



NARRABRI COAL OPERATIONS PTY LTD

ABN: 15 129 850 139

Mining Operations Plan

for the Stage 2 Longwall Project
of the Narrabri Coal Mine

for the

Period Ending 31 December 2017

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Period Ending 31 December 2017

Prepared by:

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Date: April 2011

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FOREWORD

This Mining Operations Plan (MOP) is the second MOP document submitted for the Narrabri Coal Mine. The initial MOP, for the Stage 1 continuous miner operation, was approved by the former Department of Primary Industries (DPI) in February 2008. Amendments to the MOP were subsequently approved in 2008 and 2010.

This MOP, which covers the Stage 2 longwall operation, is applicable for a period of 7 years, until 31 December 2017. Preparation of this MOP has been undertaken in accordance with the requirements of the Mining Lease (ML) 1609 and Project Approval (PA) 08_0144, granted by the Minister for Planning on the 26th July 2010 and incorporating the approved Statement of Commitments.

The MOP incorporates Stage 2 construction activities, continuous miner and longwall development and conceptual plans for the closure of the mine.

The contents of this MOP:

- Provide relevant information of the mining, processing, product dispatch and rehabilitation operations necessary for compliance with the collective conditions imposed upon the mining development by PA 08_0144 and other approvals and licences; and
- Reflects the publication titled *The Guidelines to the Mining, Rehabilitation and Environmental Management Process* prepared by the DPI – Mineral Resources (the “Guidelines” – Ref: EDG03 MREMP Guide V3.doc).

The MOP focuses upon the activities and operations within ML 1609. Details primarily relate to Stage 2 operations and ongoing Stage 1 operations, however references to completed Stage 1 activities have been included where relevant.

An updated MOP will be prepared and submitted for mining operations beyond 2017 and MOP amendments will be submitted following any significant changes during the MOP period. With an anticipated mine life of approximately 30 years, this MOP provides final rehabilitation concepts and objectives. The specific details of mine closure will be provided in a Mine Closure Plan (MCP), as required by Condition 5(5) of PA 08_0144. The MCP will describe the proposed rehabilitation techniques and methodologies for the closure of the mine and will be incorporated into the Landscape Management Plan, as required by Condition 5(3) of PA 08_0144.

Document Format

The format of this document is consistent with the Guidelines, and is detailed below:

- Section 1: Summarises the background to and history of exploration activities; outlines the objectives and scope of operations identified in the MOP; lists all approvals, leases and licences held or required and the relevant mine contacts; describes the mine geology and land ownership, and summarises the consultation undertaken with the local community and government agencies.
- Section 2: Describes the significant features of the pre-MOP environment including topography, water resources, flora, fauna and cultural heritage all of which have influenced the design of the mine.

- Section 3: Describes in detail the proposed activities during the term of the MOP. Activities described include exploration, land preparation, construction, pit bottom establishment, ventilation, gas drainage and control, mining activities, processing, waste, water and hazardous materials management.
- Section 4: Describes the rehabilitation activities proposed during the term of the MOP including stakeholder consultation, rehabilitation procedures, building demolition, water management on rehabilitated lands, and any planned rehabilitation trials and/or research.
- Section 5: Describes the anticipated rehabilitation outcomes for the mine site, proposed post site rehabilitation land use and the proposed planning criteria to be used.
- Section 6: Provides a matrix for assessing environmental risk associated with the proposed activities and identifies those activities with the greatest associated environmental risk.
- Section 7: Documents how environmental management and performance will be managed for each of the environmental risks listed in Section 6.

In accordance with the Guidelines, eight plans have been prepared to illustrate elements of the pre-MOP environment, construction, land preparation, mining and rehabilitation activities. These plans, located at the rear of the MOP, are as follows:

- Plan 1: Mine and Context - presenting the context and surrounding features of the mine.
- Plan 2A/2B: Pre-MOP Environment - presenting the status of the mine site at the commencement of the MOP term.
- Plan 3: Proposed Land Preparation - presenting all areas to be cleared of vegetation and stripped of soil during the MOP term. This Plan includes the soil mapping units, vegetation stacking areas and soil stockpile locations.
- Plan 4A: Proposed Mining Activities (Underground Mine Area) - presenting the extent of underground mining activities, including drift development, pit bottom area establishment, mains and roadway development of the MOP term.
- Plan 4B: Proposed Mining Activities (Surface Infrastructure Area) - presenting the extent of all surface mining, processing, waste emplacement, product stockpile, water management and other infrastructure features at the end of the MOP term.
- Plan 5: Proposed Rehabilitation - presenting the proposed status of rehabilitation at completion of the MOP term (Year 7).
- Plan 6: Conceptual Final Rehabilitation for Lease Relinquishment – presenting the anticipated final landform at the cessation of mining and lease relinquishment.

A1/A0 size plans are supplied separately to the MOP, however, for presentation purposes, these plans are also provided as A3 size plans within this document.

Additional figures have been provided to assist in presenting the information required in the MOP.

New South Wales

STATUTORY DECLARATION

OATHS ACT, 1900

EIGHTH SCHEDULE

I, Greig Duncan of 57 The Parkway, Stretton in the State of Queensland, solemnly and sincerely declare as follows:

1. I am the duly appointed General Manager for the Narrabri Coal Mine.
2. I am authorised to make this Declaration on behalf of the Lease Holder, Narrabri Coal Pty Ltd, ABN: 76 107 813 963.
3. All works and activities described in the Mining Operations Plan to which this declaration is attached comply with the conditions of the title of the mining lease (or mining leases) shown in the Mining Operations Plan, and with the conditions of Development Consent and all other relevant Government Agency approvals and licences granted in respect of them.
4. I confirm that all of the works and activities referred to in the previous paragraph lie wholly within the area shown in the Mining Operations Plan and that the tenements (mining leases, colliery holdings, land ownership) details of those tenements are correct.

And I make this solemn Declaration, conscientiously believing the same to be true and by virtue of the provisions of the *Oaths Act, 1900*.

Subscribed and Declared at NARRABRI
 in the State of New South Wales this FOURTEENTH day of APRIL,
 the year 2011
Greig Duncan
 before me DL Justice of the Peace
DEAN LAWRENCE. JP # 131026

GLOSSARY OF ACRONYMS

AEMR	-	Annual Environmental Management Report
CHPP	-	Coal Handling and Preparation Plant
DECC (EPA)	-	Department of Environment and Climate Change (Environment Protection Authority) (now DECCW)
DECCW	-	Department of Environment, Climate Change and Water (formerly DECC)
I&I NSW	-	Industry and Investment NSW (formerly DPI)
DoP	-	Department of Planning
DPI-MR	-	Department of Primary Industries - Mineral Resources (now Industry and Investment NSW)
DWE	-	Department of Water and Energy (now NOW)
EA	-	Environmental Assessment
EL	-	Exploration Licence
MCP	-	Mine Closure Plan
ML	-	Mining Lease
MOP	-	Mining Operations Plan
MSDS	-	Material Safety Data Sheet
Mtpa	-	Million tonnes per annum
NCOPL	-	Narrabri Coal Operations Pty Ltd
NCPL	-	Narrabri Coal Pty Ltd
NOW	-	NSW Office of Water
PA	-	Project Approval
ROM	-	Run-of-Mine
SIS	-	Surface to In-Seam
SWMP	-	Site Water Management Plan
WCL	-	Whitehaven Coal Limited

1 INTRODUCTION

1.1 History of Operations

1.1.1 Exploration

Prior to the commencement of the Narrabri Coal Mine (“the mine”) no mining operations had previously been undertaken on the Mining Lease (ML 1609 and commonly referred to throughout this document as “the mine site”).

Following drilling programs by the then Department of Mineral Resources in the 1980’s, Exploration Licence (EL) 6243 was granted to Narrabri Coal Pty Ltd (NCPL) on the 21st May 2004 for a period of five years and subsequently renewed on the 6th May 2009 (expiry date: 20th May 2014) (see Plan 1).

Between July 2004 and July 2007, NCPL completed an extensive exploration drilling programme within EL 6243 comprising 160 rotary, fully and partly cored drill holes, totalling in excess of 6,000m. The exploration programme included:

- Detailed lithological logging;
- Down-hole geophysical logging;
- Ply-by-ply quality analyses of coal core recovered from the Hoskissons Coal Seam;
- Point Load and Uniaxial Compressive Strength (UCS) determination for roof and floor strata;
- Slake Durability testing of floor strata;
- Specialist analysis of regional aeromagnetic data from HR aeromagnetic survey conducted in September 2005;
- Specialist testing, sampling and assessment of coal bed methane levels, nature and composition;
- Specialist “televiewer” investigations and reporting of three holes for evidence of stress-related break-out;
- Geotechnical review and assessment of data for prediction of mining conditions;
- Hydrogeological assessment including down-hole pump tests and the establishment of ongoing piezometers and monitoring bores; and
- Specialist investigations of coal cores for spontaneous combustion propensity

Following the geological assessments by NCPL and independent coal resource assessments by SRK Australasia, in conjunction with marketing, technical and economic feasibility studies undertaken by NCPL, it was determined that a coal resource that could support the development of a medium to large scale underground coal mine existed within EL 6243. In-situ coal resources of 229Mt have thus far been identified and a decision to proceed with the Project was made in late 2005.

Focussing on the northern half of EL 6243, mine planning, together with the preparation of a number of environmental studies, was progressed throughout 2006 with an Environmental Assessment (EA) submitted to the Department of Planning (DoP) in

August 2006 for Adequacy Assessment. Following the completion of the Adequacy Assessment, the EA was revised and then re-submitted to DoP for determination in March 2007. Following required revisions and response to submissions Project Approval (PA) 05_0102 was issued to NCPL by the Minister for Planning (on 13th November 2007). This approval permitted the development of the mine site on the basis of a maximum production rate of 2.5 million tonnes per annum (Mtpa) by continuous miner methods.

1.1.2 Operations

Since commencing Stage 1, continued geological exploration and a range of related technical studies were completed to evaluate the feasibility of converting the Stage 1 continuous mining operation to a longwall mining operation. An application for Project Approval, accompanied by an EA for the Narrabri Coal Mine Stage 2 Longwall Project ("Stage 2 EA") was issued for public exhibition in November 2009.

In recognition of the expected approval timeframes and the long lead times for selected Stage 2 construction activities, Narrabri Coal Operations Pty Ltd (NCOPL, the current operating company) sought approval to undertake some Stage 2 works via a modification to the Stage 1 Project Approval under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) while the Stage 2 EA was being assessed. PA 05_0102 MOD 1 was granted on the 26th March 2010 for activities including the construction and use of the West Mains Ventilation Shaft and gas pre-drainage infrastructure and the construction but not use of a Coal Handling and Preparation Plant (CHPP). Stage 2 operations were subsequently approved by the Minister for Planning on the 26th July 2010, via PA 08_0144.

The following list details the main activities that have been commenced or completed at the time of development of this MOP:

- Site access road (completed);
- Main office, administration and light vehicle carpark (completed with administration office currently being extended);
- Workshop and stores buildings (completed);
- Intersection upgrade between the Kamilaroi Highway and Kurrajong Creek Road (completed);
- Rail crossing upgrade over the North-Western Branch Railway Line (completed);
- Ventilation fans within the box cut (completed);
- Electrical sub-station and associated electricity infrastructure (completed);
- Equipment laydown area (completed);
- Rail loop (completed);
- Sewage treatment plant (completed);
- Box cut and mine portals (completed);
- Drift construction to pit bottom (completed);
- Drift and skyline conveyors (completed);
- Coal crushing station (completed);

- Run-of-Mine (ROM) coal and product coal pad hardstand areas (completed);
- Train loadout bin and train loader (completed);
- Water storages and lined evaporation ponds (completed with additional works to be completed as required);
- Amenity bund (completed with the exception of the north-west corner);
- Explosives magazine (completed);
- CHPP (commenced but not completed);
- West Mains ventilation shaft (commenced but not completed); and
- Gas pre-drainage infrastructure (ongoing).

1.2 Proposed and Future Operations

1.2.1 Proposed Operations

This MOP is for a period 7 years (the initial period for Stage 2 operations) and covers the following principal activities/operations:

- Progression from underground mining by continuous miner to longwall mining with an annual production rate of up to 8Mtpa, involving:
 - larger trains (with a capacity of 5,400t to 6,300t); and
 - an average of five trains despatched daily; and
- Construction and use of mine ventilation and gas drainage infrastructure;
- Mine dewatering;
- Processing, stockpiling and loading of coal, which includes construction of a Coal Handling and Preparation Plant (CHPP);
- Placement of processing reject and storage of saline water;
- Construction and use of a water pipeline from the Namoi River;
- Transportation of the coal from the mine site to Port Newcastle via train;
- Ongoing rehabilitation of areas no longer required for operations; and
- All ancillary and related activities.

1.2.2 Life of Mine

Based on the currently approved average production rate of a maximum of 8Mtpa via longwall mining operations, the expected mine life is approximately 30 years.

1.2.3 Future Operations

The top coal caving mining method has also been considered by NCOPL. This mining method provides for the extraction of the caved section of coal which forms behind the longwall unit as it retreats within each longwall panel. An advantage of this mining

method is that by recovering the caved coal, the mineable resource would almost double (ie. up to 9m of coal could be recovered as opposed to the 4.2m recovered by longwall mining alone). There are several disadvantages associated with this method, however, including:

- By removing additional coal, the potential impacts of subsidence could be increased; and
- By recovering the majority of the coal seam, including the lower quality coal near the roof of the Hoskissons Coal Seam, increased CHPP and waste storage capacity would be required.

On the basis of the additional infrastructure and disturbance associated with the top coal caving method, and given the compatibility of the longwall mining method to future progression to top coal caving, NCOPL has decided to undertake a feasibility study on the top coal caving method.

Implementation of top coal caving methods will only be initiated once all statutory approvals are obtained.

1.3 Consents, Leases and Licences

ML 1609 covers an area of 5,298ha. This includes a surface area of 458ha for the construction and operation of all mine surface facilities. The mine site is located approximately 10km north-northwest of Baan Baa, 30km south-southeast of Narrabri. The boundaries of the mine site are presented on Plan 1.

The surface facilities area of ML 1609 are located approximately 1km west of the Kamilaroi Highway and the North-Western Branch Railway Line.

Table 1.1 presents the approvals, leases and licences held for the Narrabri Coal Mine.

PA 08_0144 requires the preparation of 10 separate management plans, strategies and programs (for approval by the Director-General of the DoP). Table 1.2 lists these documents along with the required approval information. Copies of all approved plans will be made available on Whitehaven's website (www.whitehavencoal.com.au).

Narrabri Coal has been issued with a modification to the existing Stage 2 consent which requires the submission of an Extraction Plan. This Extraction Plan will remove the requirement to prepare a Subsidence Management Plan under the terms of ML 1609.

Table 1.1 Current Approvals, Leases and Licences

Issuing / Responsible Authority	Type of Lease, Licence, Approval	Date of Issue	Expiry	Comments
Industry & Investment NSW (I&I NSW) ^{*1}	Exploration Licence EL 6243	21 May 2004	20 May 2014	Approval for exploration
	Mining Lease (ML 1609)	18 January 2008	18 January 2029	Approval for mining
Minister for Planning	Project Approval (PA 05_0102)	13 November 2007	18 January 2029	Project Approval for Stage 1 To be surrendered by 26 July 2011 (within 12 months of Stage 2 approval)
	Project Approval (PA 05_0102 MOD 1)	26 March 2010	18 January 2029	Notice of modification under Section 75W of the EP&A Act 1979
	Project Approval (PA 08_0144)	26 July 2010	26 July 2031	Project Approval for Stage 2
NSW Office of Water ^{*2}	90CA811347 / WAL15922	Various	Various	GAB – Water supply (248ML)
	90WA812891 / WAL20131 90WA812891 / WAL12833			GW - Water supply (150ML) GW – Water supply (67ML)
NSW Office of Water ^{*2}	90CA802130 / WAL6762 90CA802130 / WAL2671 90CA802130 / WAL2728 90CA802130 / WAL2952	Various	Various	River – High Security (20ML) River (48ML) River (10ML) River (600ML)
	90BL254679			Aquifer Interference (818ML)
NSW Office of Water ^{*2}	90BL254481 - 90BL254487 90BL254660 - 90BL254663 90BL254658 90BL254659 90BL254701 90BL254958 - 90BL254967 90BL255167 - 90BL255173 90BL255216 - 90BL255218 90BL255769 – 90BL255772	Various	Various	Groundwater Monitoring Purposes
Department of Environment, Climate Change and Water (DECCW) ^{*3}	Environment Protection Licence 12789	20 February 2008	Nil Anniversary date: 20 February Next review: 20 Feb 2013	For mining operation to 2.5Mtpa (to be updated for Stage 2 operations)
Narrabri Shire Council (NSC)	Construction Certificate DP 816020	17 October 2008	N/A	Stage 1 Mine Surface Facilities
	Inspection Report/Permit to Occupy No 2413	6 August 2009		
Narrabri Shire Council (NSC)	Construction Certificate DP 816020	23 September 2010	N/A	Stage 2 Mine Surface Facilities
WorkCover Authority of NSW	Notification for explosives use and storage	5 August 2010	20 July 2015	Licence to store – 07-100215-001 Licence to handle – various
*1 – Previously, Department of Primary Industry – Mineral Resources (DPI – MR)				
*2 – Previously, Department of Water and Energy (DWE)				
*3 – Previously, Department of Environment and Climate Change (DECC)				

Table 1.2 Management Plans, Strategies and Programs

Title	Approval Required	Project Approval Condition (PA 08_0144)
Extraction Plans (for all second workings in the project area)	Prior to carrying out second workings covered by the Plan	Schedule 3, Condition 3
Noise Management Plan	Prior to 30 June 2011	Schedule 4, Condition 4
Air Quality Monitoring Program	Prior to 30 June 2011	Schedule 4, Condition 7
Water Management Plan, including a: <ul style="list-style-type: none"> • site water balance; • erosion and sediment control plan; • surface water monitoring plan; • raffinate discharge and transfer control and monitoring plan; • groundwater monitoring program; and • surface and groundwater response plan. 	Prior to 30 June 2011	Schedule 4, Condition 13
Aboriginal Cultural Heritage Management Plan	Prior to 30 June 2011	Schedule 4, Condition 23
Energy Savings Action Plan	Prior to 30 June 2011	Schedule 4, Condition 30
Greenhouse Gas Minimisation Plan	Prior to carrying out longwall coal mining operations	Schedule 4, Condition 32
Waste Management Plan	Prior to 30 June 2011	Schedule 4, Condition 33
Landscape Management Plan	Prior to 30 June 2011	Schedule 5, Condition 3
Environmental Management Strategy	Prior to 30 June 2011	Schedule 6, Condition 1
Major Hazard Management Plans incorporating: <ol style="list-style-type: none"> 1. Surface Transport Management Plan 2. Underground Transport Management Plan 3. Airborne Dust Management Plan 4. Explosives Handling Management Plan 5. Slope Stability Management Plan 6. Fire and Explosion Management Plan 7. Strata Failure Management Plan 8. Inrush Management Plan 9. Dust Explosion Management Plan 10. Outburst Management Plan 11. Spontaneous Combustion Management Plan 	All plans are currently managed and implemented by Narrabri Coal Operations	<i>Coal Mine Health and Safety Act 2002</i>

1.4 Mine Contacts

Personnel responsible for operational and environmental performance at the mine are as follows:

- Greig Duncan – General Manager of Narrabri Coal Operations Pty Ltd, holds overall responsibility for all mining operations. Contact: (02) 6794 4755 / 0458 944 751.
- Shane Pegg – Technical Services Manager, Narrabri Coal Operations Pty Ltd. Contact: (02) 6794 4755.
- Matthew Klein - Manager Mining Engineering, Narrabri Coal Operations Pty Ltd, retains statutory and mine management responsibility for all operational activities and safety performance at the mine. Contact: (02) 6794 4755.
- Danny Young – Group Environmental Manager for Whitehaven Coal Limited, retains responsibility for recording and reporting environmental performance at the mine. Contact: (02) 6741 9316 / 0427 497 710.

1.5 Geology

1.5.1 Regional Geology

The mine is located within the Permo-Triassic Gunnedah Basin, which forms the central part of the north-south elongate Sydney-Gunnedah-Bowen Basin system. The mine is located near the north-western boundary of the Gunnedah Basin and the eastern margin of the Surat Basin, a sub-basin of the larger Great Artesian Basin. Hence, the rocks and sediments beneath and surrounding the mine site can be grouped into:

- Undifferentiated Quaternary sediments;
- Jurassic Surat Basin sequence; and
- The Gunnedah Basin Sequence.

The Boggabri Ridge, comprising Early Permian volcanic rocks, forms the basement of the Gunnedah Basin and divides the basin into two parts; the Maules Creek sub-basin to the east and the Mullaley sub-basin to the west.

The mine site is located within the Mullaley sub-basin which contains Permian and Triassic sedimentary and volcanic rocks. In the area of ML 1609, adjacent to the Boggabri Ridge, there is a local angular unconformity between the Late Permian Black Jack Group and the overlying Triassic Digby Formation.

The western part of ML 1609 is unconformably overlain by Jurassic sedimentary and volcanic rocks along the eastern margin of the Oxley Embayment, a part of the Surat Basin.

1.5.2 Local Geology and Stratigraphy

The strata throughout ML 1609 strikes north-south and dip gently to the west. Minor variations to the north-south strike may be the result of variable thickness and compaction of the sedimentary units being draped over the faulted and uneven surface on the underlying Boggabri Volcanics. To the east of ML 1609, the Boggabri Volcanics have been uplifted and faulted along a north-south trending anticlinal structure, the

Boggabri Ridge. The proximity of ML 1609 to the Boggabri Ridge is a major control on the outcrop and structure of the local geology.

The coal resource is located within the Gunnedah Basin Sequence (Permian to Triassic) which consists of the following stratigraphy:

- Napperby Formation;
- Basalt sill (in the lower part of the Napperby Formation);
- Digby Formation (divided into two units, the lower Digby Conglomerate and the overlying Ulinda Sandstone); and
- Black Jack Group (consists of lithic sandstone, siltstone, claystone and coal with minor tuff).

The Hoskissons Coal Seam and the Melville Coal Seam are present within ML 1609. Thickness and quality characteristics are such that only the Hoskissons Coal Seam is currently considered to contain coal resources with mining potential.

Throughout the ML, the Black Jack Formation includes the following strata:

- Benelabri Formation – lithic sandstone, siltstone with minor coal. Increases in thickness towards the west away from the unconformity;
- Hoskissons Coal Seam – dull lustrous coal. Coal consists of a low ash working section (basal 4.2m) and a high ash coal with claystone bands (upper 5.2m);
- Arkarula Formation – quartzose sandstone and siltstone. Typically the upper 10m of the Black Jack Formation over the mine site;
- Brigalow Formation – coarse sandstone and conglomerate interbedded with the coal seam and grades laterally into the Arkarula Formation, thickening to the west across the mine site from 2m to 19m; and
- Pamboola Formation – lithic sandstone, siltstone, claystone and coal. Continuous over the mine site below the Arkarula Formation and Brigalow Formation with a thickness of between 55m and 75m.

1.5.3 Geological Structure and Geotechnical Attributes

Located on the eastern side of the Mullaey sub-basin adjacent to the north-south trending Boggabri Ridge, the major structural elements of the geology within the mine site are strongly influenced by the proximity to the Boggabri Ridge. The rocks overlying the Boggabri Ridge strike north-south and dip gently to the west.

Interpretation of regional aeromagnetic data identified a strong northwest structural trend with several northwest-trending fault blocks in the basement. The overlying sedimentary units are draped over this fault topography but are not apparently faulted at the level of the coal measures. No faults that would seriously affect the continuity of underground longwall mining operations have been identified by the exploration program. Table 1.3 records the geotechnical attributes of the various overlying units, the seam and the seam floor and identifies relevant issues associated with each unit.

Table 1.3 Geotechnical Attributes of the Mine Stratigraphy

Unit	Description	Comments
Napperby Formation	Comprises mudstones, siltstones, sandstones and sandstone/siltstone laminites. Some units very weak, particularly along bedding planes and laminae.	This unit is not significant operationally. However, the drifts and ventilation shaft would pass through the formation for the majority of their length. Excavation would be easy but some sections would require high density support and in these areas the depth of cut before supporting would be restricted.
Dolerite Sill	Basalt sill 40m to 60m above the coal seam which is very strong.	Operational impact expected to be slight due to the amount of interburden between it and the seam. May require blasting during construction of exhaust shafts.
Digby Formation	Weakly cemented conglomerate with high matrix to pebble ratio. Strength tests indicate moderate strength.	Operational impact is not expected to be as severe as other NSW conglomerates but the unit would behave massively, possibly more like a massive sandstone. Consequently, difficulty in achieving first cave and periodic weighting should be anticipated. Stress tests indicated it is highly stressed relative to strength which should help the unit to cave following mining.
Benelabri Formation	These sandstone, sandstone/siltstone layers are not always present. They increase in thickness towards the west, separating the coal from the conglomerate. Moderate strength.	As significant thickness of roof coal is to be carried, these layers are not of great importance in terms of roof behaviour. However, by increasing the separation between the working section and the base of the conglomerate at the face start positions in the west, they would positively influence the potential for windblasts.
Roof Coal	Generally, greater than 1m of clean coal in immediate roof.	The roof coal is expected to form a good roof with low stress such that roof support densities on development and during retreat would be towards the lower end of those commonly found in other coal regions.
Working Section	Not heavily cleated. Extent of jointing not known.	The actual rib support required can only be determined once the seam is accessed. At this stage, rib support is expected to be similar to that generally used within the industry.
Arkarula Formation/ Brigalow Formation	Tests indicate moderate strength floor with no slaking tendency.	Floor problems are not anticipated. This is a positive outcome as there are significantly few effective strategies for dealing with weak floors than there are for weak roofs.

1.5.4 Coal Resources, Reserves and Quality

The coal resource of the Narrabri Coal Mine is contained within the Hoskissons Coal Seam and the results of the exploration activity have confirmed seam characteristics within ML 1609 as follows:

- The Hoskissons Coal Seam is between 8m to 10m thick over the western half of ML 1609;

- In the eastern half of ML 1609, the seam is cut off at a depth of approximately 160m by a low angle unconformity between the coal seam and the overlying Digby Formation; and
- The coal seam strikes generally north-south, and dips gently to the west.

The Hoskissons Coal Seam comprises two plies, referred to as the Hoskissons Coal Seam Ply 1 (HC1) and Ply 2 (HC2). The lower part of the Hoskissons Coal Seam, the HC2 ply, contains low ash coal suitable for thermal applications and therefore is suitable for recovery by underground mining methods. The lower approximately 4m to 4.2m of HC2 is the targeted working section for longwall mining. A working section height of approximately 4.2m is the optimum limit for safe, productive continuous miner operations and is towards the upper end of single-pass longwall technology. The upper section of the seam, the HC1 ply, contains high ash stony coal and tuffaceous claystone bands that would remain in the roof where the seam thickness exceeds 4.2m.

Based on an average working section of 4.2m, it has been calculated that 230 million tonnes of coal occurs within the lower HC2 ply (ie. the in-situ coal of the Narrabri Coal Mine within ML 1609). An assessment of the recoverable coal resources of the mine site conducted by SRK Consulting established that 65.5% of the coal or approximately 150 million tonnes could be recovered by a longwall mining operation.

Table 1.4 provides a summary of the measured, indicated and inferred coal resources within ML 1609 drawn from the most recent Joint Ore Resources Code (JORC) assessment.

Table 1.5 lists various parameters contributing to the assessment of coal quality. Invariably, there is considerable similarity between the results for the measured, indicated and inferred resources.

Table 1.6 provides a summary of the current coal reserves within ML 1609 drawn from the assessment conducted by Minarco – Mineconsult during 2010. This reserve does not include areas of inferred coal resources in the western part of the lease.

Table 1.4 Coal Resources within ML 1609

	Seam	Coal Resources (mt)				Seam Thickness (m)
		Measured	Indicated	Inferred	TOTAL	
ML1609	HC2	119.8	79	40	238.8	4.04
	HC1	49.6	92	95	236.6	3.53
	Total	169.4	171	135	475.4	7.57

Source: Hanna Consulting Services 2009

Table 1.5 Coal Quality

Seam	Inherent Moisture % (ad)	Ash % (ad)	Volatile Matter % (ad)	Calorific Value Mj/kg (ad)	Total Sulphur % (ad)	Relative Density g/cc (ad)
HC2	4.8	11.3	27.5	28.16	0.34	1.43
HC1	4.8	30.1	23.4	24.71	0.33	1.61
Total	4.8	20.7	25.5	26.44	0.33	1.52

Source: Hanna Consulting Services 2009

Table 1.6 Coal Reserves within ML 1609

Seam	Coal Reserves		Marketable Reserves		TOTAL (Mt)
	Proved (Mt)	Probable (Mt)	Proved (Mt)	Probable (Mt)	
HSK	66.0	67.4	66.0	67.4	133.4

1.5.5 Constraints Affecting Mine Design

1.5.5.1 Geological Considerations

The exploration results identified that the coal resource includes large areas which appear to be free of major structural disturbance and accordingly these areas would support a high production longwall mining operation. The longwall panels of the underground have been defined to correspond with the limit of where the coal seam thickness is at least 4m or greater.

The geological data compiled enabled the eastern-most and shallowest area where the Hoskissons Coal Seam is present to be defined. This area then contributed to defining the locations of the box cut and portals for the transport drift and conveyor drift (ie based on a 1:8 (V:H) gradient and the need to locate the base of the drifts (the Pit Bottom Area) centrally within the resource area.

1.5.5.2 Geotechnical Considerations

A range of geotechnical studies have been undertaken to assist the design of the longwall mining operations. These studies have provided important information used in the planning of both the Stage 1 continuous miner operation (initially) and more recently the proposed longwall mining operation.

The critical geotechnical parameter influencing the design and development of the longwall mining operations, as opposed to the Stage 1 continuous miner operations, was the predicted subsidence and possible impacts of this subsidence both underground and at surface. The complete report of Ditton Geotechnical Services Pty Ltd (DGS 2009) is provided as *Part 1 of the Specialist Consultant Studies Compendium* that accompanies the Stage 2 EA.

In most cases immediately after extraction in a longwall panel, the immediate mine roof usually collapses into the void left in the seam behind the roof supports. The overlying strata or overburden then sags down onto the collapsed material, resulting in settlement of the surface. The maximum subsidence occurs in the middle of the extracted panel and is dependent on a range of factors.

Modelling completed by DGS (2009) has predicted that subsidence of up to 2.44m will be experienced, resulting in:

- Surface cracking of between 20mm and 190mm;
- Altered surface gradients of up to 6% (3°) along creeks;
- Potential ponding depths of between 0.5m and 1.5m within the watercourses in the flatter areas of the site; and
- Possible impacts on subsurface aquifers within 110m to 180m above the proposed panels as a result of direct hydraulic connection to the workings.

Based on the above assessment of potential subsidence, the impacts will be limited to the mine site, the majority of which is owned by NCOPL. The impacts of up to 2.44m of subsidence have been considered by each of the specialist consultants commissioned as part of the Stage 2 EA, with the recommended amelioration and/or mitigation measures to be implemented by NCOPL. Any impact on ground or surface water availability has also been carefully evaluated with appropriate licences and contingency strategies developed to address an impacts should they occur.

Subsidence will be monitored and managed as per an Extraction Plan.

1.5.5.3 Gas Management

Coal emissions include CO₂ and CH₄ which need to be reduced to sufficiently low concentrations to ensure safe working conditions underground. These gases will be initially pre-drained from the coal seam prior to longwall mining, removed from the underground atmosphere by ventilation during mining and drained from the collapsed goaf within the completed longwall panels. These gases are all greenhouse gases and will be dispersed to the atmosphere either from vacuum pumps installed on the drainage units or from the ventilation fans.

Several options for managing the gas and ventilated air have been investigated, including:

- Gas flaring;
- Sale of gas to Eastern Star Gas, a company which operates a coal seam gas extraction operation within a borefield to the northwest of the mine site; and
- Power generation and destruction of CH₄ by the installation and operation of one or more Ventilation Air Methane (VAM) units.

The low CH₄ concentration of the gas (10:90) makes these options unviable at this stage. While the potential to utilise or destroy CH₄ will continue to be investigated, direct dispersion to the atmosphere remains the most practical option at this time. As part of the Project Approval requirements, NCOPL will be preparing a Greenhouse Gas Minimisation Plan which will further detail current strategies and future options for gas management.

1.5.5.4 Spontaneous Combustion Potential

A spontaneous combustion assessment completed for the Hoskissons Coal Seam by Dr Basil Beamish, whilst not providing quantitative data on the heating characteristics of the coal, provided an analysis of the spontaneous combustion potential of the coal to be mined. Standard laboratory testing of core samples by Uniquet indicated that the Hoskissons Coal Seam has a high propensity to spontaneously combust.

- An R70 rate of 4°C to 9°C per hour;
- A cross-over temperature range of 120°C to 140°C;
- A self-heating temperature of 60°C to 80°C; and
- Low rank/high volatile coal.

Based on the properties described above, and the mining method to be implemented, which would leave up to 5m of inter-bedded low quality broken coal in the goaf, spontaneous combustion has been identified as a manageable at the Narrabri Coal Mine.

1.5.5.5 Economic Considerations

Although the mine site is 382km from Port Newcastle and the cost of rail freight will be significantly higher than that for mining companies in the Hunter Valley, a number of economic considerations offset this disadvantage.

The low ash, low sulphur quality of in-situ coal in the 4.2m thick working section will minimise the proportion of coal requiring washing to produce thermal coal products for sale into the export market. The high quality ensures that there will be a ready market for the coal.

Additionally, NCOPL has an existing rail allocation for the North Western Branch Railway Line and Main Northern Railway Line, ensuring that the coal produced is able to be transported to Port Newcastle for export.

1.5.5.6 Environmental Considerations

The main environmental issues considered during the design of the longwall operation include:

- **Vegetated Land / Agricultural Land** – the longwall operation will require the establishment of a Reject Emplacement Area to the immediate west of the Pit Top Area. While the exact area covered by the Reject Emplacement Area will be dependent on the coal quality as well as the amount of coal to be washed, NCOPL has allocated an area of 25ha based on the assumption that the quantity of waste represents 5% of the ROM coal feed. Notably, initial waste stream calculations have indicated that the area allocated may be at least double the required size.

The impact of the Reject Emplacement Area on current and future land capability and land use is addressed in the Soil and Land Capability Assessment undertaken by Geoff Cunningham Natural Resource Consultants Pty Ltd (GCNRC 2009b). The completed report is provided as Part 9b of the *Specialist Consultant Studies Compendium* for the Stage 2 EA.

- **Ecological Considerations** – In order to install ventilation and gas drainage system, access roads, power lines and drill sites along the alignment above the West Mains and goaf drainage access roads vegetation disturbance will be required. Underground communication (PED) lines will be installed along the same corridor. Where possible, these surface activities will be aligned to minimise disturbance to remnant vegetation.

Subsidence also has the potential to impact on the flora and fauna of the mine site, primarily as a result of surface cracking and/or changes to local drainage. An ecological assessment completed by Ecotone (2009), which is provided as Part 4 of the *Specialist Consultant Studies Compendium* for the Stage 2 EA, has determined that the proposed surface disturbance and

predicted subsidence is unlikely to have a detrimental impact on local ecology.

- **Aboriginal Heritage** – the surface disturbance associated with the installation of mine ventilation and gas drainage systems as well as mine subsidence have the potential to impact on sites or artefacts of Aboriginal heritage significance. Management of Aboriginal heritage will be undertaken as per the site's Aboriginal Cultural Heritage Management Plan.
- **Water Resources** – the groundwater that will be encountered by underground workings is saline with an average total dissolved solids concentration of between 6,000mg/L and 8,000mg/L. Due to the saline nature of the groundwater, it will require storage and segregation from natural surface water drainage. The water will be treated by ultra-filtration and reverse osmosis and then re-used underground for dust suppression and equipment cooling purposes. Any surplus to operational requirements will be discharged from the mine site to the Namoi River via a pipeline to be constructed by NCOPL.

A by-product of the water treatment will be the generation of significant volumes of brine (approximately 20ML generated for every 100ML of raw water treated). The current proposal for managing this brine is to store it at surface for the life of the mine before progressively pumping it back into the goaf and retained gate roads of the underground workings. Water management is further discussed in Section 3.8.

- **Noise** – Monitoring of noise levels during the Stage 1 construction period identified that inversion conditions much stronger than originally anticipated occur during winter mornings near the mine site and these inversions have resulted in elevated noise levels being received at some residences surrounding the Pit Top Area.

These local conditions are now better understood and have been incorporated into a revised noise modelling study for the longwall operation conducted by Spectrum Acoustics Pty Ltd (Spectrum 2009). Noise management measures are discussed in Section 7.10.

1.6 Land Ownership

NCOPL has acquired fourteen rural properties covering an area of approximately 4,700ha within or adjacent to ML 1609. These acquired properties are specifically centred on and around the Pit Top Area within ML 1609. The area of each property (along with the area included within the Pit Top Area of ML 1609) is as follows:

- “Claremont” 391ha (224ha)
- “Turrabaa” 119ha (110ha)
- “Willarah” 224ha
- “Matoppo” 397ha (109ha)
- “Omeo” 227ha
- “Westhaven” 366ha
- “Rosedale” 704ha

- “Bungaree” subdivision 106ha
- “Greylands” subdivision 201ha
- “Mayfield” 840ha
- “Barton Hedge” 127ha
- Desanti Property 353ha
- “Kurrajong” 406ha
- Unnamed Property 222ha

Plan 1 presents the ownership details for land on and surrounding the mine site and identifies nearby residences.

The central-western and south-western boundaries of ML 1609 are within the Jacks Creek and Pilliga East State Forests respectively. Native title considerations have been completed for these limited areas that lie within the ML.

1.7 Consultation

NCOPL and/or its representatives have undertaken consultation with the following government agencies and other stakeholders during preparation of the Stage 2 EA, this MOP and associated environmental management/monitoring plans (where required):

- Department of Planning;
- Industry and Investment NSW – Mineral Resources;
- Department of Environment, Climate Change and Water;
- NSW Office of Water;
- NSW Roads and Traffic Authority;
- Narrabri Shire Council;
- Australian Rail Track Corporation;
- Surrounding landholders;
- Narrabri Coal Mine Community Consultative Committee (CCC); and
- The local Aboriginal community.

1.8 Context of Operations

The operating company for the Narrabri Coal Mine is Narrabri Coal Operations Pty Ltd (NCOPL). NCOPL is a joint venture between Narrabri Coal Pty Ltd (70%), Upper Horn Investments Limited (7.5%), Electric Power Development Co. Ltd (7.5%), Daewoo International Corporation and Korea Resources Corporation (7.5%) and EDF Trading (7.5%). Narrabri Coal Pty Ltd (NCPL) is a 100% subsidiary company of Whitehaven Coal Limited (WCL), a publicly listed Company with several mining interests in the Gunnedah-Narrabri region of NSW.

2 PRE-MOP ENVIRONMENT

2.1 Preamble

The following sub-sections describe the significant features of the existing environment within ML 1609 as at the commencement of this MOP, including drainage, groundwater resources and utilisation, flora, fauna, archaeology, air quality and the acoustical environment.

Plans 2A and 2B present the pre-MOP environment, ie. the status of the mine site at the commencement of this MOP.

2.2 Topography

2.2.1 Local Topography

The mine site lies within the Namoi River Valley in an area representative of the transition from the open plains to the west in the Walgett and Coonamble areas and the more elevated and dissected country to the northeast (the Nandewar Ranges) and further south associated with the Warrumbungle and Liverpool Ranges (both of which are part of the Great Dividing Range).

The local topography is generally flat to undulating, with elevations typically up to 400m AHD in the west in Jacks Creek State Forest and decreasing to approximately 230m AHD in the east toward the Namoi River.

2.2.2 Mine Site Topography

The topography of the mine site varies from areas that are comparatively flat in the east with low, gentle and undulating topography towards the west. Elevations range from 370m AHD in the west to 240m AHD in the east. Slopes across the mine site average 3° with two low ridges orientated parallel and northeast to southwest across the mine site. The maximum slopes of approximately 18° occur in the southwest of the mine site whilst the minimum slopes of <1° are common in the northeast.

2.2.3 Pit Top Area Topography

The natural topography displays a general grade from west to east (285m AHD to 245m AHD) with slopes ranging from approximately 4° in the west to <1° in the east in the vicinity of two tributaries of Kurrajong Creek.

Since commencement of site establishment activities associated with the approved Narrabri Coal Mine (Stage 1), the topography of the Pit Top Area of the mine site has been modified, most noticeably by:

- The excavation of the box cut for entry to the underground mine;
- The construction of a 5m bund wall around the southern and western perimeter of the surface facilities;
- Cut and fill earthworks associated with the construction of the Narrabri Coal Mine rail loop and various hardstand surfaces; and

- Various soil stockpiles.

2.3 Water Resources

2.3.1 Drainage and Surface Water Quality

The mine site is located in the Namoi River catchment and within the catchments of its tributaries, Kurrajong Creek, Pine Creek and Tulla Mullen Creek. The Namoi River flows in a north-westerly direction approximately 3km to 5km to the east of the eastern boundary of ML 1609. The local catchment boundaries and drainage paths of ML 1609 are shown on Plan 2A.

Most of ML 1609 is located within the catchments of Kurrajong and Pine Creeks. Pine Creek and its tributaries traverse the northern part of ML 1609, before entering the Namoi River, while Kurrajong Creek and its tributaries originate in the south-western corner of ML 1609 and traverse the southern part of the mine site before draining to Tulla Mullen Creek and the Namoi River. Pine Creek and Kurrajong Creek are ephemeral, generally flowing for short periods after significant rainfall events or protracted wet periods. Base-flows in these creeks are insignificant.

The remaining south-eastern portion of ML 1609 drains into Tulla Mullen Creek via an unnamed tributary. Tulla Mullen Creek is also ephemeral and is fed by Kurrajong Creek and a number of smaller tributaries.

Sections of the local creeks are quite 'active' and are susceptible to high levels of erosion. The drainage paths of the smaller tributaries are poorly defined along some reaches through the mine site.

Water quality data has been obtained from locations upstream and downstream of the Pit Top Area on the tributaries of Kurrajong Creek following four storm events in July 2006, September 2008, December 2008 and February 2009. The results suggest that local surface water is of generally neutral pH, fresh with a relatively high suspended sediment level reflecting the ephemeral nature of these drainage lines.

2.3.2 Flooding

WRM (2007) completed a flood study of Kurrajong Creek Tributary 1 to the north of the Pit Top Area for the approved Stage 1 Narrabri Coal Mine. The infrastructure developed for Stage 1 was generally outside the 100 year Average Recurrence Interval (ARI) flood extent for Kurrajong Creek Tributary 1 except for a small section of the rail line adjacent to the Kamilaroi Highway. The impact of the constriction caused by the rail loop was not significant (see Plan 2A).

The additional Pit Top Area infrastructure required for the longwall operation, including the Brine Storage Area is also outside the modelled 100 year ARI flood extent. The mine site is not susceptible to flooding from the Namoi River as it is located some 20m in elevation above the Namoi River floodplain.

On this basis, the potential impacts of flooding have not been considered further.

2.3.3 Groundwater

Within and surrounding ML 1609, as part of the Mullaley Sub-basin of the Gunnedah Basin, two unconformably overlain groundwater management areas (GWMA's) have been identified by former Department of Water and Energy (DWE).

- Great Artesian Basin GWMA (601) which is defined by the easterly extent of the Surat Basin sequence. The Surat Basin is a large intracratonic basin covering approximately 270,000km² within the southern third of the basin occupying a large part of northern New South Wales. GWMA (601) can be found to occur in the western part of ML 1609; and
- Gunnedah GWMA (604) which is comprised of the Permo-Triassic Gunnedah Basin sequence and is found in the eastern part of ML 1609.

A third GWMA, the Namoi Alluvium GWMA (004), is not found within ML 1609 but occurs with thicknesses of up to 120m to the east and northeast.

Aquaterra (2009) confirmed that two groundwater flow systems occur below the mine site, namely a shallow aquifer system and a deep aquifer system.

The shallow groundwater system occurs in the upper part of the Permo-Triassic sequence where it is weathered and locally fractured. This shallow aquifer effectively occurs within a range of geological units, due to the westerly dip of the strata. Groundwater in this aquifer is localised and influenced primarily by topography and local surface drainage (ie. flow is north to northeast towards the Namoi River).

The deeper aquifer system is influenced by regional features such as basin structure and regional recharge and discharge processes, and groundwater flow occurs primarily in fractures. Visual inspection of drill core suggests that the stratigraphic units are heterogeneous with aquifer properties varying depending on the nature and continuity of fractures and joints. The limited number of formation-specific monitoring points over the mine site makes it difficult to accurately map groundwater flow patterns. An analysis of temperature variations within the monitored bores indicates an increase in temperature at depths which correspond to the Hoskissons Coal Seam. This has been interpreted to correspond to increased groundwater flow within the coal seam.

Groundwater chemistry data suggests that groundwater at ML 1609 is generally saline in the 6,000mg/L to 11,000mg/L TDS range over most of ML 1609. Groundwater pH is in the neutral to slightly alkaline range of 6.7 to 8.2. Most sampled groundwater has exceeded the ANZECC (2000) dissolved metal concentration guideline values for Cu, Pb, Ni and Zn while a number of samples also exceeded the ANZECC (2000) guidelines for Mn.

2.3.4 Water Use and Availability

Groundwater use within the boundaries of the mine site is restricted to a number of low yielding groundwater bores used for stock and domestic purposes. Surrounding the mine site (ie. within 5km of the mine site) groundwater is also used predominantly for domestic or agricultural purposes, with the extent of use invariably dependent on the quality of water and/or yield available from the bore. Groundwater use, based on consideration of the former DWE groundwater bore database and general liaison with local landholders, can be summarised as follows:

- Numerous bores are registered in the Quaternary alluvium of the Namoi River Valley (Lower and Upper Namoi Alluvial Groundwater Source). These bores are typically shallow bores screened within the Quaternary alluvium and the pumped water used for domestic, stock and irrigation purposes. Some of the deeper irrigation bores are up to 80m deep and have yields of up to 90L/s.
- To the south, north and west of the mine site, some groundwater bores screen the Pilliga Sandstone and possibly other deeper Jurassic sediments. The groundwater of these bores is generally non-saline with bore yields of between 0.1L/s and 0.8L/s. The standing water levels vary between 50m to 80m below surface level close to the mine site to typically between 30m to 40m depth further to the northeast. Other groundwater bores on or surrounding the mine site with better quality water screen the Garrawilla Volcanics.
- A limited number of groundwater bores within 5km of the mine site are identified as screening the deeper formations of the Gunnedah Basin Groundwater Source. This water is generally more saline than water drawn from the geological units of the intake beds of the Great Artesian Basin, with yields less than 2L/s.

Much of the surface water flowing across the mine site and surrounding landholdings is directed by contour banks, to and held in agricultural dams of various sizes with overflow and general surface run-off reporting ultimately to the tributaries of Kurrajong Creek and Pine Creek. Prior to commencement of construction activities for the mine, there were a total of 47 farm dams representing a combined storage estimated at 115.7ML within ML 1609. The individual storage capacities of these dams varied from approximately 0.5 to 22.5ML.

2.4 Land Capability and Agricultural Land Suitability

The 1:100,000 scale Land Capability map of the Baan Baa map sheet area prepared by the former Soil Conservation Service of NSW indicates that land within the mine site is mapped mainly as Class III land with a small area of Class IV and the remaining areas as Class VI and Class VIII near Jacks Creek State Forest.

Field investigations undertaken for the Stage 2 EA indicated that much of the area that has been cleared and farmed in the past is Class III land, land along the major drainage lines is Class IV and the remaining land of rocky ridges and sandy soils is Class VII, as described in Table 2.1 and shown in Plan 2B.

Table 2.1 Land Capability Class Descriptions

Land Capability Class	Description
Class III	Sloping land suitable for cropping on a rotational basis. Structural soil conservation works such as graded banks, waterways and diversion banks, together with soil conservation practices such as conservation tillage and adequate crop rotations are required.
Class IV	Land not capable of being regularly cultivated but suitable for grazing with occasional cultivation and requiring soil conservation practices such as pasture improvement, application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture.

Class VII	Land best protected by green timber. It generally comprises areas of steep slopes, shallow soils and/or rock outcrop. Adequate ground protection must be maintained by limiting grazing and minimising damage by fire.
Source: Environmental Assessment for the Narrabri Coal Mine Stage 2 Longwall Project	

Through reference to the classification prepared by the former Department of Primary Industries – Agriculture (DPI – Agriculture), the lands of the mine site can be classified as predominately Class 3 land with minor areas of Classes 2 and 4. Following the field survey of the mine site, GCNRC (2009a) generally confirmed the DPI – Agriculture assessment of the agricultural land suitability is generally correct, although the Class 4 lands will more appropriately be generally classed as Class 5. Agricultural land suitability class descriptions are described in the Stage 2 EA.

2.5 Flora and Fauna

The ecological assessment for the Stage 2 EA was undertaken by Ecotone Ecological Consultants Pty Ltd (Ecotone 2009), with the full assessment presented as Volume 1, Part 4 of the Stage 2 EA Specialist Consultant Studies Compendium.

2.5.1 Flora

Six broad natural, or predominately native vegetation community types, and one artificial (cleared/semi-cleared or cultivated) community occur within the mine site and water pipeline route. These are:

- Community 1 – Brown Bloodwood / Pilliga Grey Box / Red Ironbark Woodland (Sandstone Slopes Woodland);
- Community 2 – Inland Grey Box / Bimble Box / Blakely's Red Gum Woodland (Lower Flats and Floodplain Woodland);
- Community 3 – River She Oak / Belah / Inland Grey Box Forest (Riparian Forest);
- Community 4 – White Cypress Forest;
- Community 5 – River Red Gum Riparian Open Forest / Woodland;
- Community 6 – Weeping Myall Woodland; and
- Community 7 – Cleared Open Grassland / Cropland / Weedy areas / Cultivated Gardens.

One threatened species (*Bertya opposens*) has been identified whilst Community 2 qualifies as the *Threatened Species Conservation Act 1995* (TSC Act) listed Endangered Ecological Community (EEC) *Inland Grey Box Woodland in the Riverina, NSW Western Slopes, Cobar Penepplain, Nandewar and Brigalow Belt South Bioregions*. Ecotone (2009) reported that a second EEC listed by the TSC Act, *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions*, occurs in marginal form only in scattered parts of Community 1 over the western slopes of the mine site. A third EEC listed by the TSC Act, *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions* was also identified by Ecotone, both as a narrow patch of weeping

myalls (*Acacia pendula*) along both sides of a dirt road on a more elevated part of the central plains area on the mine site and at isolated locations within the road reserve of the water pipeline route.

More generally, Community 1 is contiguous with the large area of natural vegetation in Jacks Creek State Forest beyond the western boundary of the mine site. This community is of high quality and represents a large remnant of practically undisturbed, weed free natural vegetation. It has high species diversity, and is a sharply contrasting vegetation type to the community of the low-lying flats and floodplains. The natural vegetation of the low-lying flats and floodplains of Communities 2, 3 and 4 is much more disturbed by past and current clearing and grazing, however, retains a high native species diversity, particularly in the ground layer. These communities are disturbed remnants of the once extensive floodplain communities that would have occurred widely on the flat areas that are now largely cleared for grazing and agriculture.

All the remnant natural vegetation within the site has ecological value in that it facilitates movement of fauna and exchange of genetic material between native flora species locally, from one part of the mine site to another via remnant connects and riparian corridors (including scattered trees in some areas). Although loss or modification of this vegetation may not isolate any populations of flora or fauna, it could have local impacts on natural populations and compromise movements.

Weeds have been recorded almost exclusively in the cleared areas of Communities 2 and 5 over the eastern two thirds of the mine site. Six of these species are declared as noxious weeds in the Narrabri Shire Council control area, pursuant to the *Noxious Weeds Act 1993*, namely:

- Bathurst Burr (*Xanthium spinosum*) – Class 4;
- Creeping Oxalis (*Oxalis corniculata*) – Class 5;
- Mother of Millions (*Bryophyllum delagoense*) – Class 4;
- Prickly Pear (*Opuntia stricta*) – Class 4; and
- Spiny Burrgrass (*Cenchrus longispinus*) – Class 4.

Class 4 and 5 weeds are described as follows:

- Class 4 - Locally Controlled Weeds: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority; and
- Class 5 – Restricted Plants: The requirements of the Noxious Weeds Act 1993 for a notifiable weed must be complied with.

2.5.2 Fauna

A total of 27 threatened terrestrial fauna species have previously been recorded within the locality, comprising 19 bird, seven mammal and one reptile species.

During field surveys undertaken by Ecotone (2009), 156 fauna species were identified comprising 93 birds, 37 mammals, 16 reptiles and 10 frogs. Nine introduced species (two birds and seven mammals) were recorded.

The drainage lines of the mine site (Kurrajong Creek and Pine Creek and their tributaries) were inspected by Ecotone (2009) who reported that these drainage features comprise

little more than dry drainage lines lacking pools of semi-permanent or permanent water. No aquatic vegetation was recorded and no fish habitat was identified or considered likely to occur.

Fourteen threatened fauna species listed on the TSC Act were recorded during field surveys across the mine site, as listed below:

- Pale-headed snake;
- Glossy-black cockatoo;
- Turquoise parrot;
- Superb parrot;
- Speckled warbler;
- Grey-crowned babbler;
- Eastern pygmy possum;
- Diamond firetail;
- Koala;
- Delicate mouse;
- Black-striped wallaby;
- Eastern long-eared bat;
- Little pied bat; and
- Yellow-bellied sheathtail bat.

Of the fourteen threatened fauna species, the Delicate Mouse and Black Striped Wallaby are the only endangered species (TSC Act) with the remaining 12 species listed as vulnerable on the TSC Act.

The Varied sittella, for which a preliminary determination under the TSC Act for vulnerable status has been completed, was also identified on the mine site. An additional two threatened species, the squirrel glider and spotted-tailed quoll, are likely to occur but were not recorded during field surveys.

The following six threatened or migratory species listed within the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were recorded during field surveys (* indicates species also listed under the TSC Act):

- Superb parrot*;
- Delicate mouse*;
- White-throated needletail;
- Eastern long-eared bat*;
- Rainbow bee-eater; and
- Yellow-bellied sheathtail-bat*.

2.6 Aboriginal Heritage

The Aboriginal heritage assessment for the Stage 2 EA was undertaken by Archaeological Surveys & Reports Pty Ltd (AS&R). The full assessment is presented in Volume 2, Part 5 of the *Specialist Consultant Studies Compendium* of the Stage 2 EA.

In accordance with the agreed survey strategy, a field survey of the area above longwall panels 1 to 7 was undertaken by archaeologist John Appleton (AS&R 2009) and representatives of Narrabri Local Aboriginal Land Council (NLALC) and Narrabri Gomerioi Traditional Owner Group (Gomerioi) in March and April 2009. A field reconnaissance survey of the area above longwall panels 8 to 26 and pedestrian survey of the Brine Storage Area and water pipeline corridor were undertaken in July 2009.

During the Panels 1 to 7 survey, 43 sites were recorded with all but one recorded within 50m of a creek or drainage line. 69 sites were recorded over Panels 8 to 26, with nine sites recorded in the Brine Storage Area and no sites within the Water Pipeline Route. It is proposed to undertake more detailed Archaeological survey over panels 8 to 26 as mining progresses to ensure appropriate strategies are in place to protect cultural heritage. These works will be conducted in advance of development of those panels and subsequently reported to the relevant agencies.

3 PROPOSED MINING ACTIVITIES

The following sub-sections describe the activities to be undertaken within ML 1609 during the term of this MOP. Plan 3 presents the land preparation (ie. surface disturbance associated with mine site development), while Plans 4A and 4B present the underground mining and surface activities respectively, to be undertaken over the 7 year term of this MOP.

3.1 Exploration

Exploration drilling will be undertaken as required within ML 1609 for coal quality, geotechnical and/or Hydrogeological evaluation purposes.

As far as practicable, access to exploration sites will utilise existing tracks to minimise disturbance. All exploration will be undertaken in accordance with the relevant conditions of EL 6243 and ML 1609.

Further details on exploration completed and proposed over the preceding and following 12 month periods will be recorded in each AEMR for the mine. NCOPL will also provide six monthly and annual exploration reports to I&I NSW for exploration and expenditure within the EL area.

Exploration drilling will be undertaken intermittently over the next seven years to identify geological structures, coal quality changes and coal seam gas contents. Drilling is expected to be conducted in front of longwall panel development and will comprise HQ core and 125mm open hole drilling. 2 and 3 dimensional seismic surveys may be necessary to further define geological structure over the next 5 years.

3.2 Land Preparation

3.2.1 Introduction

The establishment of surface facilities associated with the Stage 2 longwall operation will involve the following tasks:

- Establishment of areas to be disturbed;
- Vegetation clearing, soil stripping and stockpiling;
- Construction of access roads to various surface facilities;
- Construction of ventilation shafts for ventilation of the underground mine workings;
- Surface to In-Seam (SIS) activities to establish gas pre-drainage bore holes;
- Drilling of goaf gas drainage bore holes and installation of goaf gas vacuum pumps;
- Installation of power lines to supply ventilation fans;
- Construction of a longwall unit assembly area (longwall pad);
- Construction of a Coal Handling and Preparation Plant (CHPP);
- An extension of the ROM coal pad;

- Construction of the Reject Emplacement Area;
- Construction of brine storage ponds within the Brine Storage Area;
- Installation of the water pipelines between the mine site and “Broadwater” property on the Namoi River; and
- Any additional infrastructure (e.g. pipelines, surface water control features and storages, water conditioning plant, soil stockpiles, amenity bund).

Plan 3 presents the extent of land preparation for the term of this MOP. Table 3.1 lists the indicative areas of disturbance associated with the individual surface components of the proposed longwall mining operations.

Table 3.1 Indicative Areas of Disturbance for Individual Surface Facilities

Component	Area (ha)
West Mains ventilation fan site	5.0
Rear of Panel Ventilation fan sites	0.25
SIS pre-drainage site (Development and Production)	3.5
Goaf gas drainage site	0.25
Internal power lines	30m wide corridor
Internal access roads and service corridors	10m wide corridor
Longwall assembly site	2.5
ROM coal storage extension	2.2
Reject Emplacement Area	25*
Brine Storage Area	160*

* Refers to the maximum area of disturbance

3.2.2 Vegetation Clearing

While the location of some of the required surface facilities within the western section of the mine site will occur within remnant woodland vegetation, NCOPL will ensure as far as practical, the requirement to clear mature trees and larger areas of native vegetation will be minimised. It is still likely, however, that some larger trees and areas of native shrub and groundcover will have to be cleared to provide for the access, manoeuvring and safe operations of equipment (eg. drill rigs).

The area to be cleared will be clearly defined (using survey pegs and/or flagging tape) and all personnel involved in the clearing activities will be made aware of the boundaries of clearing. Prior to any surface disturbance, upslope temporary water diversion banks and/or downslope silt fencing will be erected across all identified drainage lines (where necessary). When appropriate, and where weeds are sufficiently dense in areas to be cleared, weed spraying will be conducted prior to clearing and soil stripping.

The trees to be felled will be visually inspected for roosting or nesting fauna prior to clearing, with any fauna identified appropriately relocated. Trees will be stockpiled adjacent to the disturbed area for future respreading over the area as part of site rehabilitation.

The remaining understorey and groundcover will either be stripped with the topsoil to ensure maximum retention of nutrients and to facilitate the rapid vegetation of soil stockpiles to minimise the opportunity for erosion, or pushed into stockpiles adjacent to the disturbance for future respreading over the area as part of site rehabilitation.

3.2.3 Soil Stripping and Management

3.2.3.1 Introduction

The soil materials within the approximate area of disturbance for the various surface facilities required by the longwall operation were described and assessed by Geoff Cunningham Natural Resource Consultants (GCNRC 2009a and GCNRC 2009b), as provided in Parts 9a and 9b of the *Specialist Consultant Studies Compendium* for the Stage 2 EA. The assessment identified:

- The suitability of the soils present for stripping and long-term stockpiling; and
- The requirement for specific stripping and stockpiling methods and/or erosion control measures.

The assessment was based on field and laboratory examination of key physical and chemical attributes.

Soil stripping will be required for all drilling sites and ventilation shaft construction areas, as well as the Reject Emplacement Area, Brine Storage Area and ROM coal storage area extension. The remaining facilities (ie. access tracks and power lines) will be constructed or installed above the soil which would remain in-situ.

3.2.3.2 Soil Categories and Stripping

A total of 16 landform units were identified on the mine site by GCNRC (2009a and 2009b) within the four geological formations (Napperby Formation, Garrawilla Volcanics, Pilliga Sandstone and Purlawaugh Formation). Selective soil stripping will also be undertaken when installing the pipeline between the mine site and the Namoi River.

An analysis of the chemical and physical properties of the soils of the 16 landform units completed by GCNRC (2009a) has determined that with appropriate controls implemented, all of the soils could be stripped and stockpiled prior to surface disturbing activities and replaced following completion of these activities. Soil stripping associated with the longwall operations will be generally restricted to topsoil from drill sites, ventilation shaft areas and access roads. The topsoil will be stripped no deeper than the depths identified in the Stage 2 EA.

GCNRC (2009a) does note, however, that the physical or chemical characteristics of some of the soils may make them susceptible to impacts as a result of subsidence (see Section 3.4.6).

Areas of disturbance requiring soil stripping will be clearly defined following vegetation clearing (using marker pegs/posts if necessary). Soil will be stripped and stockpiled as outlined in Section 3.2.3.3. Where possible, no soil will be removed in wet conditions to avoid breakdown in soil structure.

3.2.3.3 Soil Stockpiling Methods

All soils within the areas to be disturbed will be stockpiled in wind rows immediately adjacent to the area of disturbance. The stockpiles will be left with a 'rough' surface to assist in runoff control, seed retention and germination and will be seeded using a pasture cover crop to reduce erosion potential and assist in the maintenance of the

biological viability of the soil resource. This stabilisation will be undertaken as soon as practicable after the construction of the stockpile to minimise erosion.

Table 3.2 lists the actual/indicative quantities of topsoil and subsoil stripped and respread within each of the components. The difference in soil stripped and soil respread volumes indicates the amount of soil stockpiled.

Table 3.2 Actual/Indicative Quantities of Topsoil and Subsoil Stripping

Component	Area (ha)	Volume (m3)			
		Topsoil Stripped	Subsoil Stripped	Topsoil Respread	Subsoil Respread
Box Cut and Drift Portals	4.8	7,140	11,905	7,760	-
Box Cut Perimeter Bund	2.3	3,495	5,825	6,690	-
Perimeter Amenity Bund	15.5	23,302	38,835	17,578	29,297
Hardstand Surfaces (including stockpile and site facilities areas)	13.3	20,036	30,077	989	763
Internal Service Roads	3.8	5,707	9,511	3,805	-
Site access road, soil stockpiles and carparks	4.8	7,205	12,009	2,364	-
Rail Loop	8.9	13,324	22,206	4,402	-
Evaporation / Storage Ponds	36.0	53,978	89,962	16,292	4,994
Ventilation shafts, gas pre-drainage and associated infrastructure	16.4	24,600	21,000	19,800	9100
Gas & Goaf Drainage	168	224,000	-	162,400	-
ROM Pad extension & Longwall Pad	7.4	11,100	18,500	750	1250
Brine Ponds & Waste Emplacement	60	90,000	150,000	7500	12,500
Total	341.2	476,682	409,830	250,330	122,904

* Note – greyed cells indicated works completed to date

Topsoil and subsoil will be stockpiled separately to enable their easy recognition and retrieval once rehabilitation is underway. The locations of all long-term soil stockpiles will be surveyed and documented on Pit Top Area “as constructed” plans. An inventory of soil resources, similar to that shown in Table 3.2, will also be maintained.

The following stockpile management measures will be adhered to for the life of the mine:

1. Topsoil stockpiles are to be created no higher than 2m and with slopes no greater than 1:2 (V:H) to minimise erosion.
2. Subsoil stockpiles are to be created no higher than 3m with slopes no greater than 1:2 (V:H) to minimise erosion.
3. Sedimentation controls including catchment banks, silt-stop fencing or straw bales will be placed immediately down slope of any soil stockpiles and will be maintained until such time as a stable vegetation cover over the stockpile is achieved.
4. Soil stockpiles will be left with a roughened surface and those stockpiles to be retained for more than three months that do not have a naturally established vegetation cover will be seeded with a selection of pasture species including fast-growing, non-persistent cover species like Triticale,

Ryecorn or Millet and perennial species such as Phalaris, Coxsfoot, Perennial Rye and Sub Clover.

5. In the event that unacceptable weed generation is observed on soil stockpile areas, a weed eradication program will be implemented.
6. Following stockpile construction, the operation of machinery on the topsoil and subsoil stockpiles will be avoided in order to prevent compaction and maintain soil aggregation.

3.3 Construction

3.3.1 Introduction

Construction activities planned during this MOP are presented in Plan 4B (see Plan 2B for infrastructure present at the commencement of this MOP) and include the following:

- Access roads and service corridors;
- Ventilation shafts;
- Surface to In-Seam pre-drainage drilling sites;
- Goaf gas drainage drilling sites;
- Power line installation;
- Longwall assembly site;
- CHPP;
- ROM coal pad extension;
- Reject Emplacement Area;
- Brine Storage Ponds;
- Water pipeline between the mine site and Namoi River; and
- Subsidence monitoring lines;

3.3.2 Construction of Access Roads and Service Corridors

A number of access tracks across the mine site will be aligned along pre-existing access tracks. However, in order to access the pre-drainage and goaf gas drainage sites along the length of each longwall panel, an access road and service corridor will be constructed along the tailgate of each panel, roughly 30m to the west of each retained chain pillar.

The alignment of each access track and services corridor will be defined based on the preferred surface location but with consideration for environmental value(s) of the preferred location.

3.3.3 Ventilation Shafts

Shafts of up to 6m in diameter will be constructed with the preferred construction technique being “blind bores” (ie. bores constructed from the surface into the underground workings to depths of between 170m and 320m below surface). The technique involves the drilling of the shaft to the coal seam prior to the development of

the roadways in the coal with these roadways connected to the base of the shaft after their final completion. It may be necessary to initiate small blasts within the shaft, particularly when the harder volcanic units are encountered. Such blasts are routine for shaft construction and cause few effects because of their size and depth below the surface. In any event, all blasts will satisfy DECCW blasting criteria, as detailed in Section 7.9.

The construction area for each ventilation shaft will be approximately 5ha and incorporate the following components:

- Drill rig foundation and shaft drilling zone;
- General equipment laydown area;
- Casing laydown area;
- Stores and container area;
- Parking area;
- Generator, compressor and fuel storage area;
- Spoils handling area;
- Water and drill spoil settlement pond(s);
- Sediment dam; and
- Acoustic bund wall (using waste material from the drilling process).

Additional small scale (approximately 2m diameter) ventilation shafts will be constructed at the limit of every third or fourth longwall panel and will act as either in-take or exhaust points from the underground mine.

Access to the locations of the ventilation shafts and fans will utilise existing farm tracks where possible, however some road upgrade (or construction) will be required.

Detailed information on the construction of ventilation shafts is provided in Section 2.4.9.7 of the Stage 2 EA.

3.3.4 Surface to In-Seam Pre-Drainage Drilling Sites

Surface to In-Seam (SIS) pre-drainage requires a number of small diameter SIS boreholes to be drilled into and then along the length of the coal seam. Once drilled into the Hoskissons Coal Seam, the SIS boreholes may be split into two or more smaller diameter lines to increase the capacity for gas desorption into the boreholes and therefore drainage from the seam. The effective length of these boreholes may extend to over 2km, however, the current pre-drainage proposal for the operation provides for a maximum length of 1.5km.

An area of approximately 80m x 80m will be required for each SIS borehole drill site (0.64ha), however, as with other surface drilling sites mature trees and other vegetation will be retained where practicable within each site. Each drill site will be designed and constructed such that any overflow from sediment basins or sumps will be retained on the drill pad itself (ie. no run-off will be discharged to local drainage or impact on undisturbed vegetation). Any run-off from stockpiled material will be directed to the drill site sediment basins or sumps, with overflow from these prevented from discharging.

At the lowest seam RL of each set of SIS boreholes, a pump well will be constructed to intersect each SIS borehole. A pump at the top of each well will be used to extract the gas and water accumulating in the SIS boreholes. The current pre-drainage arrangements provide for up to four pump wells at each gas production site, requiring an area of approximately 2.9ha.

It is anticipated that the majority of the longwall panels will require three sets of SIS production wells along the length of the longwall panels.

3.3.5 Goaf Gas Drainage Drilling Sites

Gas concentrating in the goaf (an area of the mine which has been previously mined and the ground has subsequently collapsed) of the underground workings will be removed via a vacuum pump attached to the top of a cased 250mm internal diameter borehole, located towards the edge of the completed longwall panel and at approximately 200m intervals. The boreholes will be drilled from surface and will therefore require the creation of a drill pad of approximately 50m x 50m. Within the drill pad, provision will be made for the drill site itself as well as two small sumps and storage of vehicles and drilling materials. An access track will also be cleared and maintained for as long as the goaf gas drainage vacuum pump is required to operate

At each drill site, vegetation clearing and soil stripping and stockpiling will be undertaken as described in Sections 3.2.2 and 3.2.3. At most locations, there will be no need to clear any trees and groundcover will be retained over any areas not required for drilling or access. Two small sumps (5m x 5m) for recycling and storage of water and drilling waste will be constructed. Drill spoil collected and consolidated within the two sumps will be removed as necessary and ultimately used, in conjunction with stockpiled subsoil, to backfill the sumps of the drill site or transported to the reject emplacement area where a greater volume of drill spoil is present. Each drill site will be designed and constructed such that any overflow from sediment basins or sumps will be retained on the drill pad itself (ie. no runoff will be discharged to local drainage or impact on undisturbed vegetation). Any runoff from stockpiled material will be directed to the drill site sediment basins or sumps, with overflow from these prevented from discharging.

As the longwall mining operation progresses to the west, and the slope of the surface increases, some of the drill sites are likely to be located adjacent to ephemeral drainage lines. To prevent runoff from significant rainfall events flowing through the disturbed areas of each drill site, upslope catch banks will be constructed parallel to the contour at each of these sites. These catch banks will divert overland flows away from the drill sites and discharge the water down-slope of the sites.

3.3.6 Power Line Installation

A power line easement and access track will be constructed and maintained to each main and tailgate ventilation surface fan, although these will only be extended as each new shaft and surface fan is constructed. As far as practicable, these easements will be aligned to avoid disturbance to any substantial trees within the 30m wide surface corridor.

3.3.7 Longwall Assembly Site

The longwall assembly area (also referred to as the longwall pad) will comprise a flat hardstand constructed by cut and fill methods to the north of the current Pit Top Area infrastructure. The area of 2.5ha comprises cleared paddocks and will not result in the clearing of any trees. Topsoil and subsoil will be initially stripped and stockpiled for use in the rehabilitation of the longwall assembly area. The excavated 'cut' material will be preferentially used to build up the 'fill' section of the area, however, this may be supplemented by material excavated from drift construction.

3.3.8 CHPP

The coal conveyor and stacking system will be upgraded to accommodate the increased volume of ROM coal produced annually. The coal processing circuit will also be modified, from that approved for the Stage 1 operations, principally to incorporate a washing circuit for the larger sized coal (>16mm) and by-pass system for the <16mm sized coal.

3.3.9 ROM Coal Pad Extension

Plan 4B identifies the proposed 2.2ha extension to the ROM coal pad and realigned road which runs around the northern areas of the Pit Top Area. The ROM coal pad extension will be constructed using material excavated from the drifts to provide a hard a flat surface. The realigned road will similarly be elevated above natural topography using material excavated from drift construction.

3.3.10 Reject Emplacement Area

The coal screening and washing process will generate both coarse and fine reject material. This reject will be transferred from the coal handling and processing facilities of the Pit Top Area to a Reject Emplacement Area (Plan 4B). An area of up to 25ha has been allocated to the west of the box cut for the storage and management of this reject material. Further detail on the generation, transfer and management of the reject material is provided in Section Coal Processing and Reject Management 3.5.2.

3.3.11 Brine Storage Ponds

A site water balance prepared for the longwall operation reflecting the results of the groundwater modelling, operational water requirements and the treatment of raw groundwater producing 80% raffinate and 20% brine, predicts that after 3 to 4 years of operations, additional brine storage will be required to that provided by Dams A2, A3 and B. The volume of surplus brine is predicted to gradually increase throughout the life of the mine. The footprint for the Brine Storage Area identified on Plan 4B covers an area of approximately 160ha, which with an average storage depth of 5m will provide sufficient storage capacity of approximately 8,000ML, sufficient for the predicted brine generated over the life of the project. This area accounts for the proposed construction of the Brine Storage Area as a series of progressively constructed cells (which will reduce the total storage capacity due to the volume of earth required to construct each cell wall).

Acknowledging the uncertainty associated with mine in-flow predictions, NCOPL will progressively construct brine storage ponds within the nominated area (generally 6-12 months prior to the cell being needed). Each cell will provide sufficient capacity for several years predicted brine generation and will provide NCOPL with flexibility to modify the brine management to reflect observed mine in-flows and brine generation.

In the event that mine in-flows are significantly less than predicted, the total footprint area will be reduced to reflect the lower volumes of brine that would be generated. Similarly, in the event that a beneficial use for either the raw groundwater or brine is identified (reducing the reliance on either brine generation or storage), the total footprint area will be reduced. In the event that mine in-flows are significantly greater than predicted, the depth of each brine storage pond will be increased to ensure that the total footprint area will not be increased.

Given the uncertainty over mine dewatering requirements, a conceptual layout for the brine storage ponds has been provided in Plan 4B for brine production for the life of mine, with the size of each cell increasing to accommodate the increasing volume of water generated by the mine throughout this period.

Each brine storage pond will be constructed with a storage depth of approximately 5m and 0.5m freeboard. The cell walls will be constructed with a slope of no greater than 3:1 (H:V). A sequential process of topsoil removal will be adopted, with subsoil recovered from the floor of each cell used to construct the perimeter walls. The topsoil will be used to stabilise the outer slopes of the cell walls (which form the perimeter of the Brine Storage Area). Surplus topsoil will be stored in dedicated stockpiles around the perimeter of the Brine Storage Area.

As the water to be held within the evaporation/storage ponds will be saline in nature, the ponds will be constructed to be effectively impermeable. Based on the South Australian publication "*EPA Guidelines – Wastewater and Evaporation Lagoon Construction (EPA 509/04)*", a permeability of $1 \times 10^{-9} \text{m/s}$ will be the maximum allowable level of material used to construct the floor and walls of the evaporation/storage ponds. To achieve this level of permeability, NCOPL will first compact a layer of clayey material, of at least 300mm thick, obtained from in-situ material over the constructed cell wall. Care will be taken to ensure that any rocks and/or coarse or sharp material is removed or compacted within the cell batter. An impermeable plastic liner (similar to that used to line Dams A1, A2, A3 and B within the rail loop) will then be laid over the cell floor and inner walls.

Management of brine is discussed in Section 3.8.1.4.

3.3.12 Water Pipeline between the Mine Site and Namoi River

Based on the predicted dewatering requirements identified in the Stage 2 EA, the volume of raffinate will exceed the storage capacity of Dams C and D after approximately 4 to 5 years. NCOPL is currently considering possible beneficial uses of this good quality water (eg. irrigation water), however, to ensure there is a confirmed method of disposing of this surplus water, it is proposed to discharge this water to the Namoi River. NCOPL will construct a pipeline between the mine site and the Namoi River, which will also be used to pump water from the Namoi River to mine site (should insufficient water be available from surface and groundwater harvesting during the initial few years of the longwall operation).

3.3.13 Subsidence Monitoring Lines

NCOPL will install subsidence monitoring survey pegs between 10m and 15m apart, both along longitudinal lines extending in-bye and out-bye from each longwall panel starting and finishing point, as well as two transverse subsidence lines across the northern and southern panels.

To establish each subsidence monitoring line, an access track the width of a light vehicle will be required (~3m). It is estimated that up to 100km of access tracks will be required throughout the mine life, with the majority of these utilising pre-existing tracks created for pre-drainage or goaf gas drainage access.

3.3.14 Summary of all Surface Disturbing Activities

Based on the proposed mine design, ventilation and gas drainage requirements, and additional disturbance associated with other activities associated with the longwall operation, Table 3.3 provides the anticipated maximum area of disturbance. In total, approximately 700ha will be disturbed to varying degrees.

Table 3.3 Indicative Disturbance for Surface Facilities within the Mine Site

Component	Area (ha)
Ventilation fan sites	17
SIS pre-drainage sites (development and production)	259*
Goaf gas drainage sites	100
Internal power lines	57
Internal access roads and service corridors	80
Longwall assembly site	2.5
ROM coal storage extension	2.2
Reject Emplacement Area	25*
Brine Storage Area	160*
Total	698.7
* Refers to the maximum area of disturbance	

3.4 Mining

3.4.1 Mining Design and Mining Method

Mining will involve the sequential development of gate road headings approximately 305m apart and orientated north-south from the West Mains to define a total of 26 longwall panels (LW1 to LW26). Two gate road headings will be developed by continuous miner to the north initially (to develop LW1 to LW13), and then south (to develop LW14 to LW26) to a point set back from the lease boundary or the Hoskissons Coal Seam where it is at least 4m thick.

Once the two gate road headings are established on both sides of each longwall panel and connected up, the longwall equipment will be installed within an installation road driven between the main and tailgate roads and the coal recovered as the longwall unit retreats back towards the West Mains. All coal will be conveyed back to the Pit Bottom Area for transfer to the surface via the conveyor drift.

The mine design will include the following design parameters:

- The longwall panels will progressively increase in length from approximately 1.8km (LW1) to 4.1km (LW9 and LW18) and will generally be 296m in width (total void width will increase to approximately 306m once the gate road either side of the panel is incorporated as the longwall unit retreats);
- The longwall panels are located at depths increasing from approximately 160m below the surface over the eastern section of the mine site to 380m below surface as the Hoskissons Coal Seam dips to the west;
- Thirteen panels (LW1 to LW13) will be formed towards the north from the centrally located main headings and thirteen panels (LW14 to LW26) will be formed towards the south from the mains;
- The longwall panels will have an average face extraction height of 4.2m taken from the floor of the seam (which is between 4.6m to 10m thick). The face height will be graded back to the gate roads at a height of 3.5m at the maingate and tailgate ends.
- The single chain pillar formed between each longwall panel will be 3.5m high with the pillar widths increasing as depth of cover increase;
- The longwall panel width to height (W/H) ratio for the proposed mining layout will range from 0.5 to 1.9. The chain pillar W/H ratio will increase from 5.6 to 10.2.

3.4.2 Equipment

The longwall design will be based on proven technology with an emphasis on reliability of equipment. The principal components of the system will include:

- Double-ended ranging drum shearer rated at 3,500tph with full horizon control;
- An armoured face conveyor rated at 3,500tph with provision for single tailgate drive and dual maingate drives;
- Beam Stage Loader rated at 3,500tph; and
- High capacity two leg and four leg chocks shields with shearer initiation, base lift and high set functions.

Additional underground mining equipment to be used in association with the longwall mining unit is listed in Table 3.4.

With respect to underground equipment, there will be regular movements of the personnel transport vehicles between the surface and underground, while the Load/Haul/Dump (LHD) vehicles will be on the surface at various times intermittently during operations for loading and unloading. The remaining equipment listed in Table 3.4 will remain underground at all times unless major maintenance is required.

Table 3.4 Indicative Underground Operational Equipment

Indicative Equipment	No.	Use
Continuous miner	4	Underground primary and secondary mining
Shuttle cars	8	Transfer of coal from continuous miner to breaker feeder
Breaker feeder	4	Breaking of coal
LHD vehicle	6	Material transport
Personnel transport vehicle	7	Personnel transport
Panel conveyor belt	3	Transfer of coal from breaker feeder to transport drift conveyor

The continuous miner units are designed to extract a 3.5m x 5.4m roadway profile. Each unit is fitted with six bolting rigs (4 roof and 2 rib-bolting rigs).

All equipment has been/will be procured new.

3.4.3 Mining Sequence

The longwall panels have been numbered LW1 to LW26 to illustrate the sequence of development (ie. LW1 will be developed and mined initially followed by LW2, then LW3 and so on).

The initial mining sequence will be the same as for the approved Stage 1 operations (ie. following the connection of the drifts to the coal seam, a continuous miner unit will be deployed to form the Pit Bottom Area and then commence driveage of the headings within the West Mains towards the west). At the same time, the first ventilation shaft will be constructed from surface and will be completed prior to the development of mains headings to this point to enable the headings of the West Mains to intersect the completed shaft.

Since the Pit Bottom Area has been established, additional continuous miners are being deployed to develop the gate road headings from the West Mains to the extent of LW1. Once each set of gate road headings are fully developed, the longwall equipment will be installed and the coal recovered as the longwall unit retreats back towards the West Mains. All coal will be conveyed back to the Pit Bottom Area for transfer to the surface via the conveyor drift.

3.4.4 Mining Rate

The headings of the West Mains will be developed by the continuous miners at a rate of approximately 140m per week, with the gate road headings developed at a rate of approximately 200m per week. On completion of the gate road headings, it will take approximately 6 weeks to install the longwall unit within LW1 or move the longwall unit from one panel to the next. With a nameplate capacity of 3,500tph and once fully operational, the longwall mining rate is forecast to be approximately 140,000 tonnes per week (up to a maximum daily rate of 50,000 tonnes). The maximum annual rate will not exceed 8Mt.

3.4.5 Mine Ventilation and Gas Drainage

Tests conducted by Geogas Pty Ltd established that while gas compositions within the Hoskissons Coal Seam vary considerably, the predominant gas is CO₂ (~90%) with concentrations of CH₄ and N₂ also present in varying proportions. The results of gas desorption tests established the total desorbable gas content within the mine will vary from 4m³/t to 9.5m³/t on a 9% ash basis. Considering these parameters, and based on the extraction of 4.2m of coal from the seam of 9m average thickness, NCOPL expects that gas emissions during development could reach 1,200L/s CO₂ in deeper horizons if high permeability persists at depth.

In order to minimise the potential for outburst, which for CO₂ rich environment requires the gas content to be less than 6.2m³/t, and to ensure safe working conditions underground, the initial gas content from the exposed coal will be drained, ventilation will be established and goaf gas drained from the extracted section of each longwall panel. Pre-drainage will be undertaken using Surface to In-Seam (SIS) boreholes drilled from the surface and/or conventional underground boreholes.

As the three mine drifts, main west headings, dual gate road headings and longwall panels are developed, the mine ventilation system will be progressively upgraded to adequately ventilated the underground workings.

As the longwall unit retreats, and the remaining section of the seam collapses, the gas accumulating in the goaf will also be drained. Goaf gas drainage will be completed either by re-using the SIS system used for pre-drainage of the gas from the panel to be developed, or by the development of additional bores from surface into the collapsed panel, with the gas drawn out the goaf by the installation and operation of a vacuum plant connected to the top of each bore.

Proposed ventilation and gas drainage strategies are described below.

3.4.5.1 Mine Ventilation

The ventilation of the mine will be progressively established to maintain the general body CO₂ concentrations well below the statutory requirement of 1.25%. This will involve the progressive establishment of three ventilation shafts from the West Mains as well as at the rear of the eight longwall panels, which could operate as ventilation intakes or exhausts.

Using a two heading gate road configuration, the main ventilation issue for a single roadway tailgate will be maintaining the general body CO₂ concentration below the statutory requirement of 1.25%.

Sources of CO₂ reporting to the tailgate ventilation will include cut coal at the longwall face, from remnant coal in the active goaf and also the adjacent goaf if there is leakage through the chain pillar seals.

The mine ventilation network has been modelled with a longwall face ventilation quantity of 80m³/s, all of which will report to the tailgate. Pre-gas drainage and goaf gas drainage techniques will be used to maintain average tailgate CO₂ concentrations below 1% to allow for peaks in gas emissions (see Section 3.4.5.2).

3.4.5.2 Gas Drainage

Pre-Drainage

SIS pre-drainage, which in contrast to conventional underground in-seam gas drainage, allows NCOPL to pre-drain the coal seam prior to establishment of the underground gate roads. Conventional underground in-seam methods will be used to supplement the SIS network. Given the likely use of both methods of pre-drainage, both are considered and described.

Surface to In-Seam Pre-drainage

SIS pre-drainage using medium radius drilling involves drilling from surface into and along the coal seam (up to 2.5km). After removal of seam water, the gas is then drawn from the seam with the assistance of a vacuum pump. Due to the very low methane concentration within the gas, power generation or flaring of the gas is not feasible and so the predominantly CO₂ gas will be dispersed.

The water pumped to the surface will be piped to the Pit Top Area for storage in one of the water storages/evaporation ponds. The dewatering associated with the pre-drainage is provided for by the mine dewatering predictions provided by the modelling of Aquaterra (2009). That is, this water is not additional to the predictions included in Section 3.8. SIS pre-drainage provides a significant advantage over conventional in-seam pre-drainage in low desorption underground environments as the coal can be drained well in advance of mining.

For gas reservoirs, such as that of the Hoskissons Coal Seam which are CO₂ rich, undersaturated with significant fluid pressure reduction required for effective pre-drainage, SIS pre-drainage allows commencement of pre-drainage well in advance of mine development. This reduces the possibility that mine development may be held up by underground in-seam-drainage requirements.

In addition to pre-drainage, SIS holes drilled in the roof of the working section can also serve as goaf drainage holes. The location of these holes is particularly important in the thick seams where significant gas emission can originate in close proximity to the face line and cannot therefore be captured by conventional vertical goaf holes.

Conventional Underground In-Seam Pre-Drainage

The conventional Underground In-Seam (UIS) pre-drainage method of gas extraction is undertaken by drilling from the developed gate road heading into the adjacent longwall panel and subsequent gateroads. The gas is collected and then pumped to the surface through an exhaust pipe range for dispersion. While the conventional UIS pre-drainage method is proven technology, and will not require additional surface disturbance, the rate of drainage will be slow for the CO₂ rich, undersaturated with high fluid pressure gas reservoir of the Hoskissons Coal Seam. As noted above, this could potentially delay the commencement of longwall mining in the initial and/or future panels while gas levels are reduced to <6.2m³/t.

Goaf Gas Drainage

As each longwall panel is completed, the remaining coal above the section mined will continue to desorb gas. In order to maintain all ventilation roadways within the legal compliance limit of 1.25%, current studies indicate that post drainage of the caved (goaf) area will be required to evacuate the CO₂ desorbed from the remaining caved roof. This can only be achieved by post mining goaf drainage via holes drilled from the surface.

NCOPL's conceptual goaf drainage design provides for 250mm internal diameter cased boreholes located about 35m off the tailgate corner of the active goaf at 200m intervals. The boreholes will be drilled to the top of the Hoskissons Coal Seam and connected to the surface goaf drainage vacuum plant. Subject to the success of the pre-drainage of roof coal, goaf hole spacing may be increased as operational experience is gained.

With respect to spontaneous combustion, coal of propensity displayed by the Hoskissons Coal Seam probably has a worst case incubation period of 1 to 2 months or approximately 4 to 8 pillars retreat at planned production rates. Nitrogen "chambers" will be used to seal the goaf from adjacent roadways.

3.4.6 Subsidence Management

The subsidence assessment undertaken by Ditton Geotechnical Services Pty Ltd (DGS) in 2009 (provided as Part 1 of *Specialist Consultant Studies Compendium* for the Stage 2 EA) predicted a maximum subsidence of 2.44m where mining is 380m below the ground surface.

The ground surface will tend to subside more towards the centre of the panel (ie. away from the chain pillars between the longwall panels). As a consequence of this differential subsidence, DGS (2009) has predicted the following possible impacts:

- Surface cracking of between 20mm (in the west) and 190mm (in the east);
- Altered surface gradients of up to 6% (3°) along creeks;
- Potential ponding depths of 0.5m to 1.5m within the watercourses in the flatter areas of the site;
- Possible interaction between discontinuous sub-surface fracturing and surface cracks (where cover depths are <215m) leading to possible flow re-routing;
- Possible impacts on subsurface aquifers within 110m to 180m above the proposed panels as a result of direct hydraulic connections to the workings.

Based on the above summary of potential subsidence, the impacts are likely to be largely limited to the mining area, the majority of which is owned by NCOPL. The potential impacts include:

- Impacts on groundwater;
- Surface cracking;
- Drainage line ponding;
- Erosion and slope stability;
- Impacts on Aboriginal sites/artefacts; and
- Impacts on local residences.

Management measures for subsidence related impacts are described in the Extraction Plan.

3.4.7 Hours of Operation

The approved hours of operation are provided in Table 3.5.

Table 3.5 Hours of Operation

Activity	Hours / Days
Surface Facilities Construction	
Vegetation clearing / soil removal	7:00am to 10:00pm / 7 days
Surface infrastructure construction	7:00am to 10:00pm / 7 days
Reject emplacement area development	7:00am to 10:00pm / 7 days
Raw materials / supply delivery	7:00am to 10:00pm / 7 days
Ventilation shaft construction	24 hours / 7 days ¹
Gas drainage bore construction	24 hours / 7 days
Mining Operations	
Pit Bottom Area development	24 hours / 7 days
Underground mining	24 hours / 7 days
Gas drainage	24 hours / 7 days
Ventilation fan operation	24 hours / 7 days
Coal processing and handling	24 hours / 7 days
Rail loading and transportation	24 hours / 7 days
Surface maintenance	24 hours / 7 days
CPP reject disposal	24 hours / 7 days ²
Raw materials / supply delivery	7:00am to 10:00pm / 7 days
Note	<p>1: Operations initially for 4 months then at approximately 5 year intervals</p> <p>2: Reject disposal activities will generally be restricted to 7:00am to 10:00pm, 7 days per week. However, it is possible that the proportion of reject material generated by the CPP may exceed the predicted average 5% level for short periods. To account for these periods of elevated reject production, contingent hours of operation will be 24 hours / 7 days (when inversion conditions do not prevail).</p>

Mining and related operations will occur on a three shift basis with the following nominal shift times:

- Day shift: 6:30am – 3:00pm;
- Afternoon shift: 2:30pm – 11pm; and
- Night shift: 10.30pm - 7.00am.

3.4.8 Employment

The workforce throughout the sixty week Stage 2 construction period is expected to be approximately 75 full time equivalent persons. At times, in excess of 100 persons will be involved in construction activities onsite.

Based on the operation of three continuous miners in conjunction with the longwall unit, it is estimated that NCOPL will employ approximately 211 persons, comprising 186 mine workers and 25 staff. The projected mine workforce assumes an average coal production

rate of up to 8Mtpa and the projected three-shift underground mining and surface coal crushing / sizing operations.

3.5 Coal Processing, Reject Management and Rail Loading

3.5.1 Coal Transfer to Surface and Processing

Transportation of the mined coal to the ROM coal stockpile will occur via the conveyor drift from the Pit Bottom Area to the box cut within the Pit Top Area. From the box cut excavation, the ROM coal will be transported to the ROM coal stockpile area by conveyor from where it will be sent to the CHPP.

The ROM coal pad extension will increase the size of the pad from approximately 2ha to approximately 4.2ha and will, in combination with the elevation of the ROM coal drift conveyor and stacking system, increase the ROM coal storage capacity to 400,000t.

The coal conveyor and stacking system will be upgraded to accommodate the increased volume of ROM coal produced annually. The coal processing circuit will also be modified from that approved for the Stage 1 operations, principally to incorporate a washing circuit for the larger sized coal (>20mm) and by-pass system for the <20mm sized coal.

Figure 3.1 identifies the following components of the coal handling and preparation facilities.

3.5.2 Coal Processing and Reject Management

The ROM coal will be drawn from the ROM coal stockpiles via one of two reclaim valves and tunnels from where it will be fed to a rotary breaker for size reduction. The broken coal will then be transferred to a dry screen with the <20mm coal transferred directly to the product coal stockpile area and the remainder transferred to the CPP where the coal will be washed and coarse and fine reject screened off. The fine and ultra-fine reject will be dewatered to produce a filter cake which will be disposed of in combination with the coarse coal reject. The washed coal will be transferred to the product coal stockpile area from where it will ultimately be loaded into train wagons for transport from site.

The coal preparation process is expected to remove up to 5% of the total ROM feed as reject, which will be predominantly rock from the floor of the mine workings. Approximately 90% of the reject will be coarse reject (16mm to 25mm) and 10% will be filter cake, with both reject streams stockpiled within a reject pile. From the reject pile, the consolidated reject will be transferred to a Reject Emplacement Area (via front-end loader and truck) on the north-facing side of a low ridge immediately to the west of the box cut.

Based on a recoverable coal resource of approximately 170 million tonnes and a 30 year mine life, the total reject to be accommodated in the Reject Emplacement Area will approximate 8.2 million tonnes. Assuming a conservative dry density of 1.5t/m³, the total volume of the reject to be managed within the Reject Emplacement Area throughout the life of the mine will approximate 5.7 million m³.

The proposed maximum footprint of the Reject Emplacement Area is approximately 25ha, however, it will be constructed progressively as a series of elongated (north-south orientated) cells in a westerly direction. The emplacement will be constructed against the slope of the ridge, rising to a maximum of 15m above the natural surface level.

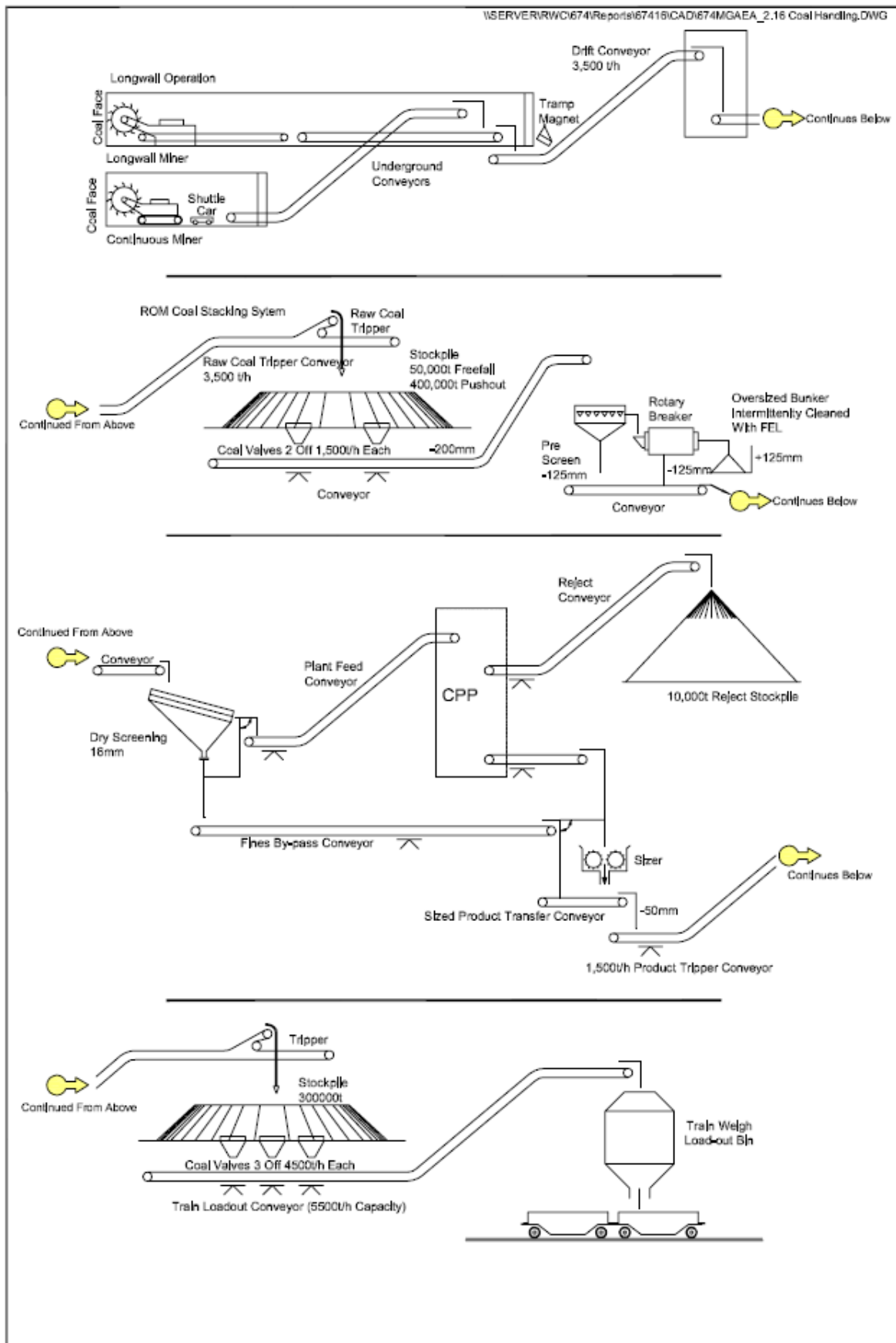


Figure 3.1 Mining/Processing Flowsheet

Each cell will be approximately 20m wide to accommodate the truck operating requirements. Prior to placing waste, the emplacement footprint will be progressively stripped of topsoil and subsoil to a depth of about 400mm, with the stripped material being either stockpiled for later use in the rehabilitation of the emplacement, or placed directly on completed sections of the emplacement or at other locations on the mine site where rehabilitation may be required. Testing of the reject will be undertaken to determine the propensity of the material to generate saline, or otherwise contaminated leachate. In the event that the testing indicates the reject has a propensity to generate saline leachate, or leachate with elevated concentrations of other contaminants, the base of each cell will be constructed to be effectively impermeable. To achieve a permeability of 1×10^{-9} m/sec or less, NCOPL will either:

- Compact a layer of clayey material (at least 300mm thick) over the base of each cell, taking care to ensure that any rocks and/or coarse or sharp material are removed or compacted within the cell barrier; or
- In the event insufficient in-situ material of suitable impermeability is not available, additional clay will be imported or an impermeable plastic liner used.

Shallow piezometers (lysimeters) will be installed down-slope of the Reject Emplacement Area to monitor salinity levels and confirm no leaching of saline material.

A comprehensive drainage system will be constructed prior to the commencement of the initial cell and all subsequent cells. The surface water system will include:

- Diversion drains to the east and south of the Reject Emplacement Area to prevent clean runoff from entering the area;
- Catchment drains at the western and northern perimeter of each cell to capture runoff from the active area of the Reject Emplacement Area; and
- A sediment basin (SB3) at the northern end of each cell from where the collected water would be pumped back to the main mine water management ponds for re-use and/or treatment as appropriate.

Reject will be paddock dumped within the active Reject Emplacement Area cell and then spread by dozer to form a typical lift thickness of about 1.5m. Each lift will be compacted by a combination of track rolling by the dozer and trafficking by the reject delivery haul trucks. The initial eastern batter of the Reject Emplacement Area, as well as the progressive development of the northern and southern batters, will be created with a slope of 14° (4H:1V) as this will form the final face of the landform once the Reject Emplacement Area is completed. The active western batter will be maintained at an angle of repose ($>30^\circ$) until the final cell is completed when the external batter will be reduced to 14° .

3.5.3 Coal Transportation

The product coal will be drawn from the stockpiles via three reclaim valves and tunnels and conveyed to the train load-out bin. The load of product coal via the drawdown valves and train load-out bin will be fully automated with batches drawn from the stockpiles and loaded into train wagons on the Narrabri Coal Rail Siding.

NCOPL forecasts that with the use of the 5,500t/h capacity overhead load-out facility, a 72 wagon train with a capacity of 5,400t will be loaded and despatched in approximately

90 minutes upon arriving at the rail loop. The Pit Top Area rail loop could accommodate longer trains, which will reduce the number of rail movements generated by the longwall operation.

While daytime loading would be preferable, it may not always be possible and as such, the operation requires 24 hour, 7 days a week train operation to ensure the flexibility to operate within the train paths allocated to the haulage contractor.

At the proposed maximum mining rate of 8Mtpa and an average train capacity of 5,400t, an average of five trains will be loaded and despatched each day of the week (this accounts for coal rail unavailability for periods during the year). NCOPL anticipates the number of loaded trains despatched daily will vary from three to seven, and occasionally eight per day. The rate of despatch will vary to meet shipping arrival schedules at Port Newcastle.

3.6 Waste Management

3.6.1 Nature of Wastes

The principal wastes that will be generated throughout the life of the mine can be categorised as production and non-production wastes.

Production wastes will include:

- Mined rock from the development of the ventilation shafts and gas drainage boreholes. Material generated from shaft construction will be excavated and used in conjunction with subsoil to create the acoustic bund wall around the ventilation shaft area. Gas goaf drainage drilling waste will be contained within two 5 x 5m sumps. Drill spoil collected and consolidated within the two sumps will be removed as necessary and ultimately used, in conjunction with stockpiled soil to backfill the sumps or disposed of in the Reject Emplacement Area where greater volumes of spoil are present.
- Coarse and fine reject generated by the CHPP. Management of coarse and fine reject generated by the CHPP is described in Section 3.5.2.
- Brine generated by the Water Conditioning Plant. The management of brine is described in Sections 3.8.1.4.

Non-production wastes will include:

- General domestic-type wastes from the on-site buildings and routine maintenance consumables (see Section 3.6.2);
- Oils and grease, including potentially contaminated water from the maintenance workshop, washdown pad and fuel storage areas (see Section 2.8.3) and
- Sewage (see Section 2.8.4).

3.6.2 Domestic-type Wastes and Routine Maintenance Consumables

All paper and general wastes originating from the surface facilities area, together with routine maintenance consumables from the daily servicing of equipment, such as grease cartridges, will be disposed of in 205L drums and 240L mobile garbage bins located adjacent to various buildings. These bins will generally be collected regularly and the

contents placed in large waste storage receptacles or dumpsters positioned adjacent to the maintenance workshop to await removal by a licenced industrial waste collection contractor. Industrial waste collection will be undertaken fortnightly, or more frequently, if required.

Separate collection systems will be employed for recyclables such as paper and cardboard, drink containers (cans and PET bottles) and ferrous and non-ferrous metals, each of which will be despatched off site at appropriate intervals.

3.6.3 Oils and Grease

Routine maintenance of the more mobile mining and earthmoving equipment will generally be undertaken in the maintenance workshop within the Pit Top Area, while underground equipment will be subject to minor maintenance in-situ and brought to the surface for more substantial maintenance. Major equipment maintenance will be undertaken at facilities away from the mine.

Within the maintenance workshop, waste oils and grease will be collected and pumped to bulk storage tanks by oil evacuation pumps. All parts and packaging will be collected and transferred to the maintenance workshop for disposal or recycling.

Waste oils and grease will be stored appropriately at the maintenance workshop and collected by a licenced waste recycling contractor as required for recycling.

The wash down facility in the vicinity of the maintenance workshop will be located on a concrete slab, be self draining to the workshop water/oil separator after which recovered oils and grease residues will be regularly pumped out by waste disposal contractor and separated water directed to an adjacent dirty water dam.

3.6.4 Sewage

NCOPL maintains toilet and ablution facilities within the mine facilities area for the site workforce and visitors. These facilities incorporate self irrigating eco-cycle septic sewage system(s) approved by Narrabri Shire Council and regularly serviced as required by Council and the manufacturer. The treated septic system water is used to irrigate an area adjacent to the system.

The existing facilities are considered adequate for the increased workforce that will be required for the Stage 2 longwall operation.

3.7 ROM Coal and Product Stockpiles

As discussed in Section 3.5, the ROM coal stockpile will be extended from approximately 2ha to 4.2ha, with a storage capacity of 400,000t. The product coal stockpile will be 350,000t with dozer push while the reject stockpile will have a capacity of 10,000t.

Table 3.6 presents the predicted production and waste schedule for the term of this MOP.

Table 3.6 Production Schedule

Item	Unit	Provisional Production During MOP Term						
		2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Stripped topsoil & subsoil	m ³	103,600	61,600	21,200	89,600	5,600	5,600	188,400
ROM Coal	t	260,000	2,735,000	5,467,000	6,562,000	6,562,000	6,497,000	6,419,000
Reject	t	9,360	98,460	196,812	236,232	236,232	233,892	231,084

3.8 Water Management

3.8.1 Groundwater

3.8.1.1 Mine Dewatering Requirements

As the underground workings and longwall panels are developed and mined, groundwater will flow into the workings. The rate of this 'mine in-flow' will ultimately be a function of the hydraulic conductivity of the geological strata above and below the coal seam, the surface area of the underground workings and the occurrence of fractures within the geological strata above the workings. A groundwater model was constructed by Aquaterra Consulting Pty Ltd (Aquaterra 2009) to predict the rate of mine in-flow throughout the life of the mine.

The predicted groundwater in-flow steadily increases over time as the effective void space underground continues to increase and peaks in Year 20 at 5.66ML/day (2,066.6ML/year) before steadily declining until the cessation of mining. The decline in in-flows is due to the fact that once mining commences in a west to east direction (LW13 to LW26), the active mining areas will be up-dip (at higher elevation) than the goaf areas. As a result groundwater accumulating in the goaf will not flow into the active panels and will not require dewatering.

3.8.1.2 Management of Dewatered Groundwater

The dewatered mine in-flows will be pumped to surface and discharged into Dam A1 within the rail loop. From Dam A1, the groundwater will be processed through an Ultrafiltration (UF) and then Reverse Osmosis (RO) circuit of the Water Conditioning Plant, approved by Condition 3(4) of PA 05_0102 but as yet not constructed, to reduce the salinity of the water (to <500mg/L). The processed (fresh) water ("raffinate") will be pumped direct into the mine storage tank for immediate use or stored in Dams C or D for later use for operational purposes and excess dealt with as described in Section 2.4.8.3. The waste product of the Water Conditioning Plant (brine) will be pumped to a series of lined brine ponds, Dam A2, A3 and B within the rail loop as well as the Brine Storage Area to the north of Kurrajong Creek Tributary 1.

It is noted the construction of the Water Conditioning Plant has been brought forward in the life of the mine (under Stage 1 Narrabri Coal Mine proposal it was anticipated the Water Conditioning Plant would be constructed once mine in-flows reached 0.88ML/day after approximately 10 years). The earlier construction of the Water Conditioning Plan is necessitated by the fact that the longwall mining process requires significantly greater volumes of 'fresh' water than a continuous miner operation. As insufficient water will be

available from surface water harvest alone, the untreated groundwater is too saline for immediate re-use underground, and to minimise the requirement to source water from offsite, the accelerated development of the Water Conditioning Plant will be completed.

3.8.1.3 Management of Surplus Raffinate

Section 3.3.12 outlines the proposed pumping of excess raffinate from the mine site to the Namoi River.

3.8.1.4 Brine Management

At an operating specification which generates a 80:20 raffinate:brine output, it is estimated that almost 6,500ML of brine will be generated throughout the life of the mine. Annual brine production will steadily increase as mine dewatering increases and based on the predicted dewatering requirements, the volume of brine will exceed the storage capacity of Dams A2, A3 and B after approximately 5 years.

The excess brine will be pumped to lined ponds that will be constructed within the Brine Storage Area footprint identified on Plan 4B. Notably, Figure 4B provides the maximum footprint of the brine storage in this area (~160ha), with ponds capable of storing the ensuing several years of brine production progressively constructed (Section 2.4.9.14 of EA provides further detail on the design and construction of the brine storage ponds). Each brine pond will be fenced as it is constructed to restrict access to both people and native fauna. Further details on the construction of the Brine Storage Area are provided in Section 3.3.10.

At the completion of mining, the brine stored within the Brine Storage Area will be pumped into the goaf and retained gate roads of the completed mine through re-use of cased goaf gas drainage drill holes. NCOPL is also investigating the potential to progressively re-inject the brine solution into the completed goaf areas of the mine as the direction of mining progresses up-dip (west to east, ie. LW14 to LW26). NCOPL intends to complete the transfer of all remaining brine to the underground by the cessation of mining in approximately 30 years.

3.8.2 Surface Water

The key principles in managing surface water within and around the mine site are to:

- Divert clean water away from disturbed areas;
- Capture dirty water and treat it so that it could be discharged in accordance with relevant criteria;
- Prevent the leakage or spillage of groundwater dewatered from the underground workings and brine generated by the Water Conditioning Plant;
- Capture and treat contaminated water prior to discharge from and/or re-use on the mine site;
- Maintain as much vegetation cover (particularly grass) as possible; and
- Manage the direct and indirect effects of mine subsidence on the hydrology of the mine site.

The intent, design and construction of the surface water management structures are presented in detail in the Site Water Management Plan (SWMP). Plan 4B presents the location of the principal surface water management structures of the surface facilities area.

3.8.2.1 Potential Sources of Water Pollution

The potential sources of water pollution from activities within the mine site include:

- Runoff from areas disturbed during construction within the Pit Top Area and progressive development of gas drainage and ventilation infrastructure;
- Runoff from stockpiles of topsoil, subsoil and mined rock;
- Surface runoff from ROM coal and coal product stockpiles;
- Runoff from hardstand areas including roads, coal crushing/sizing areas and surface buildings;
- Surface runoff from rehabilitated areas prior to full stabilisation;
- Sedimentation generated by increased or accelerated erosion within the mine site;
- Uncontrolled discharge of dewatered mine in-flows (which are anticipated to be of elevated salinity);
- Leakage or spillage of saline groundwater stored within Dam A1;
- Leakage or spillage of brine stored within Dams A2, A3, B or BR1 to BR5;
- Leakage or spillage of hydrocarbons.

For management purposes, the surface water within the proposed areas of disturbance has been divided into four categories, namely:

- **“Clean”** – surface runoff from rehabilitated catchments and catchments undisturbed or relatively undisturbed by construction, mining or related activities;
- **“Dirty”** – surface runoff from areas disturbed by construction or activities such as soil, overburden and coal stockpiling, and rehabilitation (until stabilised), all of which could contribute suspended solids to the surface water;
- **“Saline”** – water containing concentrations of total dissolved solids (TDS) greater than the ANZECC (2000) trigger level of 350mg/L; or
- **“Contaminated”** – surface water containing hydrocarbons or any other contaminant other than suspended solids.

3.8.2.2 Water Management Infrastructure

The locations of the existing and proposed water management control structures on the Pit Top Area are presented in Plan 4B. The general features of the surface water management infrastructure for the Pit Top Area remain consistent with those constructed and currently operating as part of Stage 1 works, as detailed below:

- A sediment basin (SB1) to collect dirty and contaminated runoff from the stockpiling and crushing/sizing area;
- A sump in the box cut to collect rainfall/runoff and seepage from the walls of the box cut;
- A series of sediment basins (SD1, SD2, SD3, SD4 and SD5) to collect and treat runoff from the southern section of the Pit Top Area, disturbed during Pit Top Area construction;
- A series of drains to collect runoff from the Pit Top Area and divert it to the various water management dams;
- A series of ponds within the rail loop for the storage of dewatered groundwater (Dam A1), treated raffinate (Pond D) and waste brine (Ponds A2, A3, B and C). Water will continue to be drawn from Dam A1, Dam C or D for operational purposes (depending on the quality requirements for the operation);
- A Water Conditioning Plant to treat dewatered groundwater to a sufficient quality for mine site use, increasing environmental flows in the Namoi River and potentially for use offsite.

The following additional (or modification to existing) controls are proposed as part of the longwall operation:

- The capacity of SB1 will be increased and an additional sediment basin (SB2) will be constructed immediately downstream of SB1 to provide additional capacity for the collection and storage of dirty runoff from the coal processing area;
- A new sediment basin (SB3) will be constructed to collect potentially dirty runoff from the Reject Emplacement Area;
- A new storage dam (SD6) will be constructed to collect potentially dirty water runoff from the initial ventilation shaft area;
- Additional brine storage ponds (identified on Plan 4B) will be progressively constructed within the Brine Storage Area to the north of Kurrajong Creek Tributary 2 to contain the brine generated by the Water Conditioning Plant;
- A new sediment basin (SB7) will be constructed to collect potentially dirty runoff from the construction of the Brine Storage Area; and
- An underground pipe will be constructed from Dam C to the Namoi River to enable the extraction of additional water from the Namoi River or discharge of surplus raffinate to the Namoi River.

The SWMP provides further details on water management at the mine site.

3.8.3 Operational Water Requirements

Operational water will be required primarily for dust suppression both underground and within the Pit Top Area, as well as within the CPP washing circuit.

Based on operational experience during Stage 1 operations, consideration of water requirements at similarly sized underground mines and the completion of a water balance analysis of the CPP, NCOPL estimate the annual water requirements will be as follows:

- Underground dust suppression and other requirements – up to 465ML
- Coal handling and processing (including sprays on conveyors, screens and crushers, dust suppression on stockpiles and coal washing) – up to 100ML; and
- Other surface water usage (dust suppression, ablutions, wash pad etc) – up to 42ML.

In addition to the above operational water requirements, between 54ML and 101ML of water is expected to be lost via evaporation from water storages each year.

Up to 607ML of water will be required by the longwall operation each year, which equates to 1.67ML per day. A proportion of this water (estimated to be between 25ML and 298ML each year) will be recycled through capture and re-use of underground make. The remaining water will be obtained from a range of sources including:

- Groundwater in-flow and capture within the box cut – 27ML;
- Harvesting of surface water runoff from the industrial hardstand and processing areas of the Pit Top Area (SB1) – 71ML;
- Harvesting of surface water runoff from the remaining sediment basins and dams on the Pit Top Area – 100ML;
- Groundwater treated through a Water Conditioning Plant – 50ML to 1,800ML; and
- Water harvested from the Namoi River under licence – 20ML high security allocation plus various low security allocations.

NCOPL holds two licences to account for the water inflows to the mine that are pumped to the surface, namely:

- 90CA811347/WAL15922 for groundwater extraction from the Intake Beds of the Great Artesian Basin of up to 248ML per year; and
- 90BL254679 for groundwater extraction from the Gunnedah Basin of up to 818ML per year.

3.9 Hazardous Materials

The Narrabri Coal Mine is currently not required to hold a Licence for the Keeping of Dangerous Goods, under the provisions of the *Occupational Health and Safety Act 2000*, based on the quantity of Class C1 diesel stored onsite (98kL total tank capacity, ~85kL safe fill). NCOPL will apply for a licence in the future, should diesel storage capacity exceed the threshold for licencing requirements.

Prior to potentially hazardous materials or substances being introduced onto the mine site, an assessment as to its suitability will be made with reference to the points outlined in the plan and through a review of the applicable Materials Safety Data Sheets (MSDS). Upon the acceptance of a new hazardous material or substance onto the site, MSDS sheets are to be held and made available for inspection by the stores and purchasing department.

From time to time, use of explosives may be required for underground operations. An explosives magazine will be maintained to the north of, and remote to, the surface

facilities with the appropriate exclusion zone, bunding and dimensions, in accordance with the NSW *Explosives Act 2003* and all other I&I NSW requirements.

Management of explosives and blasting is discussed in Section 7.9.

3.10 Other infrastructure

Plan 4B identifies the major features of the mine site surface infrastructure to be installed during the term of this MOP.

Other major features within the Pit Top Area are to include:

- One main office building comprising both bath-house and administration;
- First aid, stores, control room, covered muster area and training facility complex – brick and colourbond roof;
- Contractor office facility (comprising a number of temporary transportable buildings);
- 2 x 20 kL potable water tank;
- One fresh water filtration system;
- 3 x 300kL fire fighting/underground water supply tanks. Water supply to these tanks is pumped from the surface water storage dam via the fresh water filtration system;
- 1 x 300kL service water tank;
- 66 kV incoming power yard;
- 66 kV / 11 kV substation and yard;
- 11 kV / 415 V transformer and site reticulation grid;
- Helipad;
- Biocycle effluent management system with surface irrigation;
- Hardstand areas comprising the laydown areas for various spare mining and mining-related equipment storage;
- Various water management structures and evaporation ponds;
- Three portals (conveyor, transport and ventilation);
- Inclined stacker conveyor with associated starter house;
- Overhead gantry conveyor/s;
- Inclined transfer conveyor;
- ROM and product coal stockpiles;
- Coal Handling and Processing Plant (CHPP);
- West Mains ventilation shaft;
- Small diameter vertical ventilation shaft (rear of panel ventilation shaft);
- Gas (and potentially water) pre-drainage infrastructure;
- Fire station;

- Compressor building;
- Combined workshop, fuelling station and bunded hydrocarbon storage area;
- Main ventilation fan;
- Equipment wash down pad;
- Two crib rooms;
- Box cut/portal sump;
- 1.5km bitumen access road;
- 3.2km rail loop; and
- Carpark to accommodate approximately 100 vehicles.

4 PROPOSED REHABILITATION ACTIVITIES DURING THE MOP TERM

4.1 Stakeholder Consultation

Stakeholders in the rehabilitation of the mine site include:

- NCOPL;
- Surrounding landowners (both current and future);
- Narrabri Shire Council (NSC);
- Industry and Investment NSW (I&I NSW); and
- Other relevant State government agencies including:
 - Department of Environment, Climate Change and Water (DECCW);
 - NSW Officer of Water (NOW); and
 - Department of Planning (DoP).

Regular discussions have been held, and will continue to be held, with the surrounding landholders, I&I NSW, Narrabri Shire Council and other relevant government agencies in regard to all aspects of mine operation. In addition, and in accordance with *Condition 6(9)* of PA 08_0144, a Community Consultative Committee (CCC), which comprises representatives of NCOPL, Narrabri Shire Council and the local community, has continued to meet on a quarterly basis since 2008.

The CCC provides a forum for discussion, dissemination of information and receipt of comments regarding the mine's activities and proposals. The outcomes and issues arising from these discussions regarding site specific rehabilitation will be, where practicable, incorporated into general mine operations planning, a practice which will continue for the duration of this MOP and for the life of mine.

I&I NSW have been consulted during the preparation of the MOP and subsequent amendments, culminating in drafts being presented for review and comment prior to finalisation of the document.

Consultation regarding rehabilitation of the site was undertaken throughout the preparation of both the Stage 1 EA and Stage 2 EA.

4.2 Rehabilitation Status at MOP Commencement

Rehabilitation activities to date have comprised:

- Cover crop establishment in areas no longer required by operational activities, including the amenity bund, dam walls and drainage lines;
- Establishment of over 1,100 tubestock along the perimeter amenity bund and in strategic locations across site to improve the visual amenity for surrounding landholders and local road users; and
- Ongoing rehabilitation of areas disturbed by drilling activities.

In total, over 31ha have been rehabilitated to pasture and grasses.

4.3 Proposed Rehabilitation Status at MOP Finish

Plan 5 presents the proposed status of rehabilitation at the end of the MOP term and includes:

- Active disturbance;
- Water management and control structures; and
- Proposed areas for rehabilitation.

Rehabilitation activities to be completed during the term of this MOP will be confined to stabilisation, erosion control and revegetation of disturbed areas including:

- Areas disturbed as part of site establishment and construction activities that are not required for ongoing operations (ie. batters of cut and fill slopes);
- Drill sites and redundant gas drainage infrastructure and any associated infrastructure (access tracks etc); and
- Areas affected by subsidence.

Surface stabilisation will be achieved through sowing a pasture seed mix relevant to the season in which planting occurs. Table 4.1 lists the indicative components of both a winter and summer pasture seed mix together with typical fertiliser application rates. The actual seed mix will be based on seed availability at the time.

Table 4.1 Winter and Summer Pasture Species Seed Mixes

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

4.4 Buildings

No buildings will be removed during the term of this MOP.

4.5 Rehabilitation of Disturbed Land

4.5.1 Introduction

Progressive rehabilitation will ensure that some form of rehabilitation is undertaken over the majority of the areas disturbed during the term of this MOP. Progressive rehabilitation will comprise landform creation and stabilisation, spreading of soils and revegetation.

The following sections identify the rehabilitation and maintenance procedures to be adopted for the major disturbance activities during the MOP term as well as more general activities for the final landform.

4.5.2 Drilling and Borehole Construction

Drilling and borehole construction associated with pre- and goaf gas drainage will require areas above the underground mining area to be progressively disturbed. Access roads/tracks and power lines constructed between these sites will also be required resulting in further surface disturbance. As gas drainage for each longwall panel is completed, the bores and gas drainage infrastructure will become redundant. All infrastructure will be removed and areas of disturbance rehabilitated should they not be needed for any other reason (eg. end-of-mine brine disposal).

The following objectives have been adopted when developing the rehabilitation procedures for those temporary areas of disturbance associated with gas drainage:

- To locate each gas drainage site in such a way that minimises the amount of disturbance to native vegetation or sites of heritage significance and hence rehabilitation requirements;
- To retain soil and vegetation resources for use in the rehabilitation of each site; and
- To produce a stable final landform conforming with the vegetation type of the surrounding area.

Each site will be rehabilitated such that the final landform will be very similar to that which currently exists. The final land use of each site will correspond to that of the surrounding land.

4.5.2.1 Proposed Rehabilitation

Once gas drainage requirements are completed and there is no other identified ongoing need for the site, each site will be rehabilitated as follows:

Infrastructure Decommissioning, Bore Sealing and Capping

The gas drainage vacuum pump, generators and any other infrastructure will be removed from the site. Each borehole will then be backfilled and capped in accordance with the EDG01 guideline "*Borehole Sealing Requirements of Land: Coal Exploration*".

Sump Decommissioning and Backfill

Water retained within the sump(s) adjacent to each borehole site will be allowed to evaporate or removed by pump into a truck for reuse or disposal. Any consolidated drill cuttings and fines will be excavated, and the sump backfilled using consolidated drilling spoil stockpiled during the bore construction phase. The surface of the backfilled sumps will be covered with the topsoil and subsoil stripped and stockpiled during site establishment, lightly scarified and seeded and covered with any stockpiled vegetation retained following site establishment.

Drainage Control

Any upstream diversion banks or downstream catch banks will be pushed over and profiled to natural surface level. The profiled surface will then be ripped or lightly scarified, covered with available soil, then seeded.

Other Cleared Surfaces

Where cut and fill works were required, these areas will be re-excavated to return the site to its natural slope. This, and the remaining cleared surfaces of the drill site, will be ripped or lightly scarified and the remaining stockpiled soil and broken vegetation spread over the area. Re-seeding with pasture or native tree and shrub species will be undertaken depending on the proposed final land use (ie. agriculture or native vegetation).

Access Tracks

Unless required for future access to monitor or manage subsidence-related impacts, the tracks constructed to access each drainage site will be progressively closed and rehabilitated. The tracks will be ripped using the tynes of a bulldozer (or similar) and previously cleared topsoil and vegetation (if any) will be pushed over the ripped surface. No seeding is considered necessary as natural regeneration of vegetation from seed in the topsoil and the surrounding environs is expected. In the event that natural regeneration does not adequately establish within 3 months of ripping, the site will be seeded to an appropriate cover crop.

4.5.2.2 Monitoring and Maintenance

Once the access roads are closed and rehabilitated, access to these sites may not be viable. As such, the access tracks will only be closed and rehabilitated once periodic monitoring illustrates that the sites are stable and the designated vegetation is becoming established.

4.5.3 Exploration activities

Exploration activities will require progressive disturbance of areas across the site for drill pads, sumps and access tracks.

The following objectives have been adopted when developing the rehabilitation procedures for those temporary areas of disturbance associated with exploration:

- To locate drill sites in such a way that minimises the amount of disturbance to native vegetation or sites of heritage significance and hence rehabilitation requirements;
- To retain soil and vegetation resources for use in the rehabilitation of each site; and
- To produce a stable final landform conforming with the vegetation type of the surrounding area.

Each site will be rehabilitated such that the final landform will be very similar to that which currently exists. The final land use of each site will correspond to that of the surrounding land.

4.5.3.1 Proposed Rehabilitation

Once drill activities at a site are completed and there is no other identified ongoing need for the site, each site will be rehabilitated as follows:

Sealing and Capping

Each drill hole will be backfilled and capped in accordance with the EDG01 guideline "*Borehole Sealing Requirements of Land: Coal Exploration*".

Sump Decommissioning and Backfill

Water retained within the sump(s) adjacent to each drill site will be allowed to evaporate or removed by pump into a truck for reuse or disposal. Any consolidated drill cuttings and fines will be excavated, and the sump backfilled using consolidated drilling spoil. The surface of the backfilled sumps will be covered with the topsoil and subsoil stripped and stockpiled during site establishment, lightly scarified and seeded and covered with any stockpiled vegetation retained following site establishment.

Drainage Control

Any upstream diversion banks or downstream catch banks will be pushed over and profiled to natural surface level. The profiled surface will then be ripped or lightly scarified, covered with available soil, then seeded.

Other Cleared Surfaces

Where cut and fill works were required, these areas will be re-excavated to return the site to its natural slope. This, and the remaining cleared surfaces of the drill site, will be ripped or lightly scarified and the remaining stockpiled soil and broken vegetation spread over the area. Re-seeding with pasture or native tree and shrub species will be undertaken depending on the proposed final land use (ie. agriculture or native vegetation).

Access Tracks

Unless required for future access to monitor or manage subsidence-related impacts or to access other sites of disturbance, the tracks constructed to access each drainage site will be progressively closed and rehabilitated. The tracks will be ripped using the tynes of a bulldozer (or similar) and previously cleared topsoil and vegetation (if any) will be pushed over the ripped surface. No seeding is considered necessary as natural regeneration of vegetation from seed in the topsoil and the surrounding environs is expected. In the event that natural regeneration does not adequately establish within 3 months of ripping, the site will be seeded to an appropriate cover crop.

4.5.3.2 Monitoring and Maintenance

Once the access roads are closed and rehabilitated, access to these sites may not be viable. As such, the access tracks will only be closed and rehabilitated once periodic monitoring illustrates that the sites are stable and the designated vegetation is becoming established.

4.5.4 Subsidence Areas

The primary objective of subsidence rehabilitation is to ensure that surface cracking or surface deformation resulting in changes to local drainage patterns is identified promptly and remediated as soon as possible after the impacts are identified.

As noted previously, the likely surface cracking will typically be less than 20mm to 190mm. As such, where surface cracking occurs, the final landform and land use will be almost identical to that of the pre-subsidence environment.

4.5.4.1 Proposed Rehabilitation

Surface Cracking

Given the relatively deep soil profile above the longwall panels, and the predicted cracking widths remaining below 20cm, it is expected that many of these cracks will be in-filled naturally through action of wind, water and soil movement. Should natural processes not completely fill each crack, the ground surrounding each crack will be ripped or graded to in-fill the crack. Notably, the locations of the gas drainage sites and access roads have been located to approximate the alignment of cracking expected. This will minimise the potential for areas to be disturbed simply to access areas of subsidence-related surface cracking, thereby minimising disturbance of native vegetation principally to repair cracking.

In the event that more significant cracks occur which cannot be simply filled in through surface ripping, these may need to be filled with additional material sourced from within the footprint of the Reject Emplacement Area or nearby gas drainage drill site.

Once the cracks have been in-filled, they will be profiled to natural topographic levels and covered with available leaf litter or broken vegetation.

Local Drainage

Surface subsidence may also impact on local drainage patterns with ponding or re-direction of channels within local creeks and tributaries possible.

In the case of ponding, no further work will be undertaken unless the ponding significantly affects downstream flows and vegetation. Should this occur, or if subsidence results in re-direction of creek or tributary flows, the advice of a qualified hydrogeologist will be sought to identify the most effective way of re-establishing more natural flow patterns.

4.5.4.2 Monitoring and Maintenance

Impacts of subsidence will be monitored in accordance with the site Extraction Plan.

4.5.5 Surrounding Land Management

The land owned by NCOPL beyond the areas proposed to be disturbed will be leased to surrounding landowners for agricultural purposes and/or comprise areas proposed for future biodiversity offset requirements.

NCOPL will implement the principles of responsible land ownership and ensure that feral animals and weeds are managed appropriately across its entire land holding. Cooperation with adjoining land owners will be a regular feature of the ongoing land management within the mine site.

Table 4.2 presents a summary of the total area of disturbance at the start and end of this MOP term.

Table 4.2 Summary of Proposed Rehabilitation

	Area Affected (hectares)		
	Total Area, start of MOP	Total Area, end of MOP	At mine closure ^{*1} (anticipated)
A: MINE LEASE AREA			
A1 Mine lease(s) Area (Surface Only)	454.2ha		
B: DISTURBED AREAS			
B1 Infrastructure area (other disturbed areas to be rehabilitated at closure including facilities, roads)	120	317	17.2
B2: Active Mining Area (excluding items B3 - B5 below)	- ^{*3}	- ^{*3}	-
B3 Waste emplacements , (active/unshaped/in or out-of-pit)	- ^{*3}	55 ^{*3}	-
B4 Tailings emplacements , (active/unshaped/uncapped)	-	-	-
B5 Shaped waste emplacement (awaits final vegetation)	-	-	-
TOTAL ALL DISTURBED AREAS	120	372	17.2
C: REHABILITATION			
C1 Total Rehabilitated area			
• under maintenance	12	79	-
• complete ^{*2}	-	51	762
D: REHABILITATION ON SLOPES			
D1 10 to 18 degrees	10	16	26
D2 Greater than 18 degrees	-	18	18
D3 Less than 10 degrees	2	96	718
E: SURFACE OF REHABILITATED LAND			
E1 Pasture and grasses	-	130	552
E2 Native forest/ecosystems^{*4}	12	12	210
E3 Plantations and crops	-	-	-
E4 Other (include non-vegetative outcomes)	-	-	-
^{*1} Assumes mine closure equates to lease relinquishment. ^{*2} Assumes no maintenance requirement 3 years after establishment. ^{*3} The box cut and bund walls are not considered active mining or waste emplacement respectively, rather these are identified as infrastructure supporting or associated with the underground mining activities. ^{*4} Native tree plantings.			

The values reflect the areas of active disturbance and various stages of rehabilitation presented on Plan 5.

4.6 Water Management (Rehabilitated Land)

Where practicable, water management structures such as contour banks, diversion drains or re-established drainage lines will be constructed with longitudinal gradients which permit the transfer of water at non-erosive velocities (eg. 1:200(V:H)). Consequently, specialised rehabilitation treatments will generally not be required.

No flumes are required due to limited heights of any embankments constructed. However, in the event that unacceptable levels of erosion are observed, fast growing species identified as having a particular soil conservation application and/or specialised treatments such as jute meshing or rock lining will be implemented.

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

4.7 Other Infrastructure

No other infrastructure will be removed or rehabilitated during the MOP term.

4.8 Rehabilitation Trials and Research

No specific rehabilitation trials and/or research is considered necessary at this time. Any research or trial conducted as part of ongoing rehabilitation across the site will be reported in subsequent Annual Environmental Management Reports for the site.

5 FINAL REHABILITATION

5.1 Rehabilitated Areas and Final Features

5.1.1 Objectives

NCOPL's rehabilitation objectives for all areas of mine-related surface disturbance within the surface facilities areas can be defined in the short and long term.

In the short term, the objectives will be to stabilise all earthworks, drainage lines and disturbed areas that are required for mine-related activities in order to minimise erosion and sedimentation, and to reduce the visibility of the activities from adjacent properties and the local road network. Rehabilitation to meeting this objective was detailed in Section 4 of this MOP.

The rehabilitation of the final landform features beyond the term of this MOP will represent an extension of the rehabilitation procedures and philosophy outlined in Section 4, as refined by monitoring. Longer-term objectives (i.e. those to be achieved prior to lease relinquishment) include:

- Decommissioning and removal of all project-related infrastructure not required for the future use of the site;
- The creation of a low maintenance, geotechnically stable, safe and vegetated landform which blends with the surrounding natural landscape;
- Backfilling the box cut and blending of the final landform with the surrounding topography such that the visual impact of the post-mining landform is minimised;
- Remediating any land contaminated by accumulated salts or hydrocarbon spills / leaks; and
- Re-establishment of agricultural land of comparable land capability to that of the pre-disturbance environment (ie. Class III).

Plan 6 presents the conceptual plan for rehabilitation at lease relinquishment.

Given coal mining will continue for approximately 30 years, the information contained in this section of the MOP as well as Plan 6 is largely conceptual. A final Mine Closure Plan will be further developed in consultation with the relevant government authorities closer to the time of closure. This approach will ensure that the closure plan addresses the most relevant requirements and methods, applicable at that time.

In the event that NCOPL decides to develop the Narrabri South area (located within the southern portion of EL 6243), there is the potential, depending on its timing, to utilise either the existing surface facilities or at least disassemble and relocate specific surface infrastructure to the new mine site. This will be the subject of future environmental assessments and included in relevant future MOPs.

5.1.2 Final Landform and Land Use

With the exception of the area associated with the rail loop and Reject Emplacement Area, the final landform within the Pit Top Area and other sites of long-term disturbance will be similar to that which currently exists with the land capability / agricultural land suitability to be returned to that similar to pre-mining levels. Plan 6 shows the features of the indicative final landform within and adjacent to the Pit Top Area.

The intention to retain the rail loop may influence the succeeding land use depending upon land use around the Pit Top Area at the time.

Rehabilitation of the mine site will involve activities in five distinct areas:

1. Pit Top Area Infrastructure

All surface infrastructure, with the exception of the mine access road and rail infrastructure, will be decommissioned, dismantled and removed from the mine site. The disturbed areas of the Pit Top Area will be backfilled where appropriate (eg. box cut and underground water storage dams – after dam lining and saline material is removed), profiled, covered with available topsoil and revegetated with either pasture grass species or native tree, shrub and grass species (depending on final landform and land use requirements).

2. Reject Emplacement Area

As the permanent 14° batters of each cell of the Reject Emplacement Area are formed, they will be progressively capped with the previously stripped subsoil and topsoil. On completion of each cell to the nominated 15m height, the top surface will be profiled and revegetated with a fast growing cover crop.

3. Water and brine storage ponds

Following dewatering of the ponds, the plastic liner of each pond will be removed and transported to a waste disposal facility. Following testing to confirm there have been no breaches in the liner, the ponds will be backfilled, profiled, re-topsoiled and revegetated with pasture species to create a landform comparable with the surrounding topography.

4. Ventilation and gas drainage infrastructure

The ventilation and gas drainage infrastructure will be rehabilitated in much the same way as the Pit Top Area, albeit on a smaller and more widespread scale. When facilities are no longer required, all remaining infrastructure (eg. fans, evases, storage sheds) will be decommissioned and removed from site. The shafts will be filled in (or sealed) by a method approved by the relevant government agency. The material from the surrounding bund walls will either be pushed into the shafts, or used to backfill the sumps and profile the areas.

5. Surface cracking caused by subsidence

The disturbance resultant from any surface cracking caused by subsidence will be progressively rehabilitated. For smaller width cracking, the surface will simply be ripped to allow the cracks to be filled in. In some instances, the surface may be too wide to be effectively in-filled by surface ripping and in these instances, material excavated from within the footprint of the Reject Emplacement Area will be used to in-fill the cracks prior to ripping and revegetation.

5.2 Remaining Features

Plan 6 presents the conceptual final landform and completed rehabilitation activity at relinquishment of the lease. The retained infrastructure is identified, which at this stage will include the following features:

1. **Rail Loop** - There is potential for the rail loop to be considered valuable infrastructure for the future land owner and hence retained on closure. In the unlikely event the rail loop is not to be retained, the cutting will be filled with material excavated from the footprint of the nearby ROM and

product stockpile area and the entire disturbance footprint will be re-profiled to recreate a similar topography to that which currently exists (i.e. undulating and sloping to the east);

2. **Perimeter Amenity Bund** - With the exception of the material required to backfill the box cut, the southern extent of the perimeter amenity bund (refer Plan 6) will be retained on closure and will act as a wind break for future agricultural activities and fauna habitats; and
3. **Water Management Structures** - Most surface water structures such as the sediment dams and diversion banks will be retained to maximise the availability of water for any future land use of the mine site.

As noted previously, Plan 6 is conceptual only, with additional detail to follow in subsequent MOPs and the Mine Closure Plan. There may be potential for a future landowner to retain some additional items of surface infrastructure such as storage sheds and workshop buildings. Retention of any items will be negotiated with the future landowner and regulatory authorities at the time and these areas have been incorporated into Table 4.2.

5.3 Rehabilitation Planning Criteria

Rehabilitation planning criteria for the mine site as presented in Table 5.1 have been taken from “Strategic Framework for Mine Closure” (ANZMEC, 2000) to ensure the most appropriate and efficient rehabilitation techniques are applied. Advice will also be sought from representatives of I&I NSW, DoP, NOW, DECCW and specialist consultants employed by NCOPL regarding any additional actions that need to be adopted by the mine.

An integral part of NCOPL’s rehabilitation planning and management is the application of the recommendations and procedures set out in the various management plans and monitoring programs outlined in Table 1.2. These plans and programs will, where applicable, be used to establish the criteria for the final rehabilitation of the site. The criteria will be presented in greater detail in subsequent MOPs and the Mine Closure Strategy.

Table 5.1 Rehabilitation Planning Criteria

Criteria	Summary of Intended Action
Rehabilitation and rehabilitation outcomes consistent with the EA which forms the basis of this approval.	The rehabilitation proposed within this MOP, and the more detailed Landscape Management Plan, prepared in accordance with Condition 3 (of Schedule 5) of PA 08_0144, will build on the objectives, concepts and procedures presented in the Stage 2 EA.
Based on mine closure criteria and rehabilitation outcomes developed through stakeholder consultation.	A Mine Closure Plan will be developed, based on the final landform and land use objectives identified in the EA, continued consultation with the local community and government agencies, and the most up-to-date mine closure criteria produced by I&I NSW or other State or Commonwealth government agencies.
Integrates rehabilitated native vegetation with undisturbed native vegetation to provide larger areas and wildlife corridors.	Any disturbance will be managed as per the Landscape Management Plan. Any disturbed areas will be rehabilitated as much as practicable to their pre-disturbance state. The final landform, through vegetation of the perimeter amenity bund will provide some additional habitat for native fauna and therefore provide for a marginally larger area of native vegetation. A proposal has also been put forward to government agencies

	identifying areas both on and off the mine lease that have value as biodiversity offsets. If these areas are approved as offsets, they will add significant value to the vegetation, habitat and corridor values of the site.
Suitable for an agreed subsequent land use as far as possible compatible with the surrounding land fabric and land use requirements.	The surface facilities area will be revegetated with pasture and cropping species to the preference of the eventual land user and will be of similar land class to that which exists on the mine site. In addition, dams constructed on the mine site will be retained to assist in future agricultural activities.
Addresses limitations on the use of rehabilitated land.	The land capability class of those areas of the final landform designated for future agricultural activities will be comparable to the pre-mining classification.
Sustainable in terms of the land use.	The final land use is an extension of existing land uses.
Stable and permanent landforms, with soils, hydrology, and ecosystems with maintenance needs no greater than those of surrounding land (may include waste emplacements, voids, pits and water-bodies providing that they are part of the accepted final outcome).	The conceptual final landform has been designed with slopes comparable to the topography of the surrounding environment. The rehabilitated areas of the mine will be integrated with similar areas on the mine site and the surrounding environs to prevent isolation and decreased viability.
Securely and safely contain waste substances that have the potential to affect land use or result in pollution.	Any saline material accumulated in the evaporation ponds or brine storage ponds will either be placed in the drifts prior to backfilling of the box cut and/or reinjected into the goaf at the end of mine life. Alternate measures for disposal will also be investigated on an ongoing basis as required in the project approval. The Reject Emplacement Area will be rehabilitated to a stable, low maintenance landform.
Not present a hazard to persons, stock or native fauna.	The final landform will be created with safe and stable slopes and as such will not present a greater than normal risk to persons, stock or native fauna when compared to elements of the existing landform.
Addresses threatened species issues.	Threatened species will be managed as per the Landscape Management Plan and Biodiversity Offset Strategy.
Addresses heritage issues.	All identified sites will be managed to ensure these are not damaged. The management controls and procedures will be documented in the Aboriginal Cultural Heritage Management Plan for the mine.
Clean and tidy, and free of rubbish, metal and derelict equipment/structures, except for heritage and other agreed features.	All non-production waste materials generated by the mine and associated activities will be disposed off-site by waste contractors licensed in this function.
Freedom from unacceptable air and water pollution, and other environmental effect outside the disturbed area.	The mine will be operated in accordance with conditions imposed by the development consent and Environment Protection Licence (EPL). Monitoring programs for air quality, noise, blasting, surface water and groundwater will be prepared and implemented to verify compliance with consent and EPL conditions.

5.4 Monitoring and Maintenance

NCOPL's commitment to effective rehabilitation will involve an ongoing monitoring and maintenance program for the life of the mine.

The areas of the Pit Top Area and other surface disturbance which have been progressively rehabilitated to date (as part of site stabilisation activities) are, and will continue to be, regularly inspected and assessed against the short and long term

rehabilitation objectives outlined in Section 5.1.1. During regular inspections, aspects of rehabilitation to be monitored will include:

- Evidence of any erosion or sedimentation from areas with establishing vegetation cover;
- Success of initial pasture / cover crop establishment;
- Adequacy of drainage controls; and
- General stability of the rehabilitation site.

Where rehabilitation success appears limited, maintenance activities will be initiated. These may include re-seeding and where necessary, re-topsoiling and/or the application of specialised treatments such as composted mulch to areas with poor vegetation establishment. Tree guards will be placed around planted seedlings should grazing by native animals be excessive. If drainage controls are found to be inadequate for their intended purpose or compromised by grazing stock or wildlife, these will be replaced and/or temporary fences installed to exclude grazing of native vegetation by native or domestic fauna.

Should areas of excessive erosion and sedimentation be identified, remedial works such as importation of additional fill, subsoil or topsoil material or redesigning of water management structures to address erosion will be undertaken.

6 ENVIRONMENTAL AND REHABILITATION RISK IDENTIFICATION

The risk associated with each predicted environmental impact was assessed in the Stage 2 EA without the inclusion of any operational controls or safeguards in place. Following this, controls, safeguards or mitigation measures were proposed to address each of the risks and the EA then provided an analysis of mitigated risk with consideration of these proposed measures, which is replicated in Table 6.1.

Table 6.1 Environmental Risk Identification Matrix

Potential Environmental Impacts	Level/Scale of Impact (if applicable)	Consequence of Occurrence if Mitigated	Likelihood of Occurrence if Mitigated	Mitigated Risk Rating
Subsidence				
Damage or destruction of structures / infrastructure	Impact on residential / domestic structures on the mine site	2	B	H
	Impact on residential / domestic structures off the mine site	2	E	L
	Impact on services infrastructure (eg. power lines, pipelines)	3	D	M
Alteration of local drainage	Ponding and altered hydrological flows along local creeks and tributaries	2	B	H
	Realignment of local creeks and tributaries	2	C	M
	Altered surface flows affecting contour banks and drainage on agricultural land	2	C	M
Increased erosion along drainage lines and subsequent decrease in water quality		2	C	M
Change to structure or composition of vegetation communities and fauna habitat		2	C	M
Reduced availability of groundwater as a result of fracturing altering Hydrogeological flow paths		3	C	M
Disturbance of, or damage to Aboriginal sites or artefacts		2	D	L
Groundwater				
Groundwater pollution by leaking/split hydrocarbon	Contamination requiring minor recovery works	1	D	L
	Contamination requiring major recovery works	3	E	M
Drawdown of groundwater	Reduced water levels within the aquifers of the Intake Beds to the Great Artesian Basin Groundwater Source	2	D	L
	Reduced water levels within the aquifers of the Lower and Upper Namoi Alluvial Groundwater Source	3	D	M
	Reduced water levels within the aquifers of the Gunnedah Basin Groundwater Source	1	B	M
Reduction in groundwater bore yields	Reduction in yield within groundwater bores on Proponent owned land	1	A	H*
	Reduction in yield of <15% of non-project related bores	1	B	M
	Reduction in yield of >15% of non-project related bores	3	D	M
Impacts on Groundwater Dependent Ecosystems		2	C	M
Surface Water/Flooding and Drainage				
Reduce natural surface water flows	Reduced productivity of downstream grazing lands	2	D	L
	Stressing of downstream native vegetation due to restricted flows	2	C	M
Consequence of Occurrence: 1 = Insignificant; 2 = Minor; 3 = Moderate; 4 = Major; 5 = Catastrophic Likelihood of Occurrence: A = Almost Certain; B = Likely; C = Possible; D = Unlikely; E = Rare Risk Ranking: E = Extreme; H = High; M = Moderate; L = Low				
Note *: Represents the lowest risk rating that can be assigned as the lowest possible consequence or likelihood has been assigned.				

Table 6.1 Environmental Risk Identification Matrix (cont.)

Potential Environmental Impacts	Level/Scale of Impact (if applicable)	Consequence of Occurrence if Mitigated	Likelihood of Occurrence if Mitigated	Mitigated Risk Rating
Surface Water/Flooding and Drainage (continued)				
Reduced quality of downstream waters	Isolated and minor event resulting in temporary degradation of water quality in local creeks and tributaries, eg. minor discharge of saline water	2	D	L
	Continuing discharge of contaminated water resulting in ongoing degradation of water quality in local creeks and tributaries, eg. regular discharge of saline or dirty water	4	E	H*
	Isolated and major event resulting in temporary but wider spread degradation of water quality, eg. discharge of hydrocarbons reaching Namoi River	4	E	H*
	Repeated major event resulting in long-term and wide spread degradation of water quality, eg. continued discharge of saline water reaching the Namoi River	5	E	H*
Changes to local flooding patterns	Change to structure and composition of vegetation communities and fauna habitat	2	E	L
	Reduction in the value of agricultural land	1	D	L
Soil Erosion and Sedimentation				
Soil erosion	Minor gully erosion of drainage lines, stockpiles or created slopes	1	C	L
	Minor sheet or gully erosion of rehabilitated landform	1	C	L
	Major gully or sheet erosion formation	2	D	L
Sediment load and turbidity	One-off discharge of dirty water from the mine site	2	D	L
	Regular discharge of water from the mine site	3	E	M*
Threatened Flora and Fauna				
Loss of, or alteration to, existing habitats	Disturbance to native vegetation/habitat in accordance with the proposed activities	1	A	H*
	Disturbance to native vegetation/habitat outside the areas nominated as part of the proposed activities	2	D	L
Direct adverse impact on threatened species	Disturbance to threatened flora, fauna or endangered communities	3	D	M
	Disturbance leading to local population reduction	4	E	H*
	Disturbance leading to local extinction(s)	4	E	H*
Reduced biodiversity	Local biodiversity	3	E	M*
	Regional biodiversity	4	E	H*
Aboriginal Heritage				
Impact on identified sites and/or artefacts of Aboriginal cultural heritage as a result of the proposed construction and mining activities and without the permission of the registered Aboriginal stakeholders or DECC		4	E	H*
Impact on unidentified sites and/or artefacts of Aboriginal cultural heritage as a result of subsidence and without the permission of LALC or DECC		3	D	M
Noise and Blasting				
Increased noise levels associated with mine site activities causing annoyance distractions, ie. amenity impacts	Occasional minor exceedance of noise criteria (1-2dB(A))	1	B	M
	Regular minor exceedance of noise criteria (1-2dB(A))	2	B	H
	Marginal exceedance of noise criteria (3-5dB(A))	2	B	H
	Regular marginal exceedance of noise criteria (3-5dB(A))	3	B	H
	Occasional major exceedance of noise criteria (>5dB(A))	2	E	L
	Regular major exceedance of noise criteria (>5dB(A))	3	E	M
Consequence of Occurrence: 1 = Insignificant; 2 = Minor; 3 = Moderate; 4 = Major; 5 = Catastrophic				
Likelihood of Occurrence: A = Almost Certain; B = Likely; C = Possible; D = Unlikely; E = Rare				
Risk Ranking: E = Extreme; H = High; M = Moderate; L = Low				
Note *: Represents the lowest risk rating that can be assigned as the lowest possible consequence or likelihood has been assigned.				

Table 6.1 Environmental Risk Identification Matrix (cont.)

Potential Environmental Impacts	Level/Scale of Impact (if applicable)	Consequence of Occurrence if Mitigated	Likelihood of Occurrence if Mitigated	Mitigated Risk Rating
Noise and Blasting (continued)				
Increased noise/vibration levels associated with project road and rail traffic activities causing annoyance, distractions, ie. amenity impacts	Occasional minor exceedance of noise criteria (1-2dB(A))	1	E	L
	Regular minor exceedance of noise criteria (1-2dB(A))	2	E	L
	Marginal exceedance of noise criteria (3-5dB(A))	2	E	L
	Regular marginal exceedance of noise criteria (3-5dB(A))	3	E	M
	Occasional major exceedance of noise criteria (>5dB(A))	2	E	L
	Regular major exceedance of noise criteria (>5dB(A))	3	E	M
Maximum noise levels resulting in sleep disturbance		3	D	M
Increased noise levels associated with the project leading to reduced production, ie. impacts on livestock		2	W	L
Blasting related ground vibration resulting in structural damage to buildings and structures		3		
Nuisance/amenity impacts on surrounding landowners/residents resultant from blasting related ground vibration and air overpressure soundwaves		2		
Reduced agricultural production resultant from blasting related distress to livestock		2		
Air Quality				
Nuisance – deposited dust	Deposited dust levels attributable to the Longwall Project occasionally exceed (for one or two months every year) the DECC guideline	1	C	L
	Deposited dust levels attributable to the Longwall Project regularly exceed (for >5 months per year) the DECC guideline	3	D	M
Health – PM ₁₀	PM ₁₀ levels attributable to the Longwall Project occasionally above the project goal at non-project related residences	2	C	L
	PM ₁₀ levels attributable to the Longwall Project regularly exceed (>5 times per year) the project goal at non-project related residences	3	D	M*
Ventilation of saline water resulting in impacts on vegetation	Restricted to predominantly non-native vegetation within immediate vicinity of ventilation shaft	1	C	L
	Impacts on native vegetation or extending beyond immediate vicinity of ventilation shaft	2	D	L
	Impacts extend beyond the mine site or impact on extensive areas of native vegetation	3	E	M*
Increased greenhouse gas emissions		1	B	M
Visual Amenity				
Reduced amenity of altered mine site landform	Temporary disturbance to landform	1	A	H*
	Marginally identifiable change to the landscape in the final landform	1	A	H*
	Highly identifiable change to the landscape in the final landform	1	C	L
Impacts on the effectiveness of the Siding Springs Observatory		2	E	L
Traffic and Transport				
Increased traffic congestion		1	E	L
Road pavement deterioration		1	D	L
Consequence of Occurrence: 1 = Insignificant; 2 = Minor; 3 = Moderate; 4 = Major; 5 = Catastrophic				
Likelihood of Occurrence: A = Almost Certain; B = Likely; C = Possible; D = Unlikely; E = Rare				
Risk Ranking: E = Extreme; H = High; M = Moderate; L = Low				
Note *: Represents the lowest risk rating that can be assigned as the lowest possible consequence or likelihood has been assigned.				

Table 6.1 Environmental Risk Identification Matrix (cont.)

Potential Environmental Impacts	Level/Scale of Impact (if applicable)	Consequence of Occurrence if Mitigated	Likelihood of Occurrence if Mitigated	Mitigated Risk Rating
Traffic and Transport (continued)				
Elevated risk of accident/incident on local roads	Minor accident – no injury	1	D	L
	Minor accident – minor injury	2	D	L
	Major accident – moderate injuries requiring hospitalisation	3	E	M*
	Severe accident – severe injuries or death injury	4	E	H*
Elevated risk of rail related accident/incident	Minor accident – no injury	1	D	L
	Minor accident – minor injury	2	D	L
	Major accident – moderate injuries requiring hospitalisation	3	E	M*
	Severe accident – severe injuries or death injury	4	E	H*
Soils and Land Capability				
Insufficient soil quantities for rehabilitation		2	D	L
Reduced soil quality	Temporary disturbance to soil	1	B	M*
	Degradation of soil quality	2	D	L
Elevated erosion or erosion potential		2	D	L
Decreased land and agricultural capacity of the final landform		3	E	M*
Rehabilitation, Final Landform & Biodiversity Offsets				
Reduced access to agricultural lands		2	D	L
Increase in areas designated for native vegetation conservation		n/a	n/a	n/a
Waste Management				
Contamination by waste oil	Contamination requiring minor recovery works	1	D	L
	Contamination requiring major recovery works	3	E	M*
Acid generation from overburden used in construction of bunds and Pit Top Area structures		3	E	M*
Reduced amenity of mine site due to poor rubbish, litter management		1	D	L
Land Contamination				
Transfer of contaminated material	Small area affected (<0.01ha)	1	E	L
	Large area affected (>0.01ha)	2	E	L
Contamination of surface water as a result of exposing contaminated lands	Minor and temporary contamination of water quality in local creeks and tributaries	1	D	L
	Minor and continuing contamination of water quality in local creeks and tributaries	3	E	M*
	Major and temporary contamination of water quality in local creeks and tributaries	3	E	M*
	Major and continuing contamination of water quality in local creeks and tributaries	4	E	H*
Spontaneous Combustion				
Injury sustained as a consequence of fire	Minor injury	1	E	L
	Moderate injury requiring first aid	2	E	L
	Injury requiring hospitalisation	3	E	M*
	Sever injury or death	5	E	H*
Impacts on native flora and fauna in the event of fire spreading beyond coal stockpiles	Small fire within mine site	1	E	L
	Moderate fire extending beyond the mine site	2	E	L
	Large fire extending far beyond the mine site	3	E	M*
Consequence of Occurrence: 1 = Insignificant; 2 = Minor; 3 = Moderate; 4 = Major; 5 = Catastrophic				
Likelihood of Occurrence: A = Almost Certain; B = Likely; C = Possible; D = Unlikely; E = Rare				
Risk Ranking: E = Extreme; H = High; M = Moderate; L = Low				
Note *: Represents the lowest risk rating that can be assigned as the lowest possible consequence or likelihood has been assigned.				

Table 6.1 Environmental Risk Identification Matrix (cont.)

Potential Environmental Impacts	Level/Scale of Impact (if applicable)	Consequence of Occurrence if Mitigated	Likelihood of Occurrence if Mitigated	Mitigated Risk Rating
Socio-Economic Impacts and Property Values				
Improved economic activity and related social impacts attributable to reduced employment		n/a	n/a	n/a
Reduced quality of life (actual or perceived)		3	E	M*
Reduced property values	Temporary decrease in property values	1	D	L
	Moderate term decrease in property values	2	D	L
	Long term decrease in property values	3	E	M*

Through the implementation of the proposed controls, safeguards and mitigation measures identified in the EA the risk rating for the majority of potential environmental impacts has been reduced.

In some cases, a rating is not provided as the relevant assessment recorded in the EA determined the likelihood to be so low, or consequence so insignificant, as to be virtually nonexistent. This approach was taken generally when the risk rating could not be considered any lower than “high” due to a likelihood classification as “almost certain” or consequence classification as “catastrophic” so as not to suggest a significance that does not exist.

Further consideration is given in the EA to the potential impacts which retain a “high” risk rating.

7 ENVIRONMENTAL MANAGEMENT CONTROLS

The environmental management controls for the mine site have been drawn from the Project Approval and accepted industry/operating standards. This section addresses each of the environmental risks listed in Table 6.1 to the extent necessary for each risk. Where an environmental management plan or monitoring program has been prepared for a particular environmental risk, reference is made to the relevant plan or program. All management plans and monitoring programs can be found on the Whitehaven Coal website (www.whitehavencoal.com.au).

7.1 Air Pollution

7.1.1 Environmental Management Plans

NCOPL will adopt a range of design and operational safeguards and operational procedures for the mine to ensure that the effectiveness of the air quality controls are optimised throughout all stages of the mine's development and operation.

The controls have been selected largely based on their proven effectiveness at other mines.

Vegetation Clearing

- Cleared trees and branches will be retained on the margins of cleared areas for use in stabilising disturbed areas once they are no longer required.

Soil Stripping

- Where practicable, soil stripping would be undertaken at a time when there is sufficient soil moisture to prevent significant lift-off of dust.
- Stripping will be avoided in periods of high winds.
- Dust suppression by water application will be used to increase soil moisture, if required.

Continuous Miners and Longwall Unit

- Strategically located water sprays will be operational on all continuous miners, the longwall unit and the breaker feeder to minimise dust creation underground.

Coal Transfer, Crushing and Screening

- Notwithstanding the moist nature of the ROM coal, water will be applied to the coal at the feeder hopper, crusher, and at all conveyer transfer and discharge points.
- All conveyers will be fitted with appropriate cleaning and collection devices to minimise the amount of material falling from the return conveyer belts.
- The coal breaker will be enclosed.
- All surface conveyors will be partly enclosed to minimise dust lift-off.

- Some flexibility will exist to temporarily cease operation in the event of protracted dry periods, high winds, and significant dust generation and dispersal towards surrounding residences.

Construction of the Brine Storage Ponds

- When the prevailing winds are from the northwest quadrant, construction activities within the Brine Storage Area will cease.

Wind Erosion from Exposed Surfaces and Stockpiles

- Minimising the extent of clearing/site preparation during site establishment and preparation of operational sites across the mine site including the campaigns to construct the area for reject emplacement.
- Clear definition of all the site roads and the restriction of vehicles and equipment to the roads.
- Progressive rehabilitation of areas of disturbance including topsoil and subsoil stockpiles.
- Routine application of water sprayed onto stockpiles and hardstand areas.
- Construction of a perimeter amenity bund and windbreaks.

Coal Loading to Rail Wagons

- The coal loaded onto the conveyor to the rail load-out facility will be watered as required to maintain sufficient moisture content to prevent dust lift-off during loading – noting the wagons will be loaded within the rail cutting which provides protection from the wind.

Coal Transportation

- At this stage, no specific controls are proposed for the rail wagons to be used to transport the coal between the mine site and Port Newcastle.

7.1.2 Monitoring

Refer to the Narrabri Coal Mine Air Quality Monitoring Program.

7.2 Erosion and Sediment Control

7.2.1 Environmental Management Controls

Erosion and sediment control will be managed generally as per the Narrabri Coal Mine Site Water Management Plan. Erosion and sedimentation issues related to subsidence will be specifically addressed in the Extraction Plan.

7.2.2 Monitoring

Refer to the Narrabri Coal Mine Site Water Management Plan and Subsidence Extraction Plan.

7.3 Surface Water Pollution

7.3.1 Environmental Management Controls

Surface water classifications and key management principles are discussed in Section 3.8.2. The SWMP provides further detail on surface water management onsite.

7.3.2 Monitoring

Refer to the SWMP prepared for the Narrabri Coal Mine.

7.4 Groundwater Pollution

7.4.1 Environmental Management Controls

Mine dewatering and groundwater management measures are discussed in Section 3.8.1. The SWMP provides further detail on groundwater management onsite.

7.4.2 Monitoring

Refer to the SWMP prepared for the Narrabri Coal Mine.

7.5 Contaminated Polluted Land

No contaminated or polluted land has been identified and as such no specific management controls or monitoring procedures are required. The greatest risk for the contamination or pollution of land as a result of the mine is associated with the potential for fuel or oil spills/leaks. Section 7.17 documents the management controls to be implemented by NCOPL in the event of a hydrocarbon spill or leak.

7.6 Threatened Flora

NCOPL will continue to manage all aspects of flora management as per the site's Landscape Management Plan and Biodiversity Offset Strategy.

7.7 Threatened Fauna

NCOPL will continue to manage all aspects of fauna management as per the site's Landscape Management Plan and Biodiversity Offset Strategy.

7.8 Weeds

7.8.1 Environmental Management Controls

If required, appropriate noxious weed control methods and programs will be undertaken as per the site's Landscape Management Plan.

7.8.2 Monitoring

The mine site will be regularly inspected for weeds as per the site's Landscape Management Plan. Additional monitoring will be undertaken at the request of the local weeds inspectors. The results of all monitoring and weed control works will be included in the relevant AEMR.

7.9 Blasting

7.9.1 Environmental Management Controls

Given the very minor nature of the blasts that will occur on an infrequent basis and the depth at which they will occur, no specific management measures are proposed.

7.9.2 Monitoring

No monitoring is proposed during the term of this MOP.

7.10 Operational Noise

7.10.1 Environmental Management Controls

Management of operational noise has been outlined in the Narrabri Coal Mine Noise Management Plan. Hours of operation influencing noise have also been outlined in Section 3.4.7.

Additional measures implemented at the mine include more comprehensive monitoring of inversions during the winter period and the use of real time noise monitoring at the most affected residential receivers, which provides active management of noise levels in advance of non-compliances occurring.

7.10.2 Monitoring

Refer to the Narrabri Coal Mine Noise Monitoring Program.

7.11 Visual, Stray Light

7.11.1 Environmental Management Controls

The principal visual control measures adopted within the Pit Top Area include:

- The 3m high perimeter amenity bund (refer to Plan) provides a barrier for views to the facilities within the Pit Top Area, particularly from Kurrajong Creek Road and the closest residences ("Naroo", "Ardmona" and "Bow Hills"). A cover crop has been established over the bund itself to limit its visual contrast and the bund has been, and will continue to be, planted with a range of trees and shrubs to create a long term screen and fauna movement corridor;

- All areas not required for site operations, particularly following site establishment, will be revegetated to ensure the maximum area of grassed paddock is present;
- The load-out bin and site buildings will, where possible, be a grey/green hue to limit their overall visibility; and
- A high standard of housekeeping will be adopted to maintain a tidy site.

The initial Ventilation Shaft Area has been selected in an area already shielded from residences to the south and southeast by topography and existing vegetation. The construction of the perimeter bund around the shaft itself will further reduce visual access to this area. Each additional ventilation shaft will also be surrounded by a bund wall, which will be grassed to reduce visual contrast.

Gas drainage activities will be temporary in nature, and similar visually to the exploration drilling activities which have been ongoing over the mine site for a number of years. Beyond a distance of a few hundred metres, the activities will be virtually imperceptible with dust suppression activities undertaken to reduce dust generation, likely to be the most noticeable aspect of these operations. Once completed, the gas drainage sites will be rehabilitated to establish the pre-existing vegetation.

7.11.2 Monitoring

No monitoring is proposed during the term of this MOP.

7.12 Aboriginal Heritage

Refer to the Aboriginal Cultural Heritage Management Plan prepared for the site.

7.13 Natural Heritage

No listed heritage sites were identified during a desktop survey of the mine site area. One structure of interest, an abandoned sawmill, was identified during field surveys undertaken by Archaeological Surveys and Reports Pty Ltd (AS&R). AS&R concluded, however, that the sawmill is of no local historical interest, and of only low educational value, insufficient to warrant its classification as a structure of Heritage Significance.

On this basis, no management or monitoring of natural heritage is proposed.

7.14 Spontaneous Combustion

Spontaneous combustion will be managed and monitored as per the site's Spontaneous Combustion Management Plan.

7.15 Bushfire

Refer to the Narrabri Coal Mine Landscape Management Plan for details on bushfire management.

7.16 Mine Subsidence

Subsidence impacts are described in Section 3.4.6. The Extraction Plan will provide outline subsidence management measures and monitoring requirements.

7.17 Hydrocarbon Contamination

7.17.1 Environmental Management Controls

The following controls have been, and will continue to be, implemented by NCOPL:

- All water from wash-down areas and workshops will be directed to oil separators and containment systems;
- All storage tanks will either be self bunded or partitioned with an impermeable bund with a capacity to contain a minimum 110% of the largest storage tank capacity;
- All hydrocarbon products will be securely stored; and
- With the exception of less mobile mining equipment which will be predominantly refuelled within the box cut area, designated areas will be allocated for refuelling and minor maintenance work. The use of these areas will be enforced by mine management.

7.17.2 Monitoring

In the event of a hydrocarbon spill, the affected area will be regularly inspected after rectification to ensure there is no ongoing effect on the land that will prevent it from being successfully rehabilitated.

7.18 Methane Drainage/Ventilation

7.18.1 Environmental Management Controls

Gas drainage and mine ventilation is discussed in Section 3.4.5.

7.18.2 Monitoring

Monitoring is undertaken as per the site's Health and Safety Management System, incorporating a Monitoring Arrangement Management Plan.

7.19 Public Safety

7.19.1 Site Safety Management

NCOPL implements procedures and controls to protect the safety of employees, visitors to the mine, the public in general, as well as local landowners and land users. These measures will be continued throughout the MOP period to ensure the security of the mine facilities and equipment from unauthorised access or use.

It is NCOPL's policy that each person employed on, or visiting, the mine site is provided with a safe and healthy working environment and, to achieve this, NCOPL will maintain the recruitment, induction and training program to achieve the following objectives:

- To ensure compliance with statutory regulations and maintain constant awareness of new and changing regulations;
- To eliminate or control safety and health hazards in the working environment in order to achieve the highest possible standards for occupational safety;
- To ensure the suitability of prospective employees through a structured recruitment procedure;
- To provide relevant occupational health and safety information and training to all personnel;
- To develop and constantly review safe working practices and job training;
- To conduct regular safety meetings and provide an open forum for input from all employees.
- To provide effective emergency arrangements for all employees and general public protection;
- To maintain good morale and safety awareness through regular employee assessment and counselling (if required);
- To ensure all contractors adopt NCOPL's policy objectives and maintain safety standards at all times while working on the mine site; and
- To develop public awareness of the safety standards and objectives at the project site.

Central to all aspects of site security and safety at NCOPL will be:

- The adoption of a pro-active approach to employee and public safety;
- Strict compliance at all times with the requirements of the:
 - *Coal Mine Health and Safety Act 2002*;
 - *Coal Mine Health and Safety Regulation 2006*;
 - *Dangerous Goods Act 1975*;
 - *Occupational Health and Safety Act 2000 (and Regulation 2001)*;
 - All other relevant legislation and Australian Standards;
 - WorkCover NSW; and
 - Industry and Investment NSW – Minerals.
- The prioritisation given to addressing any safety issues identified by an Inspector or Mine Safety Officer or authorised government official (as specified in the *Coal Mine Health and Safety Act 2002*); and
- A Health, Safety and Environmental Policy to cover all competent activities at the mine.

NCOPL is required under the Coal Mine Health and Safety Act 2002, to develop and implement a Health and Safety Management System and Major Hazard Management Plan.

NCOPL will continue to implement the following measures:

- Erection and maintenance of temporary fencing around the additional areas of surface disturbance associated with the operation (eg. ROM coal pad extension, CPP and Longwall Unit Assembly Area. A security fence will also be maintained to enable the continuation of agricultural activities in those areas not designated for mining-related activities;
- Signage will be maintained along the mine access road advising visitors about office locations as well as sign in and personnel protective equipment requirements;
- Position security/warning signs at strategic locations around or within the mine site indicating the presence of construction operations. The signs will be positioned to alert employees/visitors entering the Pit Top Area as well as passing motorists;
- Employee induction in safe working practices and regular follow-up safety meetings and reviews;
- Ensure all crushing and conveying equipment at all times complies with all relevant requirements and standards;
- Strictly complying with all mining lease, planning approvals and licence conditions; and
- Establishment and demarcation of construction areas within the mine site in accordance with Section 87 of the *Coal Mine Health and Safety Regulation 2006*.

7.19.2 Monitoring

No monitoring is required at this stage and none is proposed.

8 REFERENCES

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