situated along Wollombi Brook.

HLA (2000) undertook a soil survey that covered all of Area 5. The areas that may be potentially impacted by the construction of either a rail loop adjacent to the LCPP or short loop south of South Lemington Pit 1 are predominantly characterised by Soloths with the exception of a band of Alluvial Soils located around the Wollombi Brook.

GSSE (February 2005) conducted a survey that covered an area to the north-east of Area 1. This survey identified the dominant soil units in the area to the north-east of Area 1 as being Red Podzolics on the upper slopes and Yellow Solodics in the lower slopes and drainage depressions.

3) Stratified observations

Upon drafting of mapping units, surface soil exposures throughout the study areas were visually assessed to ascertain potential mapping units, delineate soil unit boundaries and determine preferred locations for targeted subsurface investigation.

2.3 Profiling

A total of 18 soil profile exposures were assessed at selected sites to enable soil profile descriptions to be made. The soil profile site locations are shown in *Figure 2*.

Subsurface exposure was generally undertaken by backhoe excavation of test pits to between 1 and 1.5 m deep. The test pit locations were chosen to provide representative profiles of the soil types encountered during the survey. The soil layers were generally distinguished on the basis of changes in texture, structure and colour. Soil colours were assessed according to the Munsell Soil Colour Charts (Macbeth, 1994).

Numerous observations of existing exposed profiles were also conducted to confirm soil units and boundaries between different soils. Soils within the glider club area (Area 3) were identified solely through observations of surface exposure.

2.4 Field Assessment

Soil layers at each profile site were assessed according to a procedure devised by Elliot & Veness (1981) for the recognition of suitable topdressing materials. This procedure assesses soils based on grading, texture, structure, consistence, mottling and root presence. A detailed explanation of the Elliot & Veness procedure is presented in *Appendix 2* to this report. The system remains the benchmark for land resource assessment in the Australian coal mining industry.

2.5 Laboratory Testing

Soil samples were collected from the exposed soil profiles of major soil units within the study areas. Of the samples collected, representative samples were selected for subsequent laboratory analysis at the Department of Lands' Soil Research Centre at Scone, NSW.

Selection of samples for analysis was based on establishing the geochemical suitability of surface and near-surface soil horizons for use as topdressing in rehabilitation works and to identify soils that may require particular management.

Soil layers are signified by /1, /2 and /3 in the sample ID with the surface horizon being /1 and subsoil horizons being /2, /3 & /4. Samples were not collected, or were not analysed, from sites 4, 12 & 17 as these profiles displayed similar soil characteristics to other sites already selected for analysis**.** *Table 1* shows samples analysed.

Table 1: Soil Samples selected for Laboratory Analysis

Site	Samples	Site	Samples
1	1/1	10	10/1, 10/2 & 10/3
2	2/1	11	11/1, 11/2 & 11/3
3	3/1, 3/2 & 3/3	13	13/1, 13/3 & 13/5
5	5/1, 5/2 & 5/3	14	14/1, 14/2 & 14/3
6	6/1, 6/2 & 6/3	15	15/1, 15/2 & 15/3
7	7/1, 7/2 & 7/3	16	16/1, 16/2 & 16/3
8	8/1, 8/2 & 8/3	18	18/1
9	9/1		

The samples were subsequently analysed for the following parameters:

- Particle Size Analysis;
- Emerson Aggregate Test (soil aggregate slaking and coherence);
- pH; and
- Electrical Conductivity.

A description of the significance of each test and typical values for each soil characteristic are included in *Appendix 3*.

The laboratory test results were used in conjunction with the field assessment results to determine the depth of soil material that is suitable for stripping and re-use for the rehabilitation of disturbed areas.

2.6 Land Capability Assessment

The land capability assessment of the study areas was conducted according to the Department of Natural Resources (DNR) (formerly the NSW Soil Conservation Service) rural land capability assessment system. The system classifies land from a soil conservation perspective, on the basis of an increasing soil erosion hazard and decreasing versatility of use. It recognises the following three types of land uses:

- land suitable for cultivation;
- land suitable for grazing; and
- land not suitable for rural production.

The capability classifications identify limitations on the use of the land as a result of the interaction between the physical resources and a specific land use. The principal limitation recognised by these capability classifications is the stability of the soil mantle (Soil Conservation Service, 1986).

The method of land capability assessment takes into account a range of factors including climate, soils, geology, geomorphology, soil erosion, topography and the effects of past land uses. The classification does not necessarily reflect the existing land use, rather it indicates the potential of the land for uses such as crop production, pasture improvement and grazing.

The system allows for land to be allocated into eight possible land capability classes (with land capability decreasing progressively from Class I to Class VIII), with two classes of land (urban and mining/quarrying) unsuitable for production. The classes are described in *Table 2* below.

A description of land capability classification for all land within the study areas is discussed in *Section 3.2.*

Table 2: Land Capability Classes

Rural Land Capability		
Land Class	**Land Suitability**	**Land Definition**
Class I	Regular Cultivation	No erosion control requirements
Class II	Regular Cultivation	Simple requirements such as crop rotation and minor strategic works
Class III	Regular Cultivation	Intensive soil conservation measures required such contour banks and waterways
Class IV	Grazing, occasional cultivation	Simple practices such as stock control and fertiliser application
Class V	Grazing, occasional cultivation	Intensive soil conservation measures required such contour ripping and banks
Class VI	Grazing only	Managed to ensure ground cover is maintained
Class VII	Unsuitable for rural production	Green timber maintained to control erosion
Class VIII	Unsuitable for rural production	Should not be cleared, logged or grazed
U	Urban areas	Unsuitable for rural production
M	Mining & quarrying areas	Unsuitable for rural production
Source: Soil Conservation Service of NSW (1986).		

2.7 Agricultural Land Suitability Assessment

Agricultural land suitability is an alternative land classification system used to assess land suitability, relative to a specific type of agricultural production. The system consists of five classes, which assess land on the basis of increasing suitability and agricultural production potential. As well as assessing land capability (soils, geology, soil erosion, topography and climate), agricultural suitability considers industry specific factors that may influence potential production. The same piece of land may be classed differently, depending on selected land-use.

The system allows for land to be allocated into five (5) possible classes (with suitability decreasing progressively from Class 1 to Class 5). The classes are described in *Table 3* below**.**

A description of agricultural suitability classification for all land within the study areas is discussed in *Section 3.3*.

Table 3: Agricultural Suitability Classes

Agricultural Land Suitability	
Class	**Description**
1	Arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent.
2	Arable land suitable for regular cultivation for crops but not suited to continuous cultivation. It has a moderate to high suitability for agriculture but edaphic (soil factors) or environmental constraints reduce the overall level of production and may reduce the cropping phase to a rotation with sown pastures.
3	Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with pasture. The overall production level is moderate because of edaphic or environmental constraints. Erosion hazard, soil structural breakdown or other factors including climate may limit the capacity for cultivation and soil conservation or drainage works may be required.
4	Land suitable for grazing but not cultivation. Agriculture is based on native pastures or improved pastures based on minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.
5	Land unsuitable for agriculture or at best only to light grazing. Agricultural production is low or zero as a result of severe constraints, including economic factors, which preclude land improvement.

3.0 RESULTS

3.1 Soils

Soil Unit Type

Six soil units were identified during the soil survey. Those soil units were:

- Yellow Duplex;
- Red Duplex;
- Siliceous Sands;
- Alluvial Soils;
- Lithosols; and
- Disturbed Land.

Yellow Duplex soils were distributed widely across all four study areas and were the dominant soil unit in Area 1, Area 3 and Area 4. Red Duplex soils and shallow rocky Lithosols were also identified within Area 2. Minor areas of Siliceous sands were identified within Area 1 and Area 4. A minor area of Alluvial Soils was also identified in the northern margins of Area 1. A substantial proportion of the study areas were classified as 'disturbed' land, especially in Area 1, which has been heavily impacted by previously approved opencut mining in Cheshunt Pit. The characteristics and distribution of these soil types are discussed in detail below. The distribution of the soil units observed during the soil survey is illustrated in *Figure 2*.

The subsoils of the Yellow Duplex soils within Area 4 were observed to be unstable with a high dispersion potential, as indicated by the consistently low Emerson ratings. Other than these subsoils, no potentially adverse soils requiring special management were identified during the survey.

A description of each soil unit is presented in this section, along with representative profile descriptions for the major soil units. *Appendix 2* provides a brief guideline to interpreting soil analytical results.

Yellow Duplex

Yellow Duplex soils have a clear to sharp boundary between the sandy to silty loam surface horizons and the underlying clay subsoils. They are located throughout all four study areas and consist mainly of Yellow Solodic soils. These soils are generally associated with the gently falling drainage lines, flat areas and gently rising slopes throughout the study areas. With the exception of minor areas of Alluvial soils and Siliceous Sands, Yellow Duplex soils were observed to cover almost all of the undisturbed land within Area 1. They were observed to cover approximately half the undisturbed land in Area 2 and all the undisturbed land in Area 3. With the exception of a minor area of Siliceous Sands, Yellow Duplex soils were observed to cover almost all of Area 4. Minor areas of gravelly Red Duplex soils were also observed amongst the more dominant Yellow Duplex within Area 1.

Topsoil

The topsoil ranges in depth from 8cm to 18cm and is generally dark brown in colour, with most sites displaying a bleached light yellowish brown A2 horizon. The soils are weakly structured or apedal (single grained) with textures ranging from silty loams through to sandy loams and sandy clay loams. These textural groups will allow for high infiltration, but moderate to low water holding capacity. The topsoils are structurally stable (Emerson rating of 3(1) to 8/3(1) – slightly dispersive to non-dispersive), therefore, should not be prone to surface sealing, leading to effective infiltration and aeration for root development.

The topsoils are non-saline (EC range of 0.01 to 0.20 dS/m) and generally neutral to mildly alkaline (pH range of 5.5 to 6.5). The sites generally displayed a moderate to sporadic surface pasture cover and root penetration in the topsoil was common, indicating potential suitability for post-mining vegetation establishment. Although generally weak in structure, this topsoil is still generally suitable for stripping and use as topdressing material in post-mine vegetation establishment.

Subsoil

The subsoil ranges in depth, up to 120cm. It is generally yellowish brown, brownish yellow or olive brown, with moderate to strong blocky structure, grading to apedal massive at depth. The textures are most commonly medium clays, with clay content increasing with depth. The soil is generally non-saline to low salinity (EC of range of 0.19 to 0.72 dS/m) and of low to moderate alkalinity (pH range of 6.6 to 9.3). The subsoils were generally noted to display a high dispersion potential, with Emerson ratings of between 1 and 3(1). This indicates that the subsoils pose a high erosion risk, if exposed to water. The constraining factors include fine texture (high clay content) and massive structure, increasing the potential for poor aeration and infiltration. There is also a high potential for dispersiveness, leading to erosion and hardsetting. This subsoil layer is not suitable for stripping and use as a topdressing material. A typical Yellow Duplex profile is presented in *Table 4*. An example of a Yellow Duplex profile is presented in *Plate 1*.

Table 4: Typical Yellow Duplex Profile

LAYER	DEPTH (m)	DESCRIPTION
1	0 – 0.11	Brown to dark yellowish brown (7.5YR 5/3, 10YR 4/4) silty loam. Weak consistence and apedal single grained. Generally <2% stones and roots commonly occur in the layer. The lower boundary is clear and even to layer 2.
2	0.11 – 0.25	Bleached light yellowish brown (10YR 6/4) silty loam A2 horizon. Weak consistence and apedal single grained. Generally <2% stones and roots are common. The lower boundary is clear and even to layer 3.
3	0.25 – >1.20	Yellowish brown (10YR 5/8) medium clay. Moderate to strong consistence and generally apedal massive. No roots or stones.

Red Duplex

Red Duplex soils have a clear to sharp boundary between the loam surface horizons and the underlying clay subsoils. They were generally observed to be associated with the steeper mid to upper slopes within Area 2 and as minor intergrades amongst the dominant Yellow Duplex soils within Area 1. The Red Duplex soils were generally noted as Podzolics. Shallow rocky variants of the Red Duplex were also observed on the mid to upper slopes in the western half of Area 2, grading into rocky Lithosols on the upper slopes and crests.

Topsoil

The topsoil was generally 15cm in depth and is generally reddish brown in colour. The soils are of moderate to strong angular blocky structure. Textures range from clay loams to silty clay loams. These textural groups will allow for moderate to high infiltration and water holding capacity, both necessary for effective vegetative growth. The topsoils are structurally stable (Emerson rating of 8/3(1) – slightly dispersive to non-dispersive), therefore, should not be prone to surface sealing, leading to effective infiltration and aeration for root development.

The topsoils are non-saline (EC range of 0.04 to 0.06 dS/m) and generally neutral (pH range of 5.9 to 6.5). The sites generally displayed a uniform to patchy surface pasture cover and root penetration in the topsoil was common, indicating potential suitability for post-mining vegetation establishment. This topsoil is generally suitable for stripping and use as topdressing material in post-mine vegetation establishment.

Subsoil

The subsoil ranges in depth, up to 75cm. It is generally reddish brown to yellowish red, with a strong blocky structure, grading to apedal massive at depth. The textures are most commonly medium to heavy clays. Some profiles contained large rocks throughout the subsoil layers. The soil is generally non-saline (EC of range of 0.19 to 0.42 dS/m), but moderately alkaline (pH range of 9.0 to 9.6). Emerson ratings of between 2(1) and 4 indicate a moderate dispersion potential. The constraining factors for these subsoils include fine texture (high clay content) and massive structure, increasing the potential for poor aeration and infiltration. There is also a moderate potential for erosion and hardsetting. This subsoil layer is not suitable for stripping and use as a topdressing material. A typical Red duplex profile is presented in *Table 5*. An example of a Red duplex profile is presented in *Plate 2*.

Table 5: Typical Red Duplex Profile

LAYER	DEPTH (m)	DESCRIPTION
1	0 – 0.15	Dark reddish brown (5YR 3/4) silty loam. Weak consistence and moderate pedality with rough-faced sub-angular blocky 20-50mm peds. Generally <2% stones and roots commonly occur in the layer. The lower boundary is clear and even to layer 2.
2	0.15 – 0.72	Reddish brown (10YR 6/4) medium clay. Strong consistence and strong pedality, with rough-faced sub-angular blocky 20-50mm peds. Generally <2% stones and roots are common. The lower boundary is clear and even to layer 3.
3	0.72 - >1.04	Yellowish red (7.5YR 5/6) heavy clay. Strong consistence and apedal massive. Few to no roots and 10% stone content of weathered angular sedimentary rock.

Lithosols

Lithosolic soils are characterised by a shallow, rocky profile that displays very little pedological development. They were generally observed to be associated with the steeper upper slopes and hill crests in the western half of Area 2. Sandstone outcropping is a common feature within the areas covered by Lithosols. No samples were collected for analysis from the Lithosols.

Topsoil

The topsoil is generally very thin (up to 10cm in depth) and is highly variable in colour due to the high content of weathered bedrock, but generally reddish brown. The soils are of weak structure and textures range from sandy loams to sandy clays. This topsoil is generally unsuitable for stripping and use as topdressing material in post-mine vegetation establishment due to the high rock content and poor structure.

Subsoil

The Lithosols are generally shallow uniform profiles. However, where subsoils are distinguishable, they are generally high in rock content and overly shallow bedrock. The subsoils are generally reddish brown to pale brown in colour. The textures are most commonly sandy clays to clays, with a weak to moderate structure. The constraining factors for these subsoils include the high rock content and generally poor structure. This subsoil layer is not suitable for stripping and use as a topdressing material. A typical Lithosol profile is presented in *Table 6*.

Table 6: Typical Lithosol Profile

LAYER	DEPTH (m)	DESCRIPTION
1	0 – 0.10	Reddish brown (5YR 5/4) sandy loam. Weak consistence and weak structure. Generally 10-20% rock content and roots are few. The lower boundary is gradual and irregular to layer 2.
2	0.10 – 0.60	Pale brown (10YR 6/3) sandy clay with weak consistence and weak pedality to apedal massive. Generally rock content of 50-90% and roots are few. Refusal usually on weathered sedimentary bedrock.

Siliceous Sands

Siliceous Sands generally display little pedological development and are characterised by a uniform sandy profile. Minor areas of Siliceous Sands were observed in the central northern undisturbed section of Area 1 and the north-western extremity of Area 4.

The topsoil was generally 2-3cm in depth and characterised by a thin, light grey layer of sand and decaying vegetation. Below this thin surface layer, the profile is generally uniform. The soils have a single grained structure and a texture consisting of coarse grained sand. The soils are highly permeable and display high infiltration and extremely low water holding capacity. The topsoils are structurally stable (Emerson rating of 3(1) – slightly dispersive) and should not be prone to surface sealing. However, the soils do have high erosion potential due to the single grained structure, and are susceptible to wind and water erosion.

The soils are non-saline (EC range of <0.01 to 0.04 dS/m) and generally neutral to slightly acidic (pH range of 5.7 to 5.8). By itself, this sandy soil is generally unsuitable for stripping and use as topdressing material in post-mine vegetation establishment. However, if suitable clay topsoil can be sourced and mixed thoroughly with the sand, the resulting blended material may be useful as a growth medium for native vegetation establishment. An example of a Siliceous Sands profile is shown in Plate 3.

Alluvial Soils

The Alluvial Soils were surveyed from surface observations and the description of this unit was sourced largely from the 1998 ERM Mitchell McCotter EIS report. The Alluvial Soils unit covers a minor area in the central northern section of Area 1, adjacent to the Hunter River and extending south along a minor drainage line. The unit consists of a brown sandy clay loam to silty clay loam topsoil, overlying a brownish black sandy clay or light alluvial clay. The alluvial profiles may also include bands of gravel or stone. No samples were collected for analysis from the alluvial soils, however a stripping depth of 50cm is recommended in the ERM Mitchell McCotter report.

Plate 1: Yellow Duplex profile at Site 13.

Plate 2: Red Duplex profile at Site 10.

Plate 3: Siliceous Sands at Site 2.

3.2 Land Capability

Land Capability is an assessment system that classifies land from a soil conservation perspective. Land is classed from Class I to Class VIII, based on the decreasing versatility of use, as limited by an increase in soil erosion hazard. A full explanation of the eight (8) classes is presented in *Table 2*.

The remaining undisturbed land in Area 1 is limited to Class VI – suitable for grazing only. The flat land adjacent to the Hunter River is not suitable for cultivation due to the presence of Yellow Duplex soils and the fragmented nature of the landscape caused by drainage depressions, dams and drains. The remainder of Area 1 is limited to Class VI, due to the subsoil properties of Yellow Duplex soils and the slope gradient.

Area 2 is generally limited to Class VI due to slope gradient and soil type (Yellow and Red Duplex). The western third of Area 2 is limited to Class VII, due to slope steepness, soil type (Duplex soils) and surface rockiness (Lithosols and outcropping on upper slopes and crests).

Areas 3 and 4 are limited to Class VI due to the high erosion potential of the subsoils associated with the Yellow Duplex soils. The Siliceous Sands at the north-western end of Area 4 are Class VII due to the high potential for erosion associated with the Siliceous Sands.

As reported by HLA (2000), the majority of Area 5 is Class IV with the area south of South Lemington Pit 1 Class V.

Land within all areas that has been disturbed by mining is considered to be Class M, unsuitable for agricultural production due to mining or quarrying activities.

3.3 Agricultural Land Suitability

Agricultural land suitability classifies land relative to a specific type of agricultural production. The system classes land Class 1 to Class 5 based on increasing potential for agricultural production. A full explanation of the five (5) classes is presented in *Table 3*. The current, or most recent, agricultural land-use within the study areas is cattle grazing.

The majority of the undisturbed land within the four study areas is Class 4; suitable for grazing with significant limitations. This is due to soil characteristics for the Yellow Duplex subsoils within the areas. Slope gradient is also a limiting factor in the eastern half of Areas 1 and 2. The western half of Area 2 is limited to Class 5; unsuitable for agricultural production or light grazing. This is due to soil type, slope gradient and surface rockiness within the area. The northern end of Area 4 is also limited to Class 5, due to the poor soil characteristics of the Siliceous Sands. The area north of Wollombi within Area 5 was assessed by HLA (2000), as Class 3. The entire area south of Wollombi Brook was assessed as Class 5.

Mining impacted land within the study areas is limited to Class 5; unsuitable for agriculture, or at best light grazing; due to mining disturbance.

4.0 RECOMMENDATIONS

4.1 Topsoil Suitability

Details of the soil test results were used in conjunction with the field assessment (refer *Appendix 2*) to determine the depth or thickness of soil materials that are suitable for stripping and re-use as a surface cover in the rehabilitation of disturbed areas. Suitable stripping depths for each soil unit are provided in *Table 7*.

Table 7: Suitable Topsoil Stripping Depths for Soil Types

Soil Unit Type	Suitable Stripping Depth (cm)
Yellow Duplex	10
Red Duplex	10
Lithosols	Not suitable for stripping
Siliceous Sands	Not suitable for stripping*
Alluvial Soils	50
Disturbed Land	Not suitable for stripping
*unless mixed with clay material (see section 3.1)	

4.2 Topsoil Stripping and Handling

The following topsoil stripping and stockpiling techniques are appropriate to prevent excessive soil deterioration:

- strip material to the depths stated in *Table 7*, subject to further investigation as required. Topsoil should be maintained in a slightly moist condition during stripping. Material should not be stripped in either an excessively dry or wet condition;

- place stripped material directly onto reshaped overburden and spread immediately (if mining sequences, equipment scheduling and weather conditions permit) to avoid the requirement for stockpiling;

- grading or pushing soil into windrows with graders or dozers for later collection by elevating scrapers, or for loading into rear dump trucks by front-end loaders, are examples of less aggressive soil handling systems. This minimises compression effects of the heavy equipment that is often necessary for economical transport of soil material;

- soil transported by dump trucks may be placed directly into storage. Soil transported by bottom dumping scrapers is best pushed to form stockpiles by other equipment (eg: dozer) to avoid tracking over previously laid soil by the scraper;

- the surface of soil stockpiles should be left in as coarsely textured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established to prevent anaerobic zones forming;

- as a general rule, maintain a maximum stockpile depth of 3 m. Clayey soils, such as the dark clay topsoil, should be stored in lower stockpiles for shorter periods of time compared to sandier soils, such as the topsoil sourced from the Yellow Duplex soils;

- if long-term stockpiling is planned (ie: greater than 12 months), seed and fertilise stockpiles as soon as possible; and

- prior to re-spreading stockpiled topsoil onto reshaped overburden (particularly onto designated tree seeding areas), an assessment of weed infestation on stockpiles should be undertaken to determine if individual stockpiles require herbicide application and / or "scalping" of weed species prior to topsoil spreading.

4.3 Topsoil Respreading

Where possible, suitable topsoil should be re-spread directly onto reshaped areas. Where topsoil resources allow, topsoil should be spread to a minimum depth of 20 cm on all regraded spoil. Topsoil should be spread, treated and seeded in one consecutive operation. To prevent loss of topsoil to wind and water erosion, topsoil should not be left spread and untreated/unseeded.

4.4 Landform Design and Erosion Control

Rehabilitation strategies and concepts proposed below have been formulated according to results of industry wide research and experience.

Post Disturbance Regrading

The main objective of regrading is to produce slope angles, lengths and shapes that are compatible with the proposed land use and not prone to an unacceptable rate of erosion. Integrated with this is a drainage pattern that is capable of conveying runoff from the newly created catchments whilst minimising risk of erosion and sedimentation. Final slope gradient should not exceed 17%, or approximately 10^0.

Erosion and Sediment Control

The most significant means of controlling surface flow on disturbed areas is to construct contour furrows or contour banks at intervals down the slope. The effect of these is to divide a long slope into a series of short slopes with the catchment area commencing at each bank or furrow. This prevents runoff from reaching a depth of flow or velocity that would cause erosion. As the slope angle increases, the banks or furrows must be spaced closer together until a point is reached where they are no longer effective.

Contour ripping across the grade is by far the most common form of structural erosion control on mine sites as it simultaneously provides some measure of erosion protection and cultivates the surface in readiness for sowing.

Graded banks are essentially a much larger version of contour furrows, with a proportionately greater capacity to store runoff and/or drain it to some chosen discharge point. The banks are constructed away from the true contour, at a designed gradient (1%

to 2%) so that they drain water from one part of a slope to another; for example, towards a watercourse or a sediment control dam.

Eventually, runoff that has been intercepted and diverted must be disposed of down slope. The use of engineered waterways using erosion blankets and/or rip rap is recommended to safely dispose of runoff downslope.

The construction of sediment control dams is recommended for the purpose of capturing sediment laden runoff prior to off-site release. Sediment control dams are responsible for improving water quality throughout the mine site and enhance the ecological diversity of the area.

The following points should be considered when selecting sites for sediment control dams:

- each dam should be located so that runoff may easily directed to it, without the need for extensive channel excavation or for excessive channel gradient. Channels must be able to discharge into the dam without risk of erosion. Similarly, spillways must be designed and located so as to safely convey the maximum anticipated discharge;

- the material from which the dam is constructed must be stable. Dispersible clays, such as the subsoils (> 15-20cm depth) of the Yellow Duplex soils, will require treatment with lime, gypsum and/or bentonite to prevent failure of the wall by tunnel erosion. Failure by tunnelling is most likely in dams which store a considerable depth of water above ground level, or whose water level fluctuates widely. Dams should always be well sealed, as leakage may lead to instability, as well as allowing less control over the storage and release of water; and

- the number and capacity of dams should be related to the total area of catchment and the anticipated volume of runoff. The most damaging rains, in terms of erosion and sediment problems are localised, high intensity storms.

Seedbed Preparation

Thorough site preparation should be undertaken to ensure optimum establishment and growth of vegetation. To minimise erosion, ripping should be undertaken on the contour and the tines lifted for approximately 2m every 200m to reduce the potential for channelised erosion. Best results will be obtained by ripping when soil is moist and when undertaken immediately prior to sowing.

All topsoiled areas should be contour ripped (after topsoil spreading) to create a “key” between the soil and the spoil.

5.0 REFERENCES

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Appendix 1 – Glossary

A Horizon
The original top layer of mineral soil divided into A_1 (typically from 5 to 30 cm thick; generally referred to as topsoil

Alluvial Soils
Soils developed from recently deposited alluvium, normally characterise little or no modification of the deposited material by soil forming processes, particularly with respect to soil horizon development.

Brown Clays
Soil determined by high clay contents. Typically, moderately deep to very deep soils with uniform colour and texture profiles, weak horizonation mostly related to structure differentiation.

Consistence
The attribute of the soil material that is expressed by the degree and kind of cohesion and adhesion or by the resistance to deformation or rupture.

Electrical Conductivity
The property of the conduction of electricity through water extract of soil. Used to determine the soluble salts in the extract, and hence soil stability.

Emerson Aggregate Test (EAT)
A classification of soil based on soil aggregate coherence when immersed water. Classifies soils into eight classes and assists in identifying whether soils will slake, swell or disperse.

Gravel
The >2 mm materials that occur on the surface and in the A_1 horizon and include hard, coarse fragments.

Lithosols
Stony or gravelly soils lacking horizon and structure development. They are usually shallow and contain a large proportion of fragmented rock. Textures usually range from sands to clay loams.

Loam
A medium, textured soil of approximate composition 10 - 25% clay, 25 - 50% silt and <50% sand.

Mottling
The presence of more than one soil colour in the same soil horizon, not including different nodule or cutan colours.

Particle Size Analysis (PSA)
The determination of the amount of the different size fractions in a soil sample such as clay, silt, fine sand, coarse sand and gravel.

Pedality
The relative proportion of peds in the soil (as strongly pedal, weakly pedal or non-pedal).

pH
A measure of the acidity or alkalinity of a soil.

Solodic Soils
Strong texture differentiation with a very abrupt wavy boundary between A and B horizons, a well-developed bleached A2 horizon and a medium to coarse blocky clay B horizon.

Soloths
Similar to a solodic soil but acidic throughout the profile. Tends to be a more typical soil of the humid regions where the exchangeable cations in the B Horizon of the solodised soils have been leached out.

Podzolics
Podzolic soils are acidic throughout and have a clear boundary between the topsoil and subsoil. The topsoils are loams with a brownish grey colour. The lower part of the topsoil has a pale light colour and may be bleached with a nearly white, light grey colour.

Ped
An individual, natural soil aggregate.

Sodicity
A measure of exchangeable sodium in the soil. High levels adversely affect soil stability, plant growth and/or land use.

Soil Mantle
The upper layer of the Earth’s mantle, between consolidated bedrock and the surface, that contains the soil. Also known as the regolith.

Subsoil

Topsoil

Appendix 2 – Field Assessment Procedure

FIELD ASSESSMENT PROCEDURE

Elliott and Veness (1981) have described the basic procedure, adopted in this survey, for the recognition of suitable topdressing materials. In this procedure, the following soils factors are analysed. They are listed in decreasing order of importance.

Structure Grade

Good permeability to water and adequate aeration are essential for the germination and establishment of plants. The ability of water to enter soil generally varies with structure grade (Charman, 1978) and depends on the proportion of coarse peds in the soil surface.

Better structured soils have higher infiltration rates and better aeration characteristics. Structureless soils without pores are considered unsuitable as topdressing materials.

Consistence - Shearing Test

The shearing test is used as a measure of the ability of soils to maintain structure grade.

Brittle soils are not considered suitable for revegetation where structure grade is weak or moderate because peds are likely to be destroyed and structure is likely to become massive following mechanical work associated with the extraction, transportation and spreading of topdressing material.

Consequently, surface sealing and reduced infiltration of water may occur which will restrict the establishment of plants.

Consistence - Disruptive Test

The force to disrupt peds, when assessed on soil in a moderately moist state, is an indicator of solidity and the method of ped formation. Deflocculated soils are hard when dry and slake when wet, whereas flocculated soils produce crumbly peds in both the wet and dry state. The deflocculated soils are not suitable for revegetation and may be identified by a strong force required to break aggregates.

Mottling

The presence of mottling within the soil may indicate reducing conditions and poor soil aeration. These factors are common in soil with low permeabilities; however, some soils are mottled due to other reasons, including proximity to high water-tables or inheritance of mottles from previous conditions. Reducing soils and poorly aerated soils are unsuitable for revegetation purposes.

Macrostructure

Refers to the combination or arrangement of the larger aggregates or peds in the soil. Where these peds are larger than 10 cm (smaller dimension) in the subsoil, soils are likely to either slake or be hardsetting and prone to surface sealing. Such soils are undesirable as topdressing materials.

Texture

Sandy soils are poorly suited to plant growth because they are extremely erodible and have low water holding capacities. For these reasons soils with textures equal to or coarser than sandy loams are considered unsuitable as topdressing materials for climates of relatively unreliable rainfall, such as Central Queensland.

Root Density and Root Pattern

Root abundance and root branching is a reliable indicator of the capability for propagation and stockpiling.

Field Exposure Indicators

The extent of colonisation of vegetation on exposed materials as well as the surface behavior and condition after exposure is a reliable field indicator for suitability for topdressing purposes. These layers may alternate with other layers which are unsuitable. Unsuitable materials may be included in the topdressing mixture if they are less than 15cm thick and comprise less than 30 per cent of the total volume of soil material to be used for topdressing. Where unsuitable soil materials are more than 15 cm thick they should be selectively discarded.

Appendix 3 – Soil Information

TEST SIGNIFICANCE AND TYPICAL VALUES

Particle Size Analysis

Particle size analysis measures the size of the soil particles in terms of grainsize fractions, and expresses the proportions of these fractions as a percentage of the sample. The grainsize fractions are:

- clay (<0.002 mm)
- silt (0.002 to 0.02 mm)
- fine sand (0.02 to 0.2 mm)
- medium and coarse sand (0.2 to 2 mm)

Particles greater than 2 mm, that is gravel and coarser material, are not included in the analysis.

Emerson Aggregate Test

Emerson aggregate test measures the susceptibility to dispersion of the soil in water. Dispersion describes the tendency for the clay fraction of a soil to go into colloidal suspension in water. The test indicates the credibility and structural stability of the soil and its susceptibility to surface sealing under irrigation and rainfall. Soils are divided into eight classes on the basis of the coherence of soil aggregates in water. The eight classes and their properties are:

Class 1	-	very dispersible soils with a high tunnel erosion susceptibility.
Class 2	-	moderately dispersible soils with some degree of tunnel erosion susceptibility.
Class 3	-	slightly or non-dispersible soils which are generally stable and suitable for soil conservation earthworks.
Class 4-6	-	more highly aggregated materials which are less likely to hold water. Special compactive efforts are required in the construction of earthworks.
Class 7-8	-	highly aggregated materials exhibiting low dispersion characteristics.

The following subdivisions within Emerson classes may be applied:

(1) slight milkiness, immediately adjacent to the aggregate

(2) obvious milkiness, less than 50% of the aggregate affected

(3) obvious milkiness, more than 50% of the aggregate affected

(4) total dispersion, leaving only sand grains.

Salinity

Salinity is measured as electrical conductivity on a 1:5 soil:water suspension to give EC (1:5). The effects of salinity levels expressed as EC at 25^{o} (*d*S/cm), on plants are:

0 to 1 very low salinity, effects on plants mostly negligible.

1 to 2 low salinity, only yields of very sensitive crops are restricted.

greater than 2 saline soils, yields of many crops restricted.

pH

The pH is a measure of acidity and alkalinity. For 1:5 soil:water suspensions, soils having pH values less than 4.5 are regarded as strongly acid, 4.5 to 5.0 moderately acidic, and values greater than 7.0 are regarded as alkaline. Most plants grow best in slightly acidic soils.

LABORATORY TEST METHODS

Particle Size Analysis

Determination by sieving and hydrometer of percentage, by weight, of particle size classes: Gravel >2mm, Coarse Sand 0.2-2 mm, Fine Sand 0.02-0.2 mm, Silt 0.002-0.2 mm and Clay <0.002 mm SCS Standard method. Reference - Bond, R, Craze B, Rayment G, and Higginson (in press 1990) **Australia Soil and Land Survey Laboratory Handbook**, Inkata Press, Melbourne.

Emerson Aggregate Test

An eight class classification of soil aggregate coherence (slaking and dispersion) in water. SCS Standard Method closely related to Australian Standard AS1289. The degree of dispersion is included in brackets for class 2 and 3 aggregates. Reference - Bond R., Craze, B., Rayment, G., Higginson, F.R., (in press 1990). **Australian Soil and Land Survey Laboratory Handbook**, Inkata Press, Melbourne.

EC

Electrical Conductivity determined on a 1:5 soil:water suspension. Prepared from the fine earth fraction of the sample. Reference - Bond R, Craze B, Rayment G, Higginson FR (in press 1990) **Australian Soil and Land Survey Handbook.** Inkata Press, Melbourne.

pH

Determined on a 1:5 soil:water suspension. Soil refers to the fine earth fraction of the sample. Reference - Bond, R., Craze, B., Rayment, G., Higginson, F.R. (in press 1990). **Australian Soil and Land Survey Handbook.** Inkata Press, Melbourne.

Annex Q

Draft Land Management Plans

LAND MANAGEMENT
Bushfire Management Plan

Objective	To: • Ensure that statutory requirements and corporate standards are met; • Work with neighbours to minimise the risk of bushfires and rapidly control outbreaks should they occur; • Protect people, property and assets; • Protect areas of heritage value; and • Protect areas of threatened flora and/or fauna.
Scope	HVO • Lease Area and surrounds
Key Environmental Issues	Construction and mining activity in and around the operations may increase the risk of fires. Should a fire occur and be allowed to continue unchecked, it will pose a threat to: • Grass cover, exposing the land to soil erosion; • Flora and fauna habitat; • Land productivity; • Mining equipment and other company assets; and • The safety and property of neighbouring land owners.
Performance Criteria	The objectives will be achieved if fire reduction and hazard control is carried out on a regular basis and in consultation with the NSW Rural Fire Service.
Control Measures	Control measures for prevention and control of bushfires include: • Grazing of pastures to minimise fuel build-up; • Slashing grass around infrastructure; • Maintaining fire breaks as required; and • Ongoing communications with the NSW Rural Fire Service. These measures aim to reduce the severity of a bushfire by reducing the amount of fuel available to burn, should one occur. This makes a bushfire easier to control and reduces the level of damage. More detail on control measures is included in Appendix 1. <u>Ground Disturbance Permit</u> Control measures will be undertaken with regard to the impact on flora and fauna. Warkworth Mine and Hunter Valley's West Pit have known populations of threatened species that must be protected. Prior to any clearing of land for firebreaks, a Ground Disturbance Permit must be completed. <u>Fire Fighting Equipment</u> All operations have existing fire control infrastructure, with fire fighting

	equipment at key points (that is serviced regularly), and an emergency response team. Appendix 2 includes an indicative list of equipment that may be of use in an emergency situation, however, not all of this equipment is able to travel off-site due to impacts on local roads. Each site has a number of water trucks, all of which have STORZ fittings, compatible with the NSW Fire Brigade and NSW Rural Fire Service. A plan with each sites colliery holding area, mining lease, infrastructure, access points, which will also serve as staging areas, key waterways and roads is attached in Appendix 3. <u>Emergency Response</u> Occurrence of a fire will trigger CNA's emergency response procedures with the NSW Rural Fire Service being notified though the 000 number. If CNA can control the fire or external assistance is not required, notification of all fires is still requested. This will be done in accordance with CNA's procedure for managing external affairs when contacting external emergency services.
Monitoring & Inspection	<u>Land Management Inspections</u> Regular inspections will be conducted by the Land & Property group to ensure adequacy of fire control measures. This will include: • The assessment of stocking levels on pasture; • Identification of areas that require slashing; and • inspection of firebreaks to ensure they are adequate for bushfire management. Maintenance of bushfire controls will be carried out as required following regular inspections. <u>Landcare Audits</u> Landcare audits will be conducted bi-annually on all CNA owned buffer land by the Land & Property group. These audits will be the means of assessing risk associated with bushfire control and provide a direction for management measures.
Incident Management	<u>Incident Reporting</u> Incident reporting as per CNA Environmental Procedure *Incident Management and Reporting* (EP1.8). <u>Complaints Management</u> Complaints management as per CNA Environmental Procedure *Communications* (EP1.9). <u>Incident Response – Incident or Complaint</u>

	Investigate event and identify location and operations to determine if additional management measures are required.
Performance Reporting	Performance against the objectives of this Plan will be reported in the relevant AEMR. Information will include a summary of any bushfire management issues and actions arising throughout the year.
Key Documents	<u>Development Consents</u> DA 450-10-2003, Conditions 4.60 and 4.61 DA 114-12-98, Conditions 3.2(d), 3.8, 3.9(a ii) and 5.4(a ii) DA 215/97, Condition 7 <u>Licences</u> EPL 640 <u>External Guidelines</u> Coal Mines Regulations Act (2000) Rural Fires Act (1997) Environmental Planning and Assessment Act (1979) Rural Fires and Environmental Assessment Legislation Amendment Act (2000) <u>Standards and Procedures</u> RT Environment Standard *Land Use Stewardship* (V1.0) CNA Environmental Standard *Land Management* (ES10) CNA Environmental Procedure *Communications* (EP1.9) CNA Environmental Procedure *Incident Management and Reporting* (EP1.8) CNA Environmental Procedure *Rehabilitation* (EP5.1)

LAND MANAGEMENT
Bushfire Management Plan

Appendix 1: BUSHFIRE CONTROL MEASURES

CONTROL MEASURE		**RESPONSIBILITY**	**TIMING / FREQUENCY**
1	All new Employees and Contractors to attend a CNA induction prior to commencement of work on site. Inductions will ensure awareness and understanding of CNA objectives and emergency procedures.	All Staff and Contractors.	Prior to commencement of work.
2	All major contracts require a Safety and Environmental Risk Assessment prior to commencing new tasks on site. Copies of the risk assessment will be kept by both parties for use as an environmental checklist.	Contractor / Department Manager.	Prior to commencement of work.
3	Where possible, pasture in the buffer zone around the lease will be grazed to avoid the build-up of excessive fuels.	Manager Land & Property.	Ongoing.
4	If necessary, in areas where grazing is not practical, other risk management measures will be taken, such as slashing, grading of fire trails or hazard reduction burning, except in areas where threatened flora and fauna are present.	Manager Land & Property.	Ongoing.
5	Prior to the disturbance of CNA land for firebreaks, a Ground Disturbance Permit must be obtained.	Manager Land & Property.	As required.
6	Permits for hazard reduction burning must be obtained from the Rural Fire Service during the fire danger period. In addition, a hazard reduction certificate will be obtained for hazard reduction works in the asset protection zone or strategic fire advantage zone.	Manager Land & Property.	As required.
7	A regular slashing and maintenance program around roads and infrastructure will be carried out.	Manager Land & Property.	Ongoing.
8	Firebreaks will be maintained where required around the perimeter of the operating area to prevent the spread of fire onto or off the site.	Manager Land & Property / Area Statutory Manager.	Ongoing.
9	Ongoing communications will be maintained with the NSW Rural Fire Service.	Manager Land & Property.	Ongoing.
10	Currently approved fire control systems (including site communications, fire extinguishers and other equipment) will be maintained.	Area Emergency Response Coordinator.	Ongoing.
11	Site Emergency Response teams will service the site in the event of a fire, and the appropriate Statutory Authority will be contacted.	Area Statutory Manager.	Ongoing.
12	Landcare audits will be conducted on all CNA owned buffer land to ensure the objectives of this plan are being met.	Manager Land & Property.	As required.
13	All fires on CNA land during the bushfire danger period that are not in a mining lease will be reported to 000.	Manager Land & Property.	As required.
14	Access points will be used by CNA as staging areas. In the case of a fire requiring assistance the fire service contacted will be informed of which access point/gate to stage at for briefing by CNA and will then be accompanied onto the site.	Area Emergency Response Coordinator.	As required.
15	A summary of bushfire management issues and actions will be presented in the AEMR.	Manager Environmental Services.	Annually.

LAND MANAGEMENT
Bushfire Management Plan

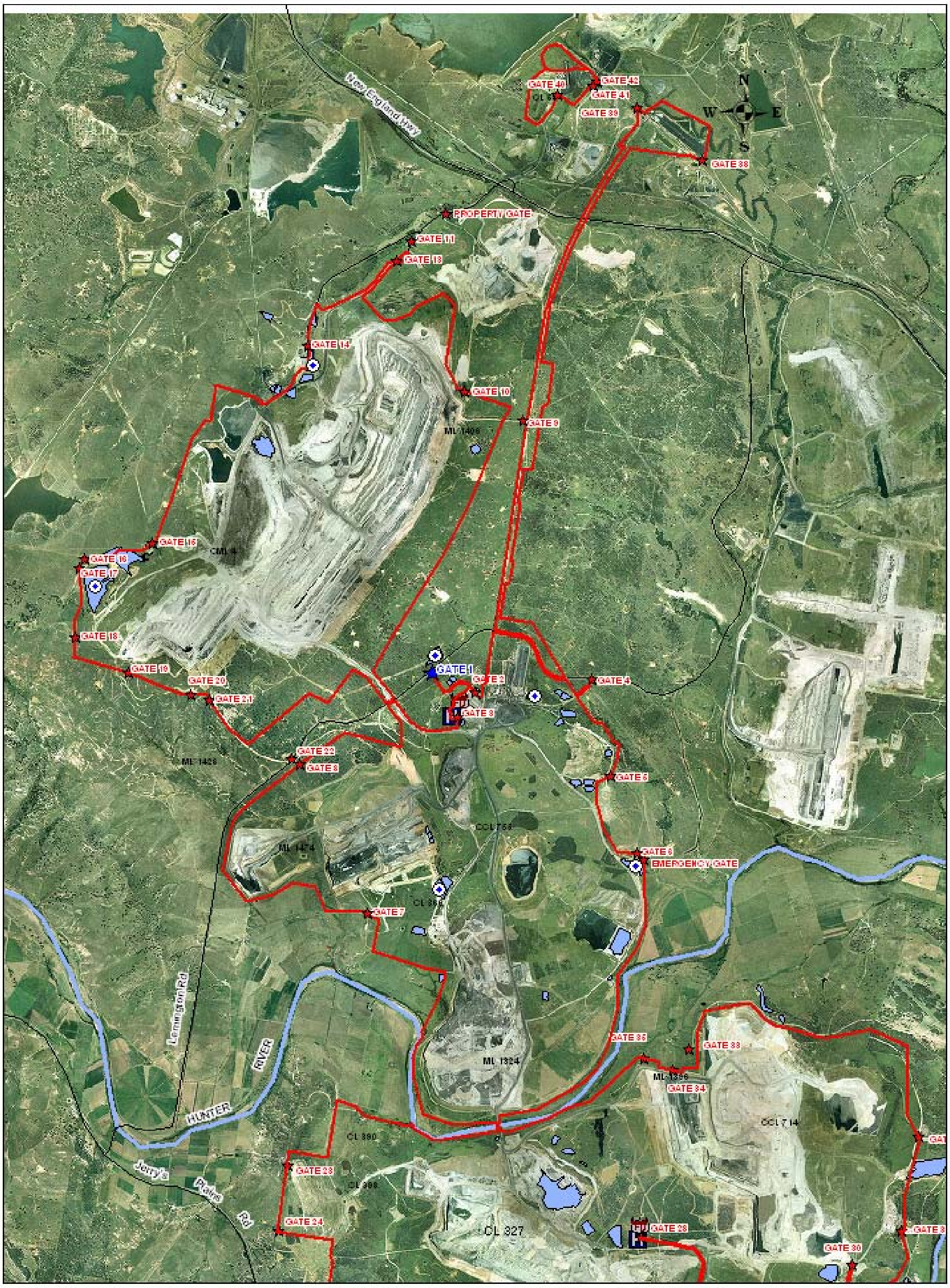
Appendix 2: LIST OF EQUIPMENT

Compiled from CNA's asset register on the intranet Maintenance site:
http://www.rtcnsw.riotinto.com.au//docs/technical/Maintenance/Managing Maintenance.htm

Hunter Valley Operations		
Equipment	**Make**	**Capacity**
Dozer	Caterpillar D11N	-
Dozer	Komatsu D375-1	-
Dozer	Komatsu D475-2	-
Dozer	Komatsu D475-3	-
Dozer	Caterpillar D11R	-
Rubber tyre Dozer	Komatsu WD600-1	-
Rubber tyre Dozer	Caterpillar 690D	-
Rubber tyre Dozer	Caterpillar 690A	-
Grader	Caterpillar 16G	-
Grader	Caterpillar 16H	-
Grader	Caterpillar 24H	-
Water Truck	Caterpillar 777B	77T
Water Truck	Caterpillar 777B	86T
Water Truck	Caterpillar 777C	86T
Water Truck	Caterpillar 777	80,000L
Water Truck	Caterpillar 773	50,000L
Fire truck (x2)	-	-
Fire trailer (x2)	-	-

LAND MANAGEMENT
Bushfire Management Plan

Appendix 3: SITE PLANS



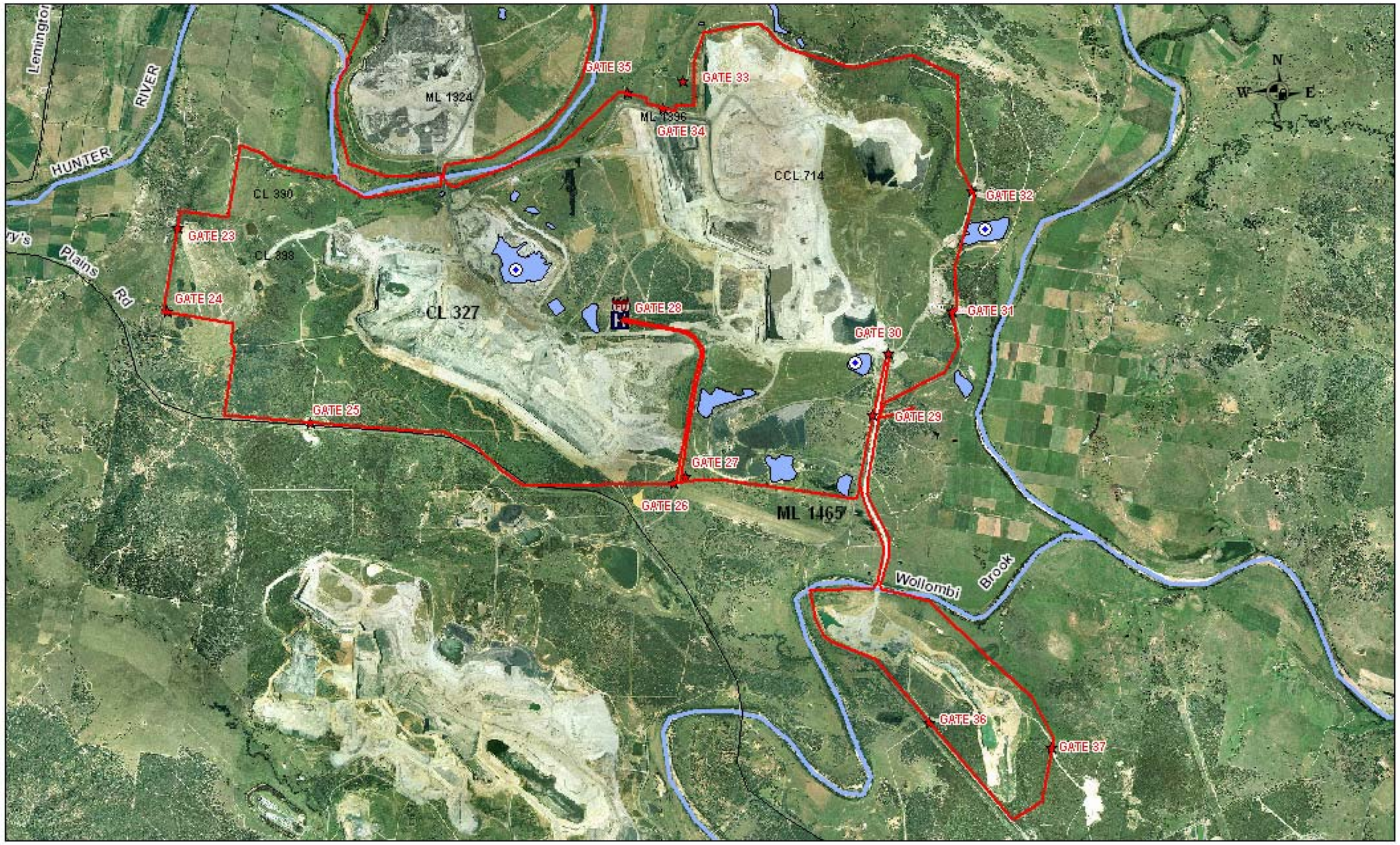
HUNTER VALLEY OPERATIONS - NORTH BUSHFIRE PLAN

0 0.5 1
kilometers

LEGEND

Colliery holding
Road
Creeks
GATE ★ Locked Access Point
GATE ★ Open Access Point
Vehicle Water Points
Fire Truck/Trailer
Helicopter Pad
Dams

LAND MANAGEMENT
Bushfire Management Plan



HUNTER VALLEY OPERATIONS - SOUTH BUSHFIRE PLAN

0 1 2
kilometers

LEGEND

Colliery holding	GATE★ Locked Access Point	Fire Truck/Trailer
Road	GATE★ Open Access Point	Helicopter Pad
Creeks	Vehicle Water Points	Dams

LAND MANAGEMENT
Erosion and Sediment Control Management Plan

Objective	To: • Ensure that statutory requirements and corporate standards are met; • Manage the activities in a way that minimises erosion and sedimentation impacts to environment and neighbours, and limits interference to mining production; • Protect natural and rehabilitated landforms and minimise erosion; • Minimise sedimentation of natural waterbodies and watercourses.
Scope	HVO • Operating Pits • Pre-strip Areas • Rehabilitation Areas
Key Environmental Issues	Land disturbance impacts associated with construction, operational and rehabilitation activities that may increase risk of erosion and sedimentation of natural watercourses and water bodies. Relevant watercourses, water bodies and catchments • Hunter River • Wollombi Brook (tributary of Hunter River) • Loders Creek (tributary of Hunter River) • Salt Pan Creek (tributary of Wollombi Brook) • Doctors Creek (tributary of Loders Creek) • Carrington Billabong
Performance Criteria	The objectives will be achieved if erosion and sediment controls are in place where required and maintenance activities are carried out on a regular basis.
Control Measures	Disturbance from Construction, Mining and Rehabilitation Activities • The extent of disturbance (including trafficable areas) will be minimised and identified using barriers and signage. • Prior to disturbance of land, appropriate erosion and sediment controls will be established and approved by Environmental Services. A combination of temporary and permanent measures may be necessary for disturbances associated with construction, mining, landscaping and rehabilitation. • Runoff from undisturbed catchments will be diverted around the disturbance areas via diversion drains and banks to discharge into natural watercourses, where practicable. • Where practicable, runoff from disturbed and rehabilitated areas will be diverted into sediment dams (designed to a 1:20 year storm event) and allowed to settle prior to discharge into the natural system. • Drains, diversion banks and channels will be compacted and stabilized as they are constructed and scour protection will be provided as necessary.

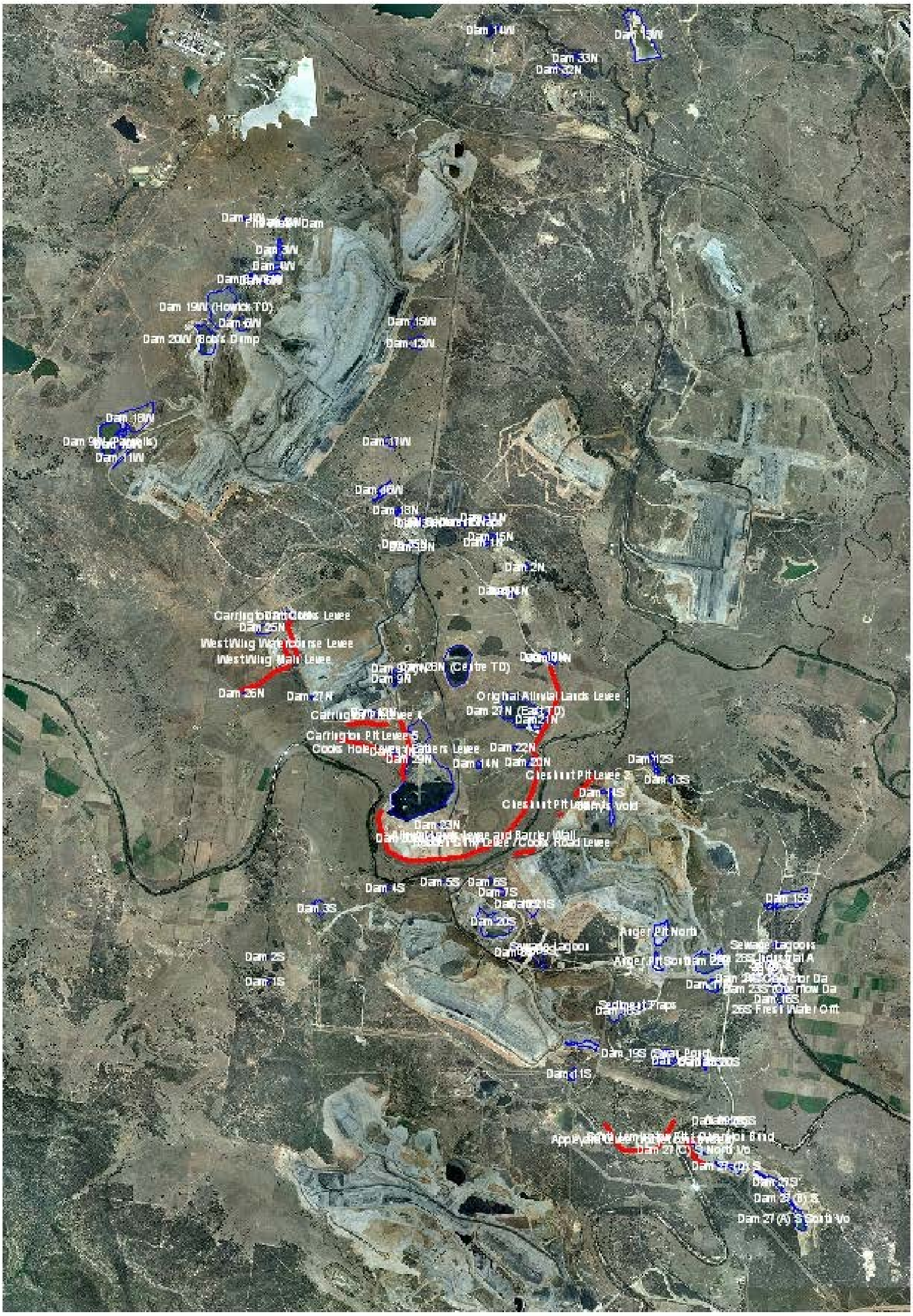
LAND MANAGEMENT
Erosion and Sediment Control Management Plan

	• Temporary erosion and sediment control measures that may be used include silt fences and hay bales. • All erosion and sediment control measures will remain in place until exposed areas are rehabilitated and stabilised. • Progressive rehabilitation of mined areas will be undertaken as soon as possible. Reshaped areas awaiting revegetation will be cultivated on the contour to maximise infiltration. • Topsoil will be stockpiled for reuse and all stockpiles will be managed as noted in the *Topsoil Stripping and Stockpiling Management Plan.* • Soil and/or vegetation material that is removed from the area of operation will not be placed in a position where it could be swept into the Hunter River. Non-Disturbance Areas • No interference with the stability of watercourses/water bodies outside the DA areas will occur. • A buffer zone to the mine workings, of a minimum of 150 metres, or less if otherwise agreed by DLWC, from the boundary of the Hunter River system comprising the river banks and adjacent alluvium excepting the area of Hobden Gully. Disturbance from Decommissioning Activities • Erosion and sediment control structures will remain in place to divert water away from the final void. • Sediment dams will remain as farm dams to enhance the value of the resultant land for agriculture purposes, where practicable. Note: Salinity is addressed in the *Dewatering and Water Management Plan*.
Monitoring & Inspection	• Erosion and sediment controls (dams, sediment traps, contour banks, channels and diversions, silts fences and hay bales) will be inspected weekly and after significant rainfall events. • Monitoring of water quality from sedimentation dams will be undertaken during overflow events. This will include measurement of suspended solids, pH and EC or as required by EPA Licence Conditions. • All surface water management structures will be inspected at least quarterly to ensure the integrity of the system is maintained. • All sediment dams will be inspected quarterly to ensure they have at least 75% of their capacity available for runoff/sediment retention. Desilting will be undertaken as soon as practicable, with silt being disposed of to an area approved by CNA.
Incident Management	Incident Reporting Incident reporting as per CNA Environmental Procedure *Incident Management and Reporting* (EP1.8).

LAND MANAGEMENT
Erosion and Sediment Control Management Plan

	Complaints Management Complaints management as per CNA Environmental Procedure *Communications* (EP1.9). Incident Response – Incident or Complaint Investigate event and identify location and operations to determine if additional management measures are required.
Performance Reporting	Performance against the objectives of this Plan will be reported in the relevant AEMR (incorporating the Annual Rehabilitation Report). Information will include: • Measured water quality in water courses and water bodies; • Observations regarding active erosion / siltation in rehabilitated areas and watercourses downstream of the mine; and • Review of disturbance activities and rehabilitation performance as outlined in MOPs.
Key Documents	Development Consents DA 450-10-2003, Conditions 4.23(b) and 4.25 DA 114-12-98, Conditions 3.2(d), 3.4(a iii) and 3.5 DA 215/97, Conditions 8(ii), 23 and 25 Licences EPL 640 External Guidelines DLWC (now DWE) *Guidelines for Establishing Stable Drainage Lines on Rehabilitated Minesites* NSW Department of Housing *Managing Urban Stormwater: Soils and Construction Manuals* Standards and Procedures RT Environment Standard *Land Use Stewardship* (V1.0) CNA Environmental Procedure *Rehabilitation* (EP5.1) Forms Ground Disturbance Permit

LAND MANAGEMENT
Erosion and Sediment Control Management Plan



HVO Erosion and Sediment Control Structures

S:\HSSE\Environmental Services after restructure\EMM (Environmental Management and Monitoring)\Management Plans & Strategies\Sub Plan Templates\Management Plans\Land Managemen

LAND MANAGEMENT
Subsidence Management Plan

Objective	To: • Ensure that statutory requirements and corporate standards are met; • Manage the operations in a way that minimises subsidence impacts to environment and neighbours, and limits interference to mining production; • Optimise resource extraction while managing subsidence impacts.
Scope	HVO • Lease Area
Key Environmental Issues	Subsidence impacts to • Natural surface features • Public and private utilities • Buildings • Farmland • Groundwater aquifers as a result of undermining activities.
Performance Criteria	Subsidence limit as determined by assessment relevant to mining area
Control Measures	• Subsidence Assessment to determine preferred mine design and/or mitigation measures to minimise potential impact • Pre-mining consultation • Detailed Subsidence Management Plan • Strengthening support structures prior to mining • Repair/rehabilitation work following mining • Monitoring the impacts • Complaints and incident response systems
Monitoring & Inspection	• Survey of pre- and post-mined land surface contours • Survey of pre- and post-mining condition of natural and artificial features identified as potentially impacted upon
Incident Management	<u>Incident Reporting</u> Incident reporting as per CNA Environmental Procedure *Incident Management and Reporting* (EP1.8). <u>Complaints Management</u> Complaints management as per CNA Environmental Procedure *Communications* (EP1.9). <u>Incident Response – Exceedance or Complaint</u> Investigate event and identify location and operations to determine if additional management measures are required.

LAND MANAGEMENT
Subsidence Management Plan

Performance Reporting	Performance against the objectives of this Plan will be reported in the relevant AEMR.
Key Documents	Development Consents N/A Licences EPL 640 Standards and Procedures RT Environment Standard *Land Use Stewardship* (V1.0) CNA Environmental Standard *Land Management* (ES10) CNA Environmental Procedure *Communications* (EP1.9) CNA Environmental Procedure *Incident Management and Reporting* (EP1.8). Forms CNA Ground Disturbance Permit CNA Environmental Risk Assessment Checklist

LAND MANAGEMENT
Topsoil Stripping and Stockpiling Management Plan

Objective	To: • Ensure that statutory requirements and corporate standards are met; • Manage the activities in a way that minimises groundwater impacts to environment and neighbours, and limits interference to mining production; • Understand topsoil quality and quantity; • Plan and manage topsoil stockpiles to maintain soil viability; • Achieve direct placement of topsoil from disturbed areas for rehabilitation purposes wherever possible; and • Protect stockpiles from erosion and weed infestation.
Scope	HVO • Operating Pits • Pre-strip Areas • Rehabilitation Areas
Key Environmental Issues	In order to complete effective rehabilitation across the site, all available topsoil reserves need to be stripped prior to mining.
Performance Criteria	The objectives will be achieved if topsoil stripping and stockpiling controls are in place where required and maintenance activities are carried out on a regular basis.
Control Measures	Availability of Topsoil • Soil stripping will be undertaken in accordance with Soil Stripping Plans (refer to specific environmental impact assessments & MOP), following a logical sequence in relation to mining. • All of the top soil stripped will be re-used during rehabilitation. • If topsoil cannot be used directly on rehabilitated areas, soil will be stockpiled. Pre-stripping Actions • The area to be stripped will determined by the Mine Planning Department, pegged and clearly marked by the Mine Surveyor or Civil Works Department prior to any work commencing. • Environmental Services Department must be consulted regarding visual inspection for Aboriginal artefacts and sensitive flora / fauna, and to obtain a Ground Disturbance Permit or other approval prior to stripping. • Erosion controls (e.g. diversion banks) will be constructed before stripping commences. Soil Stripping Techniques • Topsoil will be stripped using appropriately sized earthmoving equipment to minimise mechanical breakdown of soil structure (e.g.

<table>
<tr><td></td><td>dozers and loaders may be preferable to scrapers).
• As far as practicable, topsoil stripping will be carried out when the soil is moist, but not saturated, to minimise structural breakdown and dust generation.
• Excessive machinery movement over topsoil will be minimised during stripping.

<u>Stockpile Management</u>
• Stockpiles will be located to avoid erosion from surface runoff (i.e. away from drainage lines and on flat areas or along contours) and will be left in a rough condition to assist drainage.
• Stockpiles are to be set out in windrows (for maximum surface area) and limited to a maximum height of 3 metres, where practicable.
• Stockpiles will be placed as close as possible to respreading areas, but not in areas where there is potential for weeds to spread to the stockpile.
• Stockpiles will be signposted indicating soil type, volume and status (i.e. open or closed).
• Temporary stockpiles will be protected by erosion control works in accordance with the Erosion and Sediment Control Management Plan, and be revegetated to maintain soil viability and reduce weed infestation (unless soil is to be used within 6 weeks).
• Closed long-term (i.e. will not be used for 3 months) stockpiles will be fertilised and revegetated to provide stability, maintain soil viability, reduce weed infestation and minimise erosion.
• A Topsoils Stockpile Register containing annual data on the locations and volumes of all soil stockpiles, the formation new stockpiles and the removal of soil from stockpiles for respreading will be maintained.
• Weeds will be managed in accordance with the Weeds and Feral Animals Management Plan.</td></tr>
<tr><td>Monitoring & Inspection</td><td>• Stockpiles will be inspected for integrity every six months.
• Inspections for weeds will occur in accordance with the Weeds and Feral Animals Management Plan.</td></tr>
<tr><td>Incident Management</td><td><u>Incident Reporting</u>
Incident reporting as per CNA Environmental Procedure Incident Management and Reporting (EP1.8).

<u>Complaints Management</u>
Complaints management as per CNA Environmental Procedure Communications (EP1.9).

<u>Incident Response – Exceedance or Complaint</u>
Investigate event and identify location and operations to determine if</td></tr>
</table>

	additional management measures are required.
Performance Reporting	Performance against the objectives of this Plan will be reported in the relevant AEMR (incorporating the Annual Rehabilitation Reports). Information will include: • Balance of useful topsoil recovered and reused; • Review of stockpile erosion control measures; and • Review of land management measures, including weed control.
Key Documents	<u>Development Consents</u> DA 450-10-2003, Condition 4.34 DA 114-12-98, Conditions 3.2(d) and 3.5 DA 215/97, Conditions 23 and 24 <u>Licences</u> EPL 640 <u>Standards and Procedures</u> RT Environment Standard *Land Use Stewardship* (V1.0) CNA Environmental Procedure *Rehabilitation* (EP5.1) CNA *Erosion and Sediment Control Management Plan* (V2) <u>Forms</u> Ground Disturbance Permit

LAND MANAGEMENT
Weeds and Feral Animals Management Plan

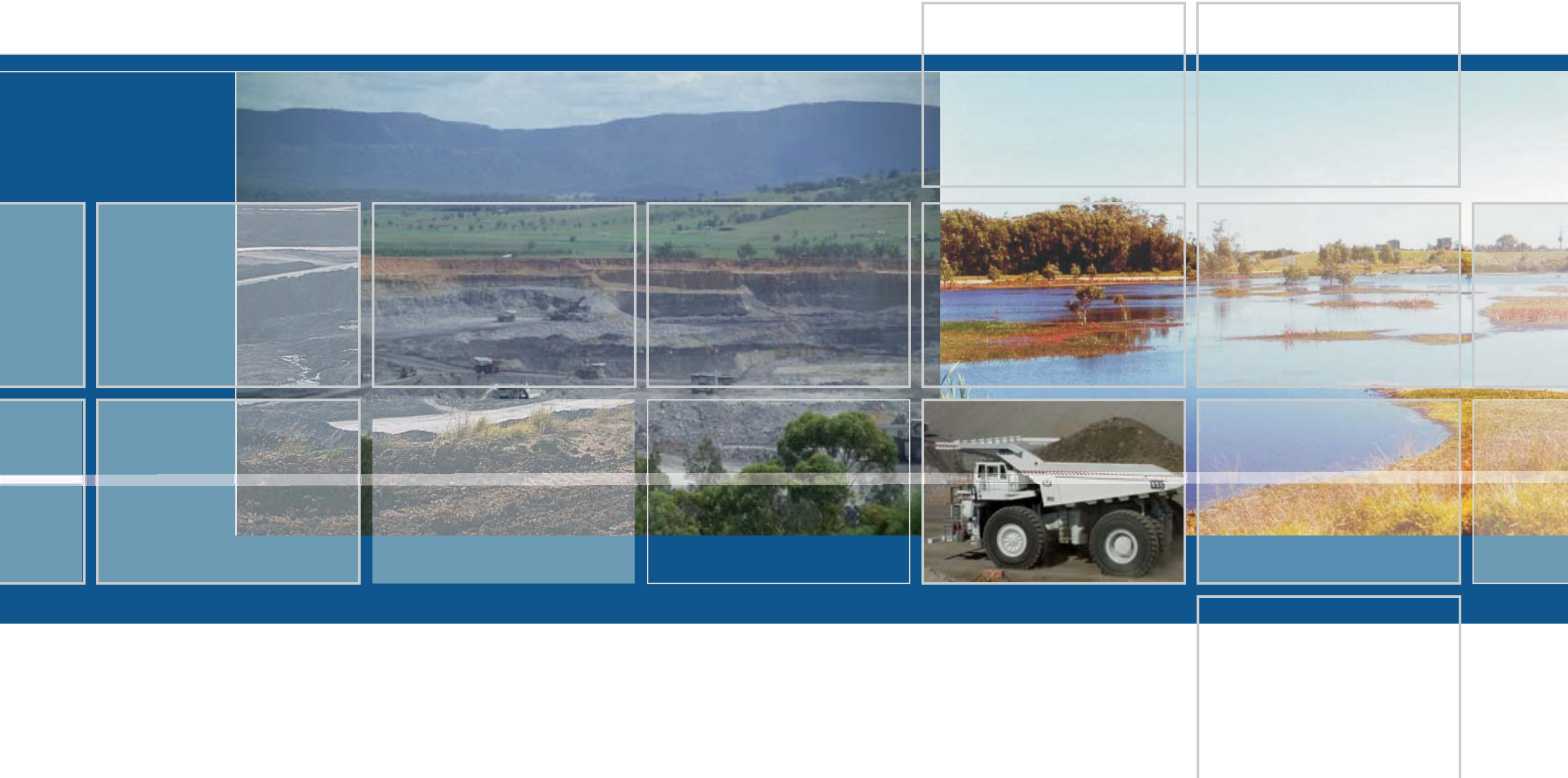
Objective	To: • Ensure that statutory requirements and corporate standards are met; • Work with neighbours in the management of weeds and feral animals; • Prevent the introduction and spread of noxious weed species and feral animals; • Implement the Weed and Feral Animal Control Program to minimise impacts to the environment.
Scope	HVO • Lease Area
Key Environmental Issues	Before, during and following mining potential exists for weed infestation and invasion by feral and other animals. The majority of weed species occur in disturbed areas including road verges, stockpiles and within pasture and native vegetation rehabilitation areas. Some weeds occur within remnant native vegetation and pasture areas. Both noxious and environmental weed species have been identified at HVO and MTW (refer to respective AEMRs). Key noxious weed species include Galenia, Prickly Pear and Tiger Pear. Feral animals observed at HVO and MTW include wild dogs and foxes (refer to respective AEMRs).
Performance Criteria	The objectives will be achieved if weed and feral animals controls are in place where required and maintenance activities are carried out on a regular basis.
Control Measures	<u>Weed Identification</u> • If inspections indicate that weeds occupy 20% of the ground cover, spraying or other treatment must be arranged by the Environmental Co-ordinator. • Noxious weeds (as declared by the Upper Hunter Weeds Authority) must be sprayed as soon as practical after the observation was made. • Areas where weed control has been conducted are recoded in a GIS Database maintained by the Environmental Co-ordinator <u>Weed Treatment & Prevention</u> • Control methods include spraying, wick weeding, cultivation, grazing and washing of equipment. • All earth moving equipment is to be inspected and if necessary washed prior to conducting works to ensure it is weed and mud free

	to prevent introduction of weeds.
	• If spraying:
	  • The chemical sprays to be used on-site must be approved and the MSDS obtained prior to spraying,
	  • Weeds must be sprayed during active growth,
	  • Records of the area sprayed, product used and dilution rates, weather conditions and other criteria as required under the *Pesticides Act 1999* must be retained.
	  • Follow up seeding should occur within 3 months after spraying.
	<u>Feral Animals</u>
	• Sitings of feral animals must be reported to the Environmental Co-ordinator in areas within the mining lease or the Property Landcare Specialist in areas outside the mining lease.
	• Eradication programmes, including baiting and shooting of bait -shy dogs, will be undertaken as necessary.

Monitoring & Inspection	• A weed inspection of old cultivation lands, rehabilitation areas and spoil dump piles will generally be undertaken every 6 months to determine whether weed eradication is necessary. The Environmental Co-ordinator will co-ordinate the weed inspection within the Mining Lease and the Property Landcare Specialist will co-ordinate the weed inspection outside of the Mining Lease. • The success of spraying should be assessed by visual inspections approximately two weeks after spraying. A final inspection is to be carried out six months after spraying to ensure that weeds have been destroyed and re-infestation has not occurred.
Incident Management	<u>Incident Reporting</u> Incident reporting as per CNA Environmental Procedure *Incident Management and Reporting* (EP1.8). <u>Complaints Management</u> Complaints management as per CNA Environmental Procedure *Communications* (EP1.9). <u>Incident Response – Exceedance or Complaint</u> Investigate event and identify location and operations to determine if additional management measures are required.
Performance Reporting	Performance against the objectives of this Plan will be reported in the relevant AEMR. Information will include: • Weed monitoring and control activities; and

LAND MANAGEMENT
Weeds and Feral Animals Management Plan

	• Feral animal eradication activities.
Key Documents	Development Consents DA 450-10-2003, Conditions 4.31(b) and 4.35 DA 114-12-98, Condition 3.9 DA 215/97, Condition 8(i) Licences EPL 640 External Guidelines DPI (NSW Agriculture) Noxious Weed Control Categories. Standards and Procedures RT Environment Standard Land Use Stewardship (V1.0) CNA Environmental Procedure Flora and Fauna (EP10.2)



Annex R

Project Team

Company / Consultant	Title	Area of Responsibility
Rio Tinto Coal Australia		
Anna McMullen	Manager Project Approvals (NSW)	HVO South Coal Project Environmental Assessment
Ruth Kinal	Environmental Coordinator – Project Approvals	HVO South Coal Project Environmental Assessment
Mark Molan	Superintendent – Hunter Valley Projects	HVO South Infrastructure Project
Mal Scott	General Manager – Mine Planning	Mine Planning
Ray Wedmaier	Senior Mining Engineer	Mine Planning
Alistair Mathias	Manager Mine Planning	Mine Planning
Jennifer Anderson	Manager Land and Property	Land and Property
David Cameron	Cultural Heritage Systems Specialist	Cultural Heritage Assessment
Rosemarie Rohr	Environmental Coordinator – Project Approvals	Historic Heritage Assessment
Rio Tinto Technology and Innovation		
Lloyd Townley	Principal Adviser – Water Management	Groundwater and Surface Water
Michael O'Keeffe	Principal Adviser – Environment	Greenhouse Gas and Energy Assessment
Rhys Jenkins	Senior Adviser – Environment	Greenhouse Gas and Energy Assessment
Environmental Resources Management Australia Pty Limited (ERM)		
Peter Southern	Partner / Project Director	HVO South Coal Project Environmental Assessment
Luke Stewart	Senior Project Manager	HVO South Coal Project Environmental Assessment
Lynette Coleman	Technical Advisor	General Assessment
Najah Ishac	Principal Acoustic Engineer	Noise and Vibration Assessment
Stefan Charteris	Senior Hydrogeologist	Groundwater Assessment
Geoff Herman	Principal Water Resources Engineer	Surface Water Assessment
Renae Baker	Senior Ecologist	Ecology Assessment
Jacqui Coughlan	Principal Ecologist	Ecology Assessment
Andrew Booth	Economics Consultant	Socio-Economic Assessment
Daniel Hall	GIS Officer	GIS
Grazia Chiavegato	Graphics Officer	Graphics
Cherie Henderson	PA / Team Secretary	Administration
Holmes Air Science		
Dr Nigel Holmes	Principal	Air Quality Assessment
GSS Environmental		
Lachlan Crawford	Projects Manager (Environmental Management)	Soil Survey and Land Resource Assessment
Rod Masters	Principal	Soil Survey and Land Resource Assessment
Strata Engineering (Australia) Pty Ltd		
Ismet Canbulat	Principal	Highwall Mining Assessment
Weir and Phillips		
Phillip Weir	Architect and Heritage Consultant	Warkworth Aerodrome – Heritage Impact Statement