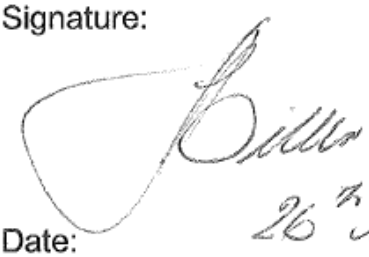
Centennial Coal

Ivanhoe North Open Cut

Mining Operations Plan

November 2013

Name of Mine	Ivanhoe North Colliery
MOP Commencement Date:	17 March 2012
MOP Completion Date:	17 March 2019
Mining Authorisations (Lease / Licence No.):	Mining Lease 1627
Name of Authorisation/Title Holder(s):	Centennial Ivanhoe Pty Limited
Name of Mine Operator (if different):	Centennial Coal Limited
Name and Contact Details of the Mine Manager (or equivalent):	Bob Miller: 02 63559810;
Name and Contact Details of Environmental Representative:	Tom Hollis- 0419111473
Name of representative(s) of the Authorisation Holder(s):	Bob Miller: 02 63559810;
Title:	Manager
Signature:  Date: 26th November, 2013	

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1. Introduction

This Mining Operations Plan (MOP) covers the Ivanhoe North Open Cut within CCL 712 and ML1627 as shown on **Figure 1**, for the period 17th March 2012 to 17th March 2019. Open cut extraction is due for completion by June 2012 following which the remainder of the site will be rehabilitated with the view of relinquishment at or prior to the expiry of the proposed MOP term.

This MOP has been prepared in accordance with guidelines EDG03 Mining, Rehabilitation and Environmental Management Process as well as the current draft Rehabilitation and Environmental Management Plan (REMP) guidelines. This MOP can be considered a REMP should the REMP process be confirmed during the term of this MOP. As both guidelines have been used, the term REMP when used in this document should be considered synonymous with the term MOP.

This MOP does not cover activities associated with Ivanhoe No 1, 2 or 4 sites which are subject to a separate MOP and rehabilitation program.

1.1 History of Operations

The Ivanhoe North Open Cut commenced operation in July 2009. The mine operates under the Environmental Protection Licence (EPL 13063) and Development Consent (05_0103). The extraction area was the subject of previous coal mining, and mining related operations including the Cullen Main West open cut mining operations completed in the years following World War II and more recently mine ventilation and mine waste disposal for the Ivanhoe and Invincible Collieries.

The main purpose of the Ivanhoe Open Cut operation was to extract the remaining coal reserves while rehabilitating the older open cut and mine ventilation facilities. The target coal was located between the old remnant open cut highwall of the Cullen Main West Open Cut and the underground workings of the Ivanhoe No 2 Colliery. The extraction is nearing completion while landform shaping and rehabilitation works are at an advanced stage over the previous extraction area.

1.2 Proposed and Future Operations

1.2.1 Scope

This MOP addresses the final rehabilitation requirements for Ivanhoe North Open Cut and provides a program of activities following the cessation of mining.

The program is based on the current Closure Plan prepared in April 2011 with only minor amendments to timing. The program has been delayed

slightly due to the coal extraction and mining phase being extended from approximately 24 months to nearly 36 months due to additional coal reserves available.

1.2.2 Objectives

The main objective in the future management of the Ivanhoe North Open cut is to rehabilitate to a comparable surrounding vegetation community. Specifically, rehabilitation objectives include:

- The creation of a stable final landform.
- The re-establishment of vegetation over the mining lease comparable in species composition, density and cover to that of the pre-mining environment and the surrounding remnant vegetation.
- The vegetation of the mining lease will be self-sustaining, with noxious weeds controlled such that they occur in equal or lesser density than elsewhere in the local area.
- The creation of a final landform and vegetation communities that enhance local and regional ecological linkages across the site and with proximate areas
- The creation of a final landform and vegetation capable of a return to the premining land use (of sustainable forestry and native vegetation conservation).

1.2.3 Period

This REMP covers the period 17 March 2012 to 17 March 2019.

1.3 Consents Leases and Licences

Ivanhoe has operated under four main documents.

- Project Approval 05_0103 (approved 11 April 2007) granted by the Minister for Planning, remains valid for a period of 3 years following the granting of a mining lease An extension of 3 months to 2nd May 12 was granted due to the roadworks delay at the start of the project.
- Environment Protection Licence No. 13063 issued by the Department of Environment and Climate Change (Environment Protection Authority) (DECC (EPA)) under the Protection of the Environment Operations Act 1997
- Mining Lease 1627 granted by the Division of Resources and Energy (DRE).
- Mining Operations Plan approval for the period ending 17 March 2012.

1.4 Mine Contacts

Key personnel responsible for managing the operation and its environmental aspects are as follows:

Name	Position	Contact Details
Neil Larcombe	Manager Mining Engineering	02 6355 9810; 0438 478868
Rob Hunt	Environmental Coordinator	02 6355 7965; 0428 602069

1.5 Resources (Mine Geology)

1.5.1 Regional Geology

Geologically, the mining lease is located within the Sydney sedimentary basin. The Sydney sedimentary basin consists of a series of gently dipping sedimentary beds of shale and sandstone of Permo-Carboniferous age capped by the Triassic sandstones and shales of the Narrabeen Group. The sandstone and shale of the Narrabeen Group forms the prominent cliffs of the Blue Mountains and underlies the city of Sydney. Conformably underlying the Triassic Narrabeen Group are the Illawarra Coal Measures, a Permian age group of shale, sandstone, conglomerate and coal. Directly beneath the Triassic sandstone these beds contain coal seams and form the Upper Coal Measures. The Permian coal measures lie unconformably over the Devonian age basement rocks of slate, quartzite, limestone and granite.

Within the Sydney sedimentary basin, ML 1627 is located in an area known as the Western Coalfield, which extends from Lithgow in the south to north of Ulan, and is generally bounded by the outcrops of the coal seams on the western edge of the Sydney sedimentary basin. There is no defined boundary of the coalfield to the east as the coal measures dip to the northeast below the Hawkesbury sandstone, which caps the Blue Mountains, at a rate of approximately 1:50 and extend out to sea.

The Illawarra Coal Measures contain five main coal seams, which in descending order of elevation area as follows.

- Katoomba Seam.
- Middle River Seam.
- Irondale Seam.
- Lidsdale Seam.
- Lithgow Seam.

The Lithgow Seam has been the primary coal seam mined in the Western Coalfield, especially where it merges with the Lidsdale Seam north of Blackmans Flat, with most of the coal mines located along its outcrop (which generally follows the Castlereagh Highway).

Faults, dykes and other seam discontinuities are relatively rare in the section of the Western Coalfield where ML 1627 is located.

1.5.2 Local Geology

Three of the coal seams identified above were previously targeted by the Cullen Main West open cut, namely the Irondale, Lidsdale and Lithgow seams. Notably, the Irondale Seam is split into the Lower and Middle Irondale within ML 1627. Recoverable coal is retained within all three seams and has been mined as described in the previous MOP. Figure 1.1 presents a representative cross-section through the open cut showing the typical seam and interburden thickness.

1.5.3 Resource Assessment

The Ivanhoe North resource was established at approximately 550 000t within the four coal seams. Table 1.1 presents a summary of the coal resource quantity and quality.

Table 1.1 Recoverable Coal Resource

Coal Seam	Average Thickness (m)	Recoverable Coal (t)	Ash Content
Middle Irondale	0.5	5 000	18% - 30%
Lower Irondale	Upper ply 0.6	20 000	8% - 16%
	Lower ply (banded) 1.9	100 000	42%[#]
Lidsdale	1.5	100 000	30%*
Lithgow	Upper plies 2.0	185 000	25%
	Lower plies 1.6	140 000	12% - 13%
Total		550 000	
[#] Selective blending would result in coal of ash content of 30% or lower * Ash content obtained through selective recovery and blending of four plies within the seam			
Source: Centennial Coal			

Extraction is due for completion by June 2012 with less than 5,000 tonnes of remaining resource

A MOP amendment approved in March 2011 allowed for mining of additional barrier pillar coal which had not been identified originally. This resulted in an additional amount of coal of around 60,000 tonnes.

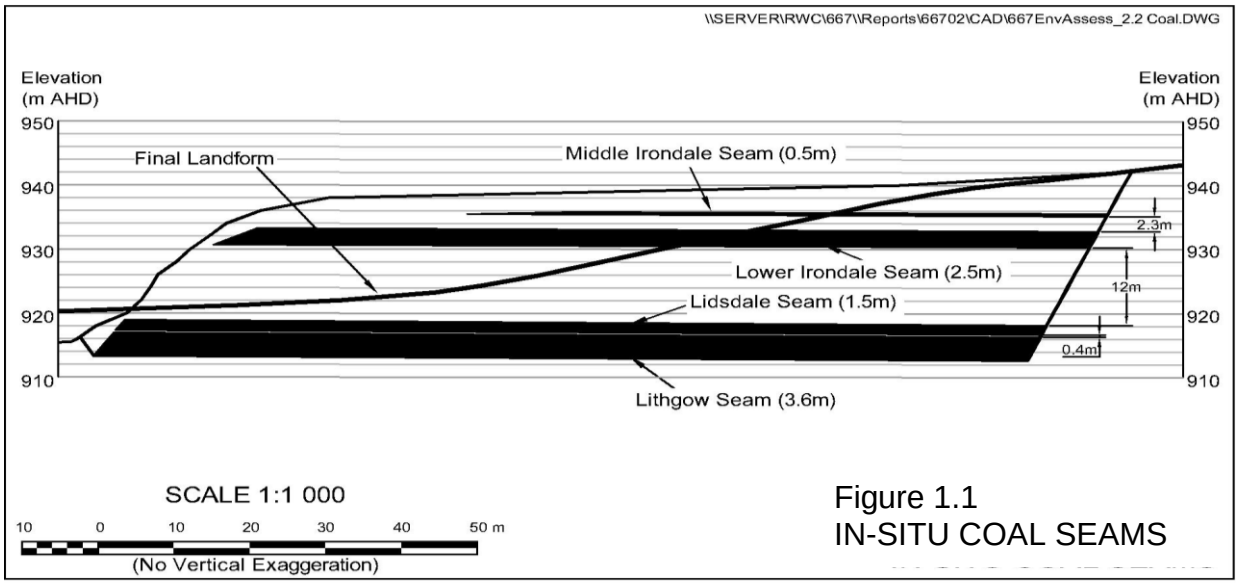


Figure 1.1
IN-SITU COAL SEAMS

1.6 Land Ownership

ML 1627 is located wholly within the Ben Bullen State Forest and includes MPL 79, (an Ivanhoe Coal Pty Ltd surface lease of 12.2ha).

The Ben Bullen State Forest is Crown land without any specific land titles. As a State Forest, the land is managed by Forests NSW. The mining operation has been approved by Forests NSW.

Table 1.2 and Plan 1 present the ownership details and dwellings on the land surrounding the ML 1627.

Table 1.2 Land Ownership

Ref*	Land Parcel (Lot / DP Number)	Land Owner	Residence(s)
1	Lot 11, DP 249955, Lot 4, DP 1008594 and Lot 112, DP 877190	M. Bulkeley	D
2	Lots 1 and 2, DP 860892	B. Muenzer	B, K
3	Lot 10, DP 249955	I. Palmer	C
4	Lot 13, DP 755769, Lot 17, DP 755769 & Lot 177, DP 755769	V. & F. Fava, C. Rositano, F. Tedesco, E. Todorello	E
5	Lot 38, DP 755769, Lot 68, DP 755769, Lot 69, DP 755769, Lot 72, DP 755769, Lot 73, DP 755769, Lot 76, DP 755769 Lot 280, DP 755769 and Lot 281, DP 755769	S. & D. Taylor	G
6	Lot 14, DP 755769, Lot 15, DP 755769, & Lot 178, DP 755769	A. & K. Brown	F
7	Lot 264, DP 755769, Lot 263, DP 755769 & Lot 186, DP 755769	J .& S. Taylor	H
8	Lot 18, DP 755769, Lot 22, DP 755769, Lot 64, DP 755769, Lot 185, DP 755769, Lot 5, DP 1071704 & Lot 6, DP 1071704	R. Clark	I
9	Lot 1, DP 1016508	G. & J. Clark	J

10	Lot 362, DP 740604, Lot 366, DP 740604	Delta Electricity	
11	Lot 11, DP 614429	Hyrock Pty Limited	
12	Lot 1, DP 180294 and Lot 113, DP 877190	Coalpac Pty Limited	A
13	Ben Bullen State Forest (no title)	Crown Land	
Source: Land Property Information Service * see **Plan 1**			

1.7 Stakeholder Consultation

The Ivanhoe North Open Cut has had minimal impact on the local community and remains largely unnoticed in the local area, mainly due to tree screening and the implementation of environmental management controls. In recognition of this, as well as the short duration of Project life (maximum of 3 years), PA 05_0103 does not include a condition requiring the formation of a Community Consultative Committee. Considering this, Centennial has not prepared any formal community information program, although irregular communications are carried out with neighbouring property owners.

Stakeholders were consulted for the 2006 EA. In addition to the Department of Planning and Infrastructure, key stakeholders in the assessment of the project included the local community, Lithgow City Council and other relevant NSW government agencies.

Current consultation with relevant stakeholders includes:

- The results of monitoring undertaken on the properties of the site's surrounding neighbours are provided to these land owners / residents via the Centennial Coal website;
- Centennial Coal advertise the site phone number locally and provide all reasonable requests for information received;
- Each year, the site prepares an Annual Environmental Management Report (AEMR). Three AEMR's have been completed for the Project;
- Regular formal and informal contact will be maintained with relevant agencies. Reports are provided to relevant authorities in the event of a non-compliance or a potential non-compliance with respect to statutory criteria or guidelines.

Future consultation will involve informing stakeholders (government and land owners) of the rehabilitation and closure process. Government agencies have been sent a copy of the 2011 Rehabilitation and Closure Plan which has now been approved by DRE.

Rehabilitation and closure has been a staged process at Ivanhoe North and consultation will be required following final closure of the site. **Table 1.3** outlines the key consultation requirements for the INRP.

Table 1.3 - Consultation Methods

Stakeholder	Information Requirements and Method of Consultation
Centennial Coal Pty Ltd	Regular updates on the status of project. Centennial corporate will be informed throughout the process and will assist in decision making.
Neighbouring mine sites (non Centennial – Invincible and Cullen Valley)	Centennial regularly meets with the neighbouring mine Invincible Colliery. Invincible will be made aware of final production date. Invincible will be made aware of status of the project during rehabilitation and closure.
Land owner (Forests NSW)	Consulted during EA. AEMR's sent to Forests NSW and invited to AEMR Presentations. A copy of the MOP will be sent to Forests NSW. Centennial will liaise with Forests NSW throughout the closure process.
Land lease from Forests NSW and nearby neighbours	Consulted during EA. Consultation throughout the project. Send letter outlining the status of the project.
Big Rim (open cut contractor)	Centennial Ivanhoe participates in regular meetings with Big Rim to discuss mine scheduling and general operations. Big Rim will be sent a copy of this MOP. A final date for end of mining will be established following discussions between Big Rim and Centennial Ivanhoe. The Big Rim Mining Contract will be completed following the completion of mining and landform shaping at Ivanhoe North to the agreed standard. All equipment and buildings owned by Big Rim will be removed from site.
Contract transport company	Centennial regularly meet with the contracting transport company. The company will be given sufficient notice prior to the completion date for coal haulage.
Nearby neighbours	A community newsletter will be distributed outlining the ceasing of operation, rehabilitation and closure methodology.
Lithgow City Council (LCC)	A copy of the 2011 Rehabilitation and Closure Plan was sent to the LCC. AEMR's sent to LCC and invited to AEMR Presentations
Department of Planning and Infrastructure(DoPI)	Consulted as part of the EA. DoPI receives a copy of AEMR and invited to AEMR Presentations.

Stakeholder	Information Requirements and Method of Consultation
Department of Trade and Investment - Division of Resources and Energy (DRE)	Consulted as part of the EA. DRE will be sent a copy of this plan. DRE receives a copy of the AEMR and invited to AEMR Presentations. Centennial will continue to consult with DRE throughout closure process. Rehabilitation monitoring results will be supplied to DRE. Centennial will discuss the lease relinquish requirements with DRE.
Office of Environment and Heritage (OEH)	Consulted as part of the EA. OEH will be sent a copy of this plan for comment. OEH will be sent a copy of the 2010 AEMR and invited to AEMR Presentations.
Transport Roads and Maritime Services (TRMA)	Consulted as part of EA and preparation of intersection. A letter will be sent to TRMA outlining the proposed date of final production.
Aboriginal Groups.	No requirement to inform. Consultation undertaken during the EA process.

2. Proposed Mining Activities

Mining activities at Ivanhoe North are nearing completion with all extraction and coal transport operations expected to be completed by June 2012. The remaining period of this MOP will involve rehabilitation and monitoring activities. It is anticipated that the rehabilitation work will be fully completed allowing application for lease relinquishment prior to the end of this MOP period.

2.1 Exploration

The coal resource geology is well understood and no further exploration will be undertaken during the term of this MOP. In the event exploration is undertaken, it will be completed in accordance with relevant exploration licence conditions and the Mining Lease with relevant details reported within each AEMR.

2.2 Land Preparation

2.2.1 Introduction

Land preparation refers to the sequential clearing of vegetation and stripping of soil prior to the removal of overburden and interburden, mining of the identified coal seams and progressive backfilling and rehabilitation of mined-out areas. For mine planning purposes, the areas that have been cleared (and ultimately mined and rehabilitated) have been divided into three areas, namely the “Southern” (Sth), “Central” (Cen) and “Northern” (Nth) blocks. Each of these areas were further divided into operational blocks, eg. Block Sth03, Cen04 and Nth01. **Figure 3.1** presents the general sequence of open cut development which has now been largely completed.

As illustrated on **Figure 3.1**, the Ivanhoe North Open Cut was developed in a generally south to north direction, ie. from Sth01 to Nth05, although initial preparation activities involved the establishment of an internal haul road between the mining blocks and coal crushing area. The internal roads leading to extraction areas is shown on Plate 1.

Plate 1 – Loading Coal from Area C4

As extraction is at the final mining strip, no further land preparation is required during the term of this MOP. **Plan 3** presents the extent of land preparation undertaken for previous mining strips and is included for completeness.

2.2.2 Vegetation Clearing

No further vegetation clearing is required during the term of this MOP. Existing cleared vegetation will be used for the rehabilitation program

The previous open cut operation disturbed regrowth vegetation on areas previously disturbed by the Cullen Main West open cut as well as approximately 12.3ha of the Tablelands Grassy Woodland Complex beyond the remnant highwall of the Cullen Main West open cut. An assessment of the environmental impacts of this clearing was assessed in the original environmental assessment and documented in the previous MOP. Clearing procedures as provided in the original approval and subsequent MOP have been followed during the course of mining.

2.2.3 Topsoil Management

Only a minor amount of topsoil was generated during the open cut operation, which was stockpiled adjacent to the hardstand area. Alternative topdressing material was generated by the earthworks component consisting of the friable weathered surface overburden material. This material was separated and spread over completed and shaped areas prior to sowing.

This procedure will be followed for the current and final mining strip.

2.2.4 Materials Production Schedule

The open cut operation is nearing completion and only minor volumes of overburden and coal will be removed. This operation will be completed by June 2012 but listed in the following table as Year 1 of the MOP period. All subsequent years will have no overburden, topsoil, waste or coal removed.

Table 2.1 - Materials Production Schedule During MOP Term

Material	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Stripped topsoil	m^3	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Waste Rock/Overburden	m^3	30,000	Nil	Nil	Nil	Nil	Nil	Nil
Ore	m^3	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Processing waste	m^3	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Product	t	5,000	Nil	Nil	Nil	Nil	Nil	Nil

Material volumes shown in Year 1 are nominal at this stage and includes final shaping of the remaining open cut area.

2.3 Construction

No Construction activities are proposed during the reporting period.

2.4 Mining

2.4.1 Mine Layout and Design Criteria

Plan 4 presents the progressive development of the mine since commencement, illustrating the sequential development of the open cut and rehabilitation through backfilling, profiling and revegetation. The extent of the open cut beyond the remnant highwall reflects the limit beyond which the overburden to coal stripping ratio was too high to recover the coal economically.

The original design of the mine layout considered:

- ❒ avoiding unnecessary disturbance to native vegetation;
- ❒ allowing for the rehabilitation of the new and historic disturbance to create a moderately sloped final landform which replicates that of the surrounding Ben Bullen State Forest; and
- ❒ satisfying various environmental criteria.

The operation, now drawing to a close, has achieved the original mine design and operating conditions.

2.4.2 Mining Method, Sequence and Procedures

Conventional open cut mining methods has been used to date to progressively recover the coal remaining beyond the remnant highwall. Following the completion of land preparation activities within a mining block, overburden was removed by either:

- Load and Haul: The overburden is ripped by the mine bulldozer and loaded into 50t haul trucks by a 992 front-end loader or 75t excavator for delivery to an overburden stockpile (initially) or previously mined-out blocks of the open cut (following completion of mining in southern-most blocks).
- Bulldozer Push: The ripped overburden is pushed directly into an adjacent mined-out block of the open cut.

Generally, a single active mining bench operated within each mining block, however on some occasions, separate benches were developed. As enough coal was exposed on the bench, it was ripped, excavated and transported to a Run-of-Mine (ROM) stockpile within the coal crushing area. Once the coal has been removed, the interburden material between the targeted coal seams was removed in the same manner as the overburden to create the lower mining bench. This method will continue for the last remaining mining strip and will be followed by final shaping and revegetation works.

Given the imminent completion of coal extraction and final shaping, a mining sequence has not been developed. However **Plan 4** details the overall schedule of extraction since commencement of mining.

Plate 2 – Excavators Working the Base of the Lithgow Seam

2.4.3 Mining Equipment

Table 2.2 presents the current mining equipment which will be used during this MOP term and their primary function

Table 2.1 Earthmoving and Mining Equipment

Equipment	Number	Use	Duration/Frequency
Cat D9 Bulldozer	1	• Topsoil and overburden removal. • Shaping of backfilled final landform.	• 7:00am to 6:00pm, Monday to Saturday.
Cat 992 Front-end Loader	2	• Stockpile management and loading product. Initially load and carry ore and blasted waste rock to stockpiles.	• 7:00am to 6:00pm, Monday to Saturday.
75t Excavator	1	• Construction of water management structures and site maintenance. • Loading of coal and overburden to haul trucks.	• 7:00am to 6:00pm, Monday to Saturday.
15 000L Water truck	1	• Dust suppression.	• 7:00am to 6:00pm, Monday to Saturday.
50t Capacity Haul Truck	2	• Transportation of coal to the ROM coal stockpile. • Haulage of overburden and interburden to stockpile or backfill location.	• 7:00am to 6:00pm, Monday to Saturday.

Once coal extraction has been completed, the excavator, one haul truck and one front end loader will be demobilised. The dozer, a front end loader and a truck will remain to backfill the chitter beneath the workshop and place in the last void prior to final shaping. At the completion of final shaping, all remaining mining equipment will be demobilised. Final sowing will occur in October to November 2012 depending on weather conditions.

2.5 Coal Processing

Figure 3.3 presents the layout of the Coal Crushing Area which is also shown on Plate 3, which is located within the partially backfilled void around the old ventilation entry of the Ivanhoe No. 2 underground workings (see **Plan 4**).

ROM coal transported from the last active mining block of the open cut will be unloaded and temporarily stockpiled on a ROM pad stockpile where it will then be loaded by front-end loader into a crusher. The crushed coal will then be directed by a stacker to the crushed product stockpiles. From here the coal will be transported by road to Lidsdale Siding for export. At this stage, no further coal is anticipated to be transported to local power stations.

Plate 3 – Coal Stockpiling and Crushing Area

2.6 Waste Management

2.6.1 Introduction

The waste materials produced by the mine can be categorised as either production by-products or non-production wastes.

Production by-products comprise:

- ❒ overburden and interburden from the development of the open cut; and
- ❒ crushing and screening wastes produced through the processing of ROM coal.

Non-production wastes include:

- ❒ general domestic-type wastes from the on-site buildings and routine maintenance consumables;
- ❒ oils and grease; and
- ❒ sewage.

Management of production wastes is described in Section 2.6.2 and 2.6.3. The management of domestic type wastes, waste oil and sewage is described in Sections 2.6.4, 2.6.5 and 2.6.6 respectively.

2.6.2 Overburden and Interburden

Above the Irondale Seam, the overburden commences as a clay layer, changing with depth to a weathered and then hard sandstone layer. The interburden between the Irondale Seam and Lidsdale / Lithgow Seams generally comprises interbedded layers of shale, sandstone, siltstone and conglomerate. All materials are sufficiently friable to enable removal by ripping and loading. No blasting has occurred at the mine and none will be necessary for the last mining strip.

The shale, sandstone, siltstone and conglomerate have been extensively excavated from coal mines locally and display a low potential for both acid formation and soluble salt generation. As such, there are no specific handling and emplacement requirements for these materials. Plate 4 shows backfilling of overburden against the Irondale Seam.

Plate 4 – Backfilling the Irondale Seam

Over 3 Million bank cubic meters of overburden has been removed during the course of the open cut with only a minor quantity to be moved as part of final shaping of the last mining block.

2.6.3 Crushing and Screening Waste

All coal was crushed to produce a suitable product for sale, with no reject produced.
Prior to the open cut commencing, approximately 40 000m^3 of coal reject has previously been stockpiled within the existing coarse reject

emplacement of MPL 79 (**Plan 2**). This reject will be removed and or buried within the final landform of the site (see **Plan 5**).

2.6.4 Domestic Type Wastes

All paper and general wastes originating from the site office, amenities and ablutions buildings, together with routine maintenance consumables from the daily servicing of equipment such as grease cartridges, is disposed of in 240L or similar mobile garbage bins located adjacent to the contractors area and site office. These bins are collected regularly and the contents placed in large waste storage bins positioned adjacent to the heavy vehicle maintenance building to await removal by a licensed industrial waste collection contractor. Industrial waste collection is undertaken as required.

Paper products and metals are separated for collection and recycling.

2.6.5 Oil Containment and Disposal

Routine maintenance of mining and earthmoving equipment is generally undertaken in the workshop building within the Mine Facilities Area, while major repairs are undertaken at equipment maintenance facilities offsite. Within the workshop building, waste oils and grease are collected and pumped to bulk storage tanks by oil evacuation pumps. Emergency or breakdown maintenance of equipment may also be necessary within the open cut. Under these circumstances, oils and grease will be pumped from this equipment to a tank on the service vehicle using an evacuation pump and then transferred to the bulk storage tank at the workshop building. All parts and packaging are collected and transferred to the workshop building for disposal or recycling.

All hydrocarbon wastes are stored in 205L drums or a 1000L bulk storage container within a bunded area within the maintenance container until collected by a licensed contractor. Worn tyres are temporarily stored adjacent to the maintenance container and removed from site regularly.

2.6.6 Sewage Treatment and Disposal

Sewage is captured within a septic tank and pumped out and transferred to the Lithgow Sewage Treatment Plant as required.

2.7 Product Stockpiles

The Coal Crushing Area consists of a ROM pad with a capacity of approximately 15 000 tonnes while the product stockpile is of a similar size though it can be divided into separate stockpiles depending on quality and destination, as shown on Plate 3.

2.8 Water Management

The management of surface water within ML 1627 is detailed in the Site Water Management Plan (SWMP), which has been prepared by GSS Environmental in prepared in accordance with *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004). The primary structures are presented on **Plan 4** and the following provides a brief summary of water management on site.

For management purposes, the water within the mine has been divided into two classes of runoff, namely:

- clean water – surface runoff from undisturbed catchment areas and from the sealed section of the site access road; and

- dirty water – this generally comprises stormwater runoff generated in disturbed areas such as the open cut floor, overburden emplacement, coal crushing, stockpile, and active rehabilitating areas. This water has the potential for contamination from sources such as sediment and coal fines.

2.8.1 Clean Water Management

Clean water is either diverted around the mining operations via clean water diversions and stabilised outlets into existing drainage lines or directed to temporary storage structures constructed within the natural drainage lines up-slope of the open cut. The captured water is self-syphoned through 100mm HDPE piping to a discharge point down-slope of the open cut.

2.8.2 Dirty Water Management

All activities on site have been designed so that the dirty water is contained within the disturbed area of the open cut (both former Cullen Main West and Ivanhoe North) and directed to internal erosion controls prior to discharge. The existing vegetated overburden stockpiles immediately down-slope of the open cut floor will provide a natural containment bund to ensure that there is no uncontrolled discharge from the active areas of the project.

The floor of the open cut is graded such that the water is directed to existing or constructed ponds on the open cut floor. These ponds act as sediment basins to allow for the settlement of sediment. The water which accumulates in the internal sediment ponds is pumped or self-syphoned through 100mm HDPE pipe, below the internal haul road to the out-of-pit sediment dams.

The out-of-pit sediment dams (**Plan 4**) have been designed and constructed to capture flows from the contributing catchments generally in accordance with the typical design for “Earth Basin - Wet SD 6-4” provided in (Landcom, 2004). The design capacity of the sediment dams,

determined for Type D (dispersible) soils for runoff resultant from an 80th percentile, 5 day rainfall event. A view of Sediment Dam 1 is provided as Plate 5.

Plate 5 – View of Sediment Dam 1

The dams have been located on the streams that would have the largest contributing disturbed catchment area. The remaining streams have significantly smaller catchment areas and other controls would be implemented, including, but not necessarily limited to, sediment fencing and straw bale sediment filters. If necessary, dirty water collected within the active or disturbed areas of the mine site is pumped to the out-of-pit sediment dams.

A sediment basin has also been constructed within the Coal Crushing Area to capture any runoff from within this area. This sediment basin has been designed and constructed in accordance with the recommendations of Landcom, 2004. A schedule of dams at Ivanhoe North is provided in Table 2.3.

Table 2.3 - Surface Water Storages at Ivanhoe North

Clean Water Dams	Sediment (Dirty Water) Dams
Clean Water Dam No. 1 (CWD-1)	Sediment Dam No. 1 (SD-1)
Clean Water Dam No. 2 (CWD-2)	Sediment Dam No. 2A & 2B (SD-2A & SD-2B)
Clean Water Dam No. 3 (CWD-3)	Sediment Dam No. 3 (SD-3)
Clean Water Dam No. 4 (CWD-4)	

2.8.3 Water Use

Approximately 20ML has been required annually for the suppression of dust generated by the mining-related activities, coal crushing and internal transport. This water has been obtained primarily from the dirty water collected in the in-pit, out-of-pit and Coal Crushing Area structures, supplemented by approximately 6 MLpa of clean water captured in the temporary storage dams up-slope of the open cut.

Ivanhoe North has not required trucking water into the site and there is sufficient water storage for dust suppression for the remainder of the activities on site.

2.9 Hazardous Materials

A 30 000L of diesel transtank is located within the Mine Facilities Area. All handling, storage and transportation of dangerous goods has been undertaken in accordance with relevant Australian Standards including *AS1940, AS1596* and the *Dangerous Goods Code.*

No other hazardous materials or chemicals will be stored on site.

2.10 Other Infrastructure

No other infrastructure has been constructed or affected on or adjacent to ML 1627.

3. Environmental Issues Management

This Chapter identifies the environmental management planning and controls required to address identified environmental implications of the final mining and rehabilitation activities at Ivanhoe North Open Cut.

3.1 Air Quality

To reduce the amount of "lift-off dust" discharged from the open cut operation, the Coal Crushing Area has been located within the partially filled void surrounding the Ivanhoe No.2 ventilation shaft entry point. The below surface location of the coal crusher and stockpiles will provide shielding from winds likely to result in the generation of dust.

A dust control strategy has also been implemented for the life of the Ivanhoe North Open Cut incorporating the following components.

- ❒ Watering of internal haul roads at a rate of approximately 2L/m^2 per application.
- ❒ Minimising the drop heights between front-end loader buckets and trucks carrying coal or overburden.
- ❒ Limiting disturbance to that required for 3 to 4 months operations.
- ❒ Progressive rehabilitation once mining blocks are completed.
- ❒ Cessation of dust-generating activities when strong winds blowing dust towards residences prevail.

Ultimately, the revegetation works will significantly reduce the potential for dust generation.

3.2 Erosion and Sedimentation

3.2.1 Soils

The Ivanhoe North Open Cut is located within the Wallerawang 1: 100 000 scale Soil Landscapes map sheet area and is described as bordering on an area of Hassans Walls Soil Landscape on the southeastern side and being largely surrounded by Cullen Bullen Soil Landscape on all other sides.

Soil from six test pits across the open cut area were excavated as part of the original environmental assessment which identified two separate Soil Mapping Units (SMUs). The first SMU (SMU 1) occurs in the drainage depressions which traverse the Project Site and the second (SMU 2) occurs on the slopes and crests. **Plan 3** identifies the locations of the six soil test pits and mapped boundary between the two SMU's.

Table 3.1 presents a summary of the soil profiles and characteristics of the identified SMUs.

Table 3.1 Summary of Soil Mapping Units within the Open Cut Area

General	Topsoil	Subsoil
SMU 1		
Soil depth: 215cm to 250cm *Surface:* firm *Stones:* surface stone absent or some angular surface stone 2cm-10cm	*Horizons:* single A horizon *Texture:* silty clay loam; silty clay or medium to heavy clay; many roots present *pH:* 5.5 to 6.5 *Colour:* brown / grey coloured	*Horizons:* up to three B horizons *Texture:* medium to heavy clay *pH:* 4.5 to 6.0 *Colour:* shades of white, grey, pink, yellow, brown and grey
SMU 2		
Soil depth: to 72cm deep *Surface:* soft, loose or firm *Stones:* usually some rounded or angular blocky surface stone 2cm-8cm present, occasionally surface stone absent.	*Horizons:* single A horizon *Texture:* loamy sand, silty clay loam, sandy clay loam or medium clay *pH: 5.0 to 6.5-70* *Colour:* shades of brown, light brown and pink	*Horizons:* Three B horizons *Texture:* medium clay or medium to heavy clay *pH:* not noted *Colour:* variously coloured brown, white, yellowish red

Based on the physical attributes of the soil and assessment using the SOILOSS computer program, all samples were allotted a moderate erodibility hazard. All soils are non-saline and fall within the pH range considered optimal (although towards the acidic end) for plant growth. The depth of topsoil varies between the two soil types, however, both have been used in the rehabilitation work on previous mining blocks.

3.2.2 Erosion and Sedimentation Controls

The identified areas of the open cut which may be sources of erosion include:

- ❒ Active areas of disturbance;
- ❒ ROM and product coal stockpiles;
- ❒ Haul roads
- ❒ Site access roads
- ❒ Soil stockpiles; and
- ❒ Rehabilitated areas (until stabilised).

Land disturbance will be minimised by clearing the smallest practical area of land ahead of rehabilitation and coal recovery activities and leaving this disturbed for the shortest possible time. This has been achieved by:

- ❒ Restricting the areas to be cleared of existing vegetation to the areas directly upslope of the abandoned high wall;
- ❒ Scheduling the works so that only the areas sufficient for the ensuing 1 to 2 months of operations would be cleared;
- ❒ Implementing all proposed erosion and sediment control measures in advance of, or in conjunction with, clearing and stripping operations;

- ❒ Marking the limits of disturbance prior to clearing commencing using pegs placed at intervals on each side of the disturbed area; and
- ❒ Planning all operations to ensure that there is no damage to any trees outside the limits to be cleared.

3.2.3 Management of Soil Resources

Once the larger vegetation was cleared from areas in advance of overburden removal, topsoil was stripped to a depth of 15cm from SMU1 (found within the drainage depressions of the four streams), and 10cm from SMU 2 (found on the crests and slopes of the areas to be disturbed) (GCNRC, 2006). Up to 50cm of subsoil was stripped separately to the topsoil.

Generally, stripped soil was transported to completed sections of the final landform for immediate spreading. In some cases though it was stockpiled for later use. These stockpiles were less than two metres high with a batter slope of 2:1 to preserve biological viability and reduce soil deterioration.

The stripped and stockpiled soil was re-spread in the reverse sequence to its removal, so that the organic layer, containing any seed or vegetation was returned to the surface. Topsoil was spread to a minimum depth of 50mm on 3:1 or steeper slopes and to a minimum depth of 100mm on flatter slopes. Re-spreading on the contour assisted runoff control and increases moisture retention for subsequent plant growth. Re-spread topsoil was levelled to achieve an even surface, avoiding a compacted or an over-smooth finish.

Only minor topsoil resources remain but there is sufficient to complete the remaining rehabilitation works.

3.3 Surface Water

ML1624 is located within the upper catchments of the Turon River near the divide between the Turon River and Cox's River catchments. Surface water flows on ML1624 drain locally to two sub-catchments of the Turon River identified as Sub-catchment C, which drains to Cullen Creek, and Sub-catchment H, which drains to Hunts Creek.

Within the area to be disturbed by the open cut, four ephemeral "first order" drainage lines or streams have been identified. **Table 3.2** summarises the relevant features of each of these drainage lines.

Table 3.2 – Drainage Lines within the Ivanhoe North Open Cut

Drainage Line	Sub Catchment	Catchment Area (above high wall)	Comments
Stream 1	C	12ha	Previous mining activities disturbed the natural flow path of Steam 1 with current flows to an artificial channel, constructed as part of the previous mining works.
Stream 2	H	5ha	Most of the surface flow is now captured within the open cut floor of the former open cut.
Stream 3	H	24ha	Has been largely left undisturbed by previous mining activities and has been allowed to flow along its natural flow path. Significant gully erosion evident. A figure has been prepared for the restoration of stream 3
Stream 4	H	3ha	Has been largely left undisturbed by previous mining activities and has been allowed to flow along its natural flow path.

Once extraction works are complete in each mining block, the land surface is constructed in accordance with the final landform levels and progressively rehabilitated. The natural drainage lines have been reinstated to their original position and rehabilitated to a relatively stable condition.

Initially, the drainage lines were formed as part of the landform profiling activities, ie. a very shallow gradient towards the original alignment of the four drainage lines being created. Although originally planned to remove dams and diversion channels, Forests NSW (landholder) have indicated that these structures be left after rehabilitation.

An example of these sediment dams is provided as Plate 6.

Plate 6 – Sediment Dam 2B with Monitoring Shed

3.4 Ground Water

No groundwater was encountered during the open cut operation and none is expected during the rehabilitation program.

3.5 Contaminated Land

No contaminated or polluted land was identified within the areas to be disturbed. As such, no specific management controls or monitoring procedures were required. Once the workshop, offices and bunded fuel tank are removed, any contaminated soil will be collected and removed from site by a licensed operator if considered necessary.

3.6 Flora and Fauna

3.6.1 Regional Setting

The mining lease is located within the Sydney Basin Bioregion of the Central Tablelands Botanical Subdivision. In a review of vegetation distribution throughout NSW, Keith (2004) classified the vegetation of the area within which the open cut is located, as Southern Tablelands Dry Sclerophyll Forest. This vegetation type typically occurs on the ridges and ranges of the central and southern tablelands between elevations of 600m and 1 100m AHD. It is well represented in conservation areas but requires ongoing management for control of bushfires and feral animal grazing.

3.6.2 Flora of the Mining Lease

Two vegetation types ("Vegetation Map Units" – VMUs) have been identified on the mining lease (Gingra, 2006) (see Plan 2). These are described as follows.

VMU 1 - Tablelands Grassy Woodland Complex

This VMU occurs across those sections of the mining lease which continue to support native vegetation, ie. have not been disturbed for the purposes of mining or forestry.

Table 3.3 presents a summary of the major flora noted within VMU 1 on the mining lease.

Table 3.3 - Flora of VMU1

Common Name, Scientific Name	Common Name, Scientific Name
Trees	
Red Stringybark, *Eucalyptus macrorhyncha*	Yellow Box*, *Eucalyptus melliodora*
Western Scribbly Gum, *Eucalyptus rossii*	Apple Box*, *Eucalyptus bridgesiana*
Brittle Gum, *Eucalyptus praecox*	Long-leaved Box*,*Eucalyptus goniocalyx*
Broad-leaved Peppermint, *Eucalyptus dives*	Blakely's Red Gum*,*Eucalyptus blakelyi*
Narrow-leaved Stringybark, *Eucalyptus sparsifolia*	
Understorey	
Silver Wattle, *Acacia dealbata*	*Mountain Holly, Podolobium ilicifolium*
Bossiaea neo-anglica	*Brachyloma daphnoides*
Chinese Scrub, Cassinia arcuata	*Monotoca scoparia*
Persoonia linearis	*Lissanthe strigosa*
Pultenaea microphylla	*Acacia buxifolia*
Hibbertia obtusifolia	
Ground layer	
Wallaby Grass, *Danthonia racemosa*	*Goodenia hederacea*
Redanther Wallaby Grass, *Joycea pallida*	*Gonocarpus tetragynus*
Rock Fern, Cheilanthes sieberi	*Dianella revoluta*
Snow Grass, *Poa sieberiana ssp. sieberiana*	*Hydrocotyle laxiflora*
Blue-leaved Snow Grass, *Poa sieberiana* ssp. *cyanophylla*	
Weeds	
St John's Wort, *Hypericum perforatum*	Cudweed, *Gnaphalium* sp.
Blackberry, *Rubus ulmifolius*	Catsear, *Hypochaeris radicata*
Spear Thistle, *Cirsium vulgare*	

Common Name, Scientific Name	Common Name, Scientific Name
* On the lower slopes only Source: Modified after Gingra (2006)	

Tree height is generally between 10m and 18m with the number and diversity of the tree species generally increasing with the transition from the more elevated ridges of the southeast to the more gently sloped areas to the north and west of the former open cut. The understorey composition is comparable between these two areas with an increased ground layer over occurring on the lower slopes.

On ridges and exposed slopes the dominant trees are Red Stringybark, *Eucalyptus macrorhyncha*, Western Scribbly Gum, *E. rossii*, Brittle Gum, *E. praecox* and Broad-leaved Peppermint, *E. dives* with Narrow-leaved Stringybark, *E. sparsifolia* also present on the upper slopes. In the lower gullies this VMU supports additional tree species including Yellow Box, *E. melliodora*, Apple Box, *E. bridgesiana*, Long-leaved Box, *E. goniocalyx* and Blakely's Red Gum, *E. blakelyi*.

The vegetation class into which this VMU is broadly grouped is widespread and well represented in conservation reserves.

VMU 2 - Regeneration on the Former Open Cut

This area supports some regenerating plants of VMU 1 and some exotic weeds although many bare areas remain as a result of the previous mining operation. The understorey and ground layer is generally consistent (when present) with that of VMU 2. Some of the regenerating plants appear to be the result of replanting with non-local species such as River Oak (*Casuarina cunninghamiana*).

None of the flora species identified within the mining area was considered to be of specific conservation significance (under relevant NSW or Commonwealth legislation), nor does it support any endangered ecological communities (Gingra, 2006).

3.6.3 Fauna of the Mining Lease

Three fauna habitats were identified within ML1627.

- Native woodland and/or open forest: which displays a low, fairly open canopy with sparse shrub and ground cover strata. Due to the low nutrient status of the underlying soils, fauna densities are likely to be low but important habitat features are tree hollows, a variety of perching/roosting sites, a degree of structural complexity, decorticating bark, fallen timber, grass cover and leaf litter.

- Cleared or disturbed areas: which have little habitat value for fauna, as the only vegetation is some limited regrowth of trees and shrubs.

- ❒ Ponds and drainage lines: afford habitat for a narrow range of frogs and those reptiles that prey upon them. There is no dense, fringing vegetation around the ponds nor are there any large pools in the creeks that would widen the range and increase the abundance of frogs present.

A total of 11 bird, 7 mammal and 1 reptile species were identified during a field survey conducted by Gingra Ecological Surveys Pty Ltd in 2006 (Gingra, 2006) (see **Table 3.4**).

Table 3.4 - Fauna Species of the Project Site

Common Name	Scientific Name
Birds	
Common Bronzewing Pigeon	Phaps chalcoptera
Eastern Rosella	Platycercus eximius
Southern Boobook	Ninox boobook
Laughing Kookaburra	Dacelo novaeguineae
White-throated Treecreeper	Cormobates leucophaeus
Flame Robin	Petroica phoenicea
Grey Fantail	Rhipidura fuliginosa
Buff-rumped Thornbill	Acanthiza reguloides
Spotted Pardalote	Pardalotus punctatus
Yellow-faced Honeyeater	Lichenostomus chrysops
White-eared Honeyeater	Cormobates leucophaeus
Mammals	
Ringtail Possum	Pseudecheirus peregrinus
Eastern Grey Kangaroo	Macropus giganteus
Common Brushtail Possum	Trichosurus vulpecula
Greater Glider	Petauroides volans
Swamp Wallaby	Wallabia bicolor
Common Wombat	Vombatus ursinus
Feral Pig[#]	Sus scrofa
Reptiles	
Eastern Common Froglet	Crinia signifera
# = Introduced species Source: Modified after Gingra (2006)	

None of the fauna species identified within the previous open area or surrounding areas was considered to be of specific conservation significance (under relevant NSW or Commonwealth legislation).

3.7 Weeds and Pests

During rehabilitation and revegetation programs it is common for weed invasion to occur, as conditions are made favourable to encourage plant growth. Regular inspections of the rehabilitation areas will be carried out and necessary work undertaken to remove weeds until a self sustaining

vegetation system has been established that is of sufficient health and vigour to naturally exclude weed growth.

Current weed control measures employed for the Ivanhoe North Open Cut include:

- Centennial Coal ensures that all employees are aware of the noxious weed species identified on site and will maintain relevant identification notes / pictures in the office for the reference of all employees;
- The mining lease is regularly visually inspected for the presence of weed species. Should weed species be identified on the rehabilitation areas, control actions will be implemented; and
- All weed management actions will be reported in each AEMR.

Inspections of the site indicate only a minor population of weeds across site mostly congregated in disturbed areas. It is planned to undertake weed spraying around dams and other recently disturbed areas as part of the ongoing rehabilitation maintenance and monitoring program.

At this time, no specific feral pest management programs such as trapping and destruction, or the use of baiting for foxes and feral dogs, will be undertaken. If considered necessary, these programs will be developed in consultation with appropriate representatives of the Lithgow City Council (LCC) and Forests NSW.

3.8 Blasting

No blasting will occur on site during the term of this MOP.

3.9 Noise

Specific noise mitigation measures have not been required on site to date and are unlikely to be necessary during the term of this MOP. Use of heavy machinery will be required for the final coal extraction and reshaping operation but this should be concluded by the end of June 2012.

3.10 Visual and Lighting

The topography and surrounding vegetation of Ben Bullen State Forest provides significant natural screening of the activities on the mining lease. However, to further ensure the visual impact of the mine was minimised, the following additional controls were implemented.

- The extent of disturbance was restricted to that required for the ensuing 3 to 4 months mining requirements.

- The existing spoil dumps of the former open cut, which provide an established cover of native vegetation, were retained.
- The Coal Crushing Area is located within the partially backfilled void above the Ivanhoe No. 2 ventilation fan entry, placing it below the sight line to surrounding residences and other public and private vantage points.
- The progressive rehabilitation of the mining lease will quickly create a vegetated landform similar to that of the surrounding Ben Bullen State Forest.
- Erection of a screening fence as shown on Plate 7.

Plate 7 – Section of Screening Fence

3.11 Aboriginal Heritage

A search of the Aboriginal Heritage Information Management System (AHIMS) – Aboriginal Sites Register within a 10km and 10km square area centred on the open cut site identified a total of 71 recorded sites, none of which were located over the mining lease.

No Aboriginal artefacts or sites were identified during a field survey by an archaeologist of OzArk Environment and Heritage Management Pty Ltd and a representative of the Bathurst Local Aboriginal Land Council representative (OzArk, 2006).

3.12 European Heritage

No items of European Heritage exist on site and none were disturbed by the Open Cut operation.

3.13 Spontaneous Combustion

The Lithgow Seam has a low propensity for spontaneous combustion. It can experience some heating if left exposed for extended periods in poorly formed stockpiles. All coal material stored at the sites will be removed prior to final rehabilitation and no coal will be generated or stockpiled as part of the rehabilitation activities. The previous reject emplacement has been exposed for many years and has not been subject to spontaneous combustion. The material will be buried within the final profiling of the void to ensure that the risk of future heating will be negligible.

3.14 Bushfire

Under the *Rural Fires Act 1997,* there are a number of obligations that must be met with respect to managing the land. In summary, these include:

- Occupiers of land are to extinguish fires or notify fire fighting authorities immediately; and
- It is the duty of the owner or occupier of land to take practicable steps to prevent the occurrence of bush fires on, and to minimise the danger of the spread of bush fires on or from that land.

The following measures will be employed at the site to ensure that these obligations under the Rural Fires Act are met:

- Water storages on site will be available for fighting purposes if required. This will include on site dams and water tanks.
- maintaining access to the site during rehabilitation works;
- no vegetation will be burnt on site;
- the water cart can be made available to fight fires if necessary;
- The Rural Fire Service will be informed immediately any bush fire is detected in the surrounding area.

3.15 Mine Subsidence

No underground extraction has occurred for this project and none is proposed.

4. Post Mining Land Use

4.1 Rehabilitation

4.1.1 Stakeholder Requirements

The statutory requirements for rehabilitation work in relation to surface disturbance within Coal Leases in NSW are principally governed by environmental provisions of the Mining Act 1992, which is administered by NSW Resources and Energy.

Centennial Coal has liaised with a number of government agencies through the Annual Environmental Management Report process including annual site meetings. The final land use has been discussed and a Closure Plan prepared and submitted to NSW Resources and Energy. The Closure Plan was circulated to relevant agencies and approval was received in March 2011. The Closure Plan provided for the majority of the site to be rehabilitated to a native forest ecosystem comparable with surrounding vegetation communities with some minor areas being dedicated to drainage.

In determining the final land use, the following factors were considered:

- ❒ Compatibility with surrounding land uses;
- ❒ Physical constraints;
- ❒ Soil availability or suitability of alternative top dressing materials;
- ❒ Visual implications and landscape compatibility;
- ❒ Existing ecological values;
- ❒ Existing land capability for the site and surrounding areas; and
- ❒ Requirements of state and local authorities and community organisations.

The agreed final land use from the Environmental Assessment and original Rehabilitation Management Plan was to create a native woodland habitat for the purpose of nature conservation or forestry as the site is located within state forest. The final land form will be commensurate with that of the surrounding Ben Bullen State Forest.

In addition, the following general rehabilitation requirements of NSW Resources and Energy are listed below:

- ❒ removal of all buildings, plant and infrastructure;
- ❒ retention of pollution control systems to protect water ways and surrounding ecosystems;
- ❒ removal and burial of remaining carbonaceous material;

- ❒ rehabilitation of all disturbed areas to safe and stable land forms compatible with the surrounding area;
- ❒ prevention of soil erosion;
- ❒ control of noxious weeds and vermin.

4.1.2 Rehabilitation Status at REMP Commencement

Rehabilitation works are at an advanced stage with only the last remaining extraction area and the stockpile and hardstand areas to be shaped and rehabilitated. Previous mining blocks have been shaped and revegetated while the majority of the final water management structures are in place. Vegetation growth has commenced and maintenance works will be carried out as required during the term of this MOP.

4.1.3 Proposed Rehabilitation Status at MOP Finish

At the end of this MOP it is anticipated that the site will be fully rehabilitated to a point where lease relinquishment could be requested.

4.2 Environmental and Rehabilitation Risk Identification

A Broad Brush Risk Assessment (BBRA) workshop was held at Centennial's Lidsdale Siding office on the 16 -18 March 2010 to identify and scope the risks associated with rehabilitation and mine closure for several Centennial sites in the Lithgow region. The workshop was facilitated by GSSE's Andrew Hutton (Principal Environmental Consultant), with assistance from GSSE's Chris Jones (Senior Environmental Scientist) and Ben Latimore (Graduate Environmental Engineer). Workshop attendees also included Ivanhoe North representatives Rob Hunt (Environment and Community Coordinator) and Neil Larcombe (Contract Manager).

A qualitative risk assessment methodology has been developed by GSSE specifically for undertaking risk assessments associated with mine operation applications to provide a consistent approach. The methodology has been developed in accordance with the following requirements:

- ❒ The Australian Standard AS/NZS 4360:2004 Risk Assessment;
- ❒ NSW Department of Primary Industries – Mineral Resources (DPI-MR) MDG1014: Guide to Reviewing a Risk Assessment of Mine Equipment and Operations; and
- ❒ Centennial Coal Draft Management Standard 004: Risk Management Standard.

The aspects from the Rehabilitation and Closure Costs spreadsheet were assessed for each domain. The risk assessment outlined the knowledge gaps associated with completing each rehabilitation task for each identified domain. The risk assessment report which includes the risk

register was attached to the 2010 Closure Plan while the outcomes essentially formulating the rehabilitation methods outlined in this MOP.

4.2.1 Rehabilitation Strategy

In addition to the risks associated with the rehabilitation activities, the general environmental risks associated with rehabilitating the site have been assessed and found to require only normal safety control measures.

The following Table 4.1 summarises the likely environmental risks associated with the rehabilitation of the sites in general. The risk of environmental harm resulting from each of the activities is classified as either high (H), medium (M), low (L), or not applicable (N/A) if such activity is not proposed in the future.

Table 4.1 – Environmental Risk Identification Matrix

	Mining Activity, Process or Facility														
	Exploration	Land preparation, vegetation and topsoil stripping	All construction activities including earth moving	Mine development and mining, surface and	use/maintenance of roads, tracks and equipment	waste rock emplacement management	Mineral processing facilities and infrastructure	Ore/product stockpiling and handling	Tailings impoundment	Water management including storm event contingencies	Hazardous materials and fuel, handling/spills management	Sewerage	Rubbish disposal	Rehabilitation activities	Rehabilitated land and remaining features
Air pollution, dust/other	n/a	n/a	n/a	n/a	M	L	L	M	L	L	L	L	L	M	L
Erosion/sediment minimisation	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	M	L
Surface water pollution	n/a	n/a	n/a	n/a	L:	L	L	L	L	L	L	L	L	M	L
Ground water pollution	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Contaminate or polluted land	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Threatened flora protection	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Threatened fauna protection	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Weed control and management	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Operational noise	n/a	n/a	n/a	n/a	M	L	L	M	L	L	L	L	L	L	L
Vibration and air blast	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Visual amenity, stray light	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Aboriginal heritage	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Natural heritage conservation	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Spontaneous combustion	n/a	n/a	n/a	n/a	n/a	L	n/a	L	L	n/a	n/a	n/a	n/a	n/a	n/a
Bushfire	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Mine subsidence	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hydrocarbon contamination	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L
Methane drainage/venting	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Public safety	n/a	n/a	n/a	n/a	L	L	L	L	L	L	L	L	L	L	L

5. Rehabilitation Planning

5.1 Domain Selection

Ivanhoe North has been divided into 4 rehabilitation domains as described in Table 5.1. The landform to be created incorporates the revegetated spoil dumps of the Cullen Main West open cut and recreates the natural slope of the land prior to mining related disturbance. The recreated final slopes would vary from approximately 6^{o} at the southern end of the final landform to approximately 14^{o} at the northern end. Natural drainage lines that currently traverse the abandoned Cullen Main West open cut have been reinstated and the entire site revegetated with native woodland species endemic to the local area.

Table 5.1 below illustrates the final land use domains for the Ivanhoe North Open Cut.

Table 5.1: Ivanhoe North Final Land use for Domains

Domain Number	Domain Name	Agreed Final Land Use	Reference
1	Infrastructure Area and Product Stockpiles	Nature Conservation or Forestry (woodland)	EA and original Rehabilitation Management Plan
2	Active Mining Area (Ivanhoe North Project	Nature Conservation or Forestry (woodland)	EA and original Rehabilitation Management Plan
3	Previously Disturbed Area (Cullen Main West Open Cut and other disturbance)	Nature Conservation or Forestry (woodland)	EA and original Rehabilitation Management Plan
4	Water Management	Water management	EA and original Rehabilitation Management Plan

5.2 Domain Rehabilitation Objectives

Table 5.1 above shows the stated final land use for the selected domains. For Ivanhoe North, the majority of the area will be returned to Nature Conservation or Forestry as the area is owned by NSW State Forests. In effect, this means the objective is to return the land to a comparable

woodland community consistent with surrounding vegetation systems within the Ben Bullen State Forest.

Some smaller areas will need to be devoted to permanent water management structures such as the drainage lines and dams.

5.2.1 Short to Medium Term Objectives

Short to Medium-term rehabilitation objectives reflected those to be achieved during the approved limit of operations imposed by Condition 5 (Schedule 2) of PA 05_0103, ie. within 3 years of the granting of a mining lease over the mine.

These short to medium term objectives have been achieved and included:

- ❒ Progressively backfilling and profiling to create the final landform.
- ❒ Reinstatement of a stable drainage network to reflect that of the pre-disturbance environment.
- ❒ The final landform to be covered with previously stripped soil and cleared vegetation to encourage the natural regeneration of native vegetation species.
- ❒ Previously collected provenance seed will be sown / spread over the prepared final landform with the establishing vegetation representative of the pre-disturbance environment and adjacent community types.
- ❒ Erosion to be minimised with any areas of identified sheet, rill or gully erosion remediated before compromising the rehabilitation of the mine.
- ❒ Noxious weeds to be controlled such that the rehabilitated landform does not result in an increase in the density of these species.

5.2.2 Long Term Objectives

Long-term rehabilitation objectives reflect those to be achieved prior to lease relinquishment and would reflect a final landform requiring no further maintenance.

- ❒ The creation of a stable final landform.
- ❒ The re-establishment of vegetation over the mining lease comparable in species composition, density and cover to that of the pre-mining environment and the surrounding remnant vegetation.
- ❒ The vegetation of the mining lease will be self-sustaining, with noxious weeds controlled such that they occur in equal or lesser density than elsewhere in the local area.
- ❒ The creation of a final landform and vegetation communities that enhance local and regional ecological linkages across the site and with proximate areas

- ❒ The creation of a final landform and vegetation capable of a return to the premining land use (of sustainable forestry and native vegetation conservation).

5.3 Rehabilitation Indicators and Completion Criteria

Following rehabilitation of the Ivanhoe North Open Cut, a rehabilitation monitoring and maintenance program will be undertaken. The monitoring program will be designed to demonstrate that the completion criteria have been met. This period will also include remedial action where monitoring demonstrates completion criteria are unlikely to be met. Centennial has implemented the rehabilitation monitoring methodology Ecosystem Function Analysis (EFA) for its closed operations and this will be implemented also for the Ivanhoe North site.

5.3.1 Developing Rehabilitation Completion Criteria

The principal objective for the rehabilitation of disturbed land at Ivanhoe North is to return the site to a condition where its landform, soils, hydrology, and flora and fauna are self-sustaining, and are compatible with the surrounding landform and the pre-mining land use.

EFA will assist in comparing the quality of rehabilitation against completion criteria. The post closure monitoring and measurement program will focus on those aspects of the site that have the potential to cause pollution or are being used as an indicator to verify the success or failure of the rehabilitation works. The EFA monitoring program measures:

- ❒ Landscape Function Analysis;
- ❒ Vegetation Dynamics;
- ❒ Habitat Complexity; and
- ❒ Disturbance.

The rehabilitation program will be conducted until such a time as the monitoring records demonstrate that the site is no longer contributing, nor has the potential to contribute, pollutants to the surrounding environment, and that rehabilitation has achieved a satisfactory stage of maturity and ground cover.

Until the mining lease is relinquished, regular field inspections will be undertaken of all rehabilitated areas, particularly waterways, banks and sediment control dams, and diversions. The inspections will assess signs of failure, sedimentation, erosion and any other areas that may require repair. The inspection will also include the presence of noxious weeds with a weed spraying program to be implemented as required. The frequency of the field inspections may be reduced once it can be demonstrated that the vegetation is established and the landform is stable.

Completion criteria for the open cut were developed following a decision on the final land use to be a native woodland habitat for the purpose of nature conservation or forestry (site located with state forest). The final land form will be commensurate with that of the surrounding Ben Bullen State Forest. This commitment is made in the 2006 EA.

The completion criteria from the original rehabilitation plan have been updated for this MOP and reflect the approved 2011 Closure Plan. These are detailed in Table 5.2.

Table 5.2 - Closure Criteria for Ivanhoe North

Rehabilitation Element	Indicator	Criteria
Landform stability	*Stability*	All disturbed areas should be stabilised, including construction of stable landforms
	Slope gradient	No less than 75% of the area has slopes <10°. Where the slopes are steeper, additional water management structures will be utilised (as required). Where reject layers are present and exposed the landform is capped with an inert material and be free-draining.
	Erosion control	Erosion control structures are installed at intervals commensurate with the slope of the landform. Dimensions and frequency of occurrence of erosion rills and gullies are generally no greater than that in reference sites that exhibit similar landform characteristics.
	Surface Water Drainage	Use of contour banks and diversion drains to direct water into stable areas or sediment control basins. All landforms will be free draining except where specific structures have been constructed for the storage of water as required for sediment and erosion control or some post mining land use. All ripping must prevent surface water runoff, and be in accordance with criteria established.
Water quality	*EC, pH, TSS and oil and grease*	Ensure receiving waters affected by surface water runoff have contaminant limits of the Environmental Protection Licence (EPL). The quality of water leaving the site should be such as not to cause any significant deterioration of water quality to the downstream beneficial use(s) or water quality objectives of the receiving waters declared under the Section 73 of the Water Act (1992)
Vegetation	*Land use*	Area accomplishes and remains as a healthy native woodland/ grassland. Locally species will be sourced for the rehabilitation.
	Surface cover	Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 m^2 in area or >10 m in length down slope.
	Species composition	Comprise a mixture of native trees and shrubs representative of regionally occurring woodland. Vegetation communities should be developed to attract and support the re-colonisation by native flora and fauna species found in the region.

Rehabilitation Element	Indicator	Criteria
	Resilience to disturbance	Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species. Introduction and spread of weeds and pests, should be prevented and an active program in place to minimise their presence
	Sustainability	Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of shrub and understorey species. Vegetation develops and maintains a litter layer evidenced by a consistent mass and depth of litter over subsequent seasons. More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead. All surfaces should be revegetated to a self sustaining condition similar to vegetation in comparable local areas
Fauna	*Vertebrate species*	Representation of a range of species characteristics from each faunal assemblage group (e.g. reptiles, birds, mammals), present in the ecosystem type, based on pre-mine fauna lists and sighted within the three-year period preceding mine closure. The number of vertebrate species does not show a decrease over a number of successive seasons prior to mine closure.
	Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.
	Habitat structure	Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including: a variety of food plants; evidence of active use of habitat provided during rehabilitation such as nest boxes, and logs and signs of natural generation of shelter sources including leaf litter.
Buildings and Infrastructure		Facilities and equipment should be removed unless they are to remain for an agreed land use. Surface infrastructure to remain unless an agreement is in place with regulatory authority.
Contamination	*Contamination*	Residual toxic material, such as chemicals, should be removed from site. All contaminated land should be remediated or contaminated land removed from site and disposed in licensed waste facility.
Safety		Risk assessment to be undertaken in accordance with relevant guidelines and Australian Standards and risks reduced to levels agreed with the stakeholders. Implementation of recommendations from risk assessment

Centennial Coal is currently using LFA/EFA as a rehabilitation monitoring methodology at other mine sites in the Lithgow region. This monitoring program will allow the comparison of rehabilitation areas against a set of

indicators to determine rehabilitation success. Further details of the LFA/EFA program is provided in Chapter 7.

6. Rehabilitation Implementation

6.1 Rehabilitation Phases

The Ivanhoe North site has been divided into 4 rehabilitation domains, based on a combination of topography, general rehabilitation requirements, infrastructure on site and the staging of rehabilitation.

The implementation methods will be the same for all areas with the exception of the drainage lines.

6.1.1 Rehabilitation and Closure Tasks for Each Domain

Key rehabilitation and closure tasks have been broken into the following procedures:

- ❒ Clearing and Seed Collection Procedures;
- ❒ Rehabilitation and Landform Design Procedures; and
- ❒ Closure Procedures

6.1.2 Clearing and Seed Collection Procedures

Collection of native seed species occurring within and adjacent to the mine will be carried out. Centennial has used the services of a local seed collector for the collection of seed after flowering. The seed collection program is aimed at producing the maximum quantity and quality of seed incorporating the correct degree of maturity for maximum germination. Where trees are cleared for mining purposes, available seed will be collected. Wherever practicable, tree felling is timed to coincide with maximum seed load (but avoiding times when native fauna would be using trees for roosts, nests etc.).

Contractors have collected seed placing bags over the flowers after pollination and by placing plastics bags to collect dropped seed. It is unlikely that all the seed requirements will be satisfied from the area immediately surrounding the site and therefore likely that additional seed will be purchased from the same contractor. As far as possible, all seed used in the revegetation program will be from the local area.

Plate 8: Seed Collection for the Ivanhoe North Project

6.1.3 Salvage and Reuse of Material

Management and salvage of the materials resulting from clearing activities within the area to be disturbed has been, and will continue to be undertaken in the following manner.

- The ground-layer vegetation and low shrubs will be incorporated into the topsoil when it is stripped.
- Trunks, logs, branches, small stumps and roots of potential habitat value removed during clearing will be cut or broken into manageable lengths using bulldozer tracks. This material will be removed from the cleared area shortly after clearing and preferably placed directly on a rehabilitated area that is designated for native vegetation re-establishment (see Plate 8).
- Where no (or inadequate) areas are available for direct transferral of clearing debris, the material will be stockpiled for later use in rehabilitation.
- Material not of habitat value will be further broken and used to stabilise rehabilitated areas or soil stockpiles (in particular stockpiles of SMU 2 topsoil).

Plate 8: Salvaged trees are stockpiled for use in rehabilitation

6.1.4 Conserving Soil Resources

Within the defined areas of disturbance, soil stripping has been undertaken in the following manner:

- ❒ Areas of disturbance requiring soil stripping are clearly defined following vegetation clearing (using marker pegs/posts if necessary).
- ❒ The top-layer (topsoil and subsoil) is stripped using a bulldozer.
- ❒ Soil is then placed either directly on areas requiring rehabilitation to minimise double handling and maximise efficiencies, or within the soil stockpiles up-slope of the mining blocks.
- ❒ The topsoil and subsoil stockpiles are no higher than 2m and 3m respectively, and with slopes no greater than 1:2 (V:H) and a slightly roughened surface to minimise erosion.
- ❒ Wherever possible, no soil will be removed in wet conditions to avoid breakdown of the soil structure.
- ❒ Appropriate sedimentation controls will be placed immediately down slope of soil stockpiles and maintained until such time as a stable vegetation cover over the stockpile is achieved.
- ❒ In the event that unacceptable weed generation is observed on the soil stockpiles, a weed eradication program will be implemented.
- ❒ There will be no vehicle access on the soil stockpiles.

Topsoil and subsoil quantity is limited at Ivanhoe North and in some areas found to be non-existent. All available topsoil and subsoil has been used,

but large sections of the rehabilitation will consist of no soil material, with revegetation to occur in overburden. Overburden has been used successfully as a growing medium at the adjacent Lamberts Gully which has produced excellent results.

6.2 Rehabilitation Procedures

6.2.1 Landform Preparation

The formation of the final landform has ensured that large bulky material and rocks are kept well below the surface to prevent exposure and disturbance of the surface whilst the process of final surface preparation and revegetation is undertaken. Examples of land preparation at Ivanhoe North is shown on Plates 9 and 10.

The final landform has been created through the replacement of mined overburden within the completed open cut. The landform incorporates the revegetated spoil dumps of the Cullen Main West open cut and recreates the natural slope of the land prior to mining related disturbance. The recreated final slopes vary from approximately 6^{o} at the southern end of the final landform to approximately 14^{o} at the northern end. Natural drainage lines that previously traversed the abandoned Cullen Main West open cut are to be reinstated and the entire site revegetated with native woodland species endemic to the local area.

The slope of the landform to be revegetated will not exceed 20^{o} (approximately 1V:2.8H) and as such the conventional method of direct seeding will be employed. This will involve the direct application of a mix of native tree, shrub and understorey species by a tractor or similar machine over the surface of the prepared landform. This method will involve contour ripping the surfaces as detailed above. The method is one which has proven successful at other mines in the district, primarily Cullen Valley Mine, Baal Bone Mine and Ulan Mine.

On profiling the backfilled landform, including the construction of drainage channels and other water management features, the previously stripped top-layer will continue to be respread to a depth of up to 50cm. The respread top-layer will then be deep ripped on the contour to allow/assist bedding of the topdressing materials.

The deep ripping creates a rough surface which encourages rainfall infiltration and reduces runoff and will therefore result in superior vegetation establishment and persistence. This is particularly true in times of drought and low rainfall areas (both applicable to local area).

Previously cleared and stockpiled vegetation is further broken or mulched and spread over the surface of the landform. Revegetation is usually undertaken prior to or shortly after the spreading of the timber mulch, primarily using direct seeding techniques.

Plate 9: Landform Preparation for the Ivanhoe North

Plate 10: Landform Preparation for the Ivanhoe North

6.2.2 Direct Seeding

The principal objective of the final rehabilitation plan is to create a stable landform which will pose no long-term environmental hazard. It is therefore proposed to rehabilitate Ivanhoe North to a woodland

environment, similar to the native vegetation surrounding the site. The goal is for the final landform to be self sustaining and require minimal maintenance requirements.

Seed from adjacent bushland will help facilitate rehabilitation around the fringe of the land disturbed by the open cut mining process.

The species list to be used (see below) reflects the native species found on the mining lease and surrounding Ben Bullen State Forest.

Potential species to be used for rehabilitation are outlined in **Table 6.1** below. A selection of those species listed in the table will be used for rehabilitation at Ivanhoe North. These species were recorded during a flora survey of the Ivanhoe North area and represent the vegetation in the area. It is recommended that 7.5kg/ha of tree and shrub species will be spread onto rehabilitation areas at Ivanhoe North, with grass species also added to the seed mix.

A large majority of the seed used for rehabilitation will need to be purchased by the local seed supplier.

Table 6.1 - Proposed Species and Sowing Rates

Scientific Name	Common Name	Scientific Name	Common Name
Acacia brownii		*Eucalyptus sparsifolia*	Narrow-leaved Stringybark
Acacia buxifolia	Box-leaved Wattle	*Exocarpos cupressiformis*	Native Cherry
Acacia dealbata	Silver Wattle	*Geranium solanderi*	
Acacia gunnii		*Glycine clandestina*	
Acacia longifolia	Sydney Golden Wattle	*Gnaphalium sp.*	Cudweed
Acacia terminalis	Sunshine Wattle	*Gompholobium huegelii*	
Acaena novae-zelandiae	Bidgee-widgee	*Gonocarpus tetragynus*	
Amyema miquelii	Mistletoe	*Goodenia hederacea*	
Aristida ramosa	Wiregrass	*Haloragis heterophylla*	
Aristida vagans	Wiregrass	*Helichrysum scorpioides*	
Asperula conferta		*Hibbertia obtusifolia*	
Astroloma humifusum		*Hovea linearis*	
Austrodanthonia caespitosa	Ringed Wallaby Grass	*Hydrocotyle laxiflora*	
Austrodanthonia racemosa		*Hypericum gramineum*	
Austrodanthonia setacea	Small Flowered	*Hypericum perforatum*	St John's Wort
Austrodanthonia tenuior		*Hypochaeris radicata*	Catsear
Austrostipa rudis ssp. nervosa	Spear Grass	*Indigofera australis*	Austral Indigo
Billardiera scandens	Apple Dumpling	*Joycea pallida*	Red-anthered Wallaby Grass
Bossiaea buxifolia		*Lagenifera stipitata*	
Bossiaea neo-anglica		*Lepidium africanum*	Peppercress
Brachyloma daphnoides		*Lepidosperma laterale*	Saw-sedge
Cassinia arcuata	Chinese Scrub, Sifton Bush	*Leptospermum polygalifolium*	Yellow Tea-tree

Scientific Name	Common Name	Scientific Name	Common Name
Cassinia quinquefaria		*Lissanthe strigosa*	
Cassytha glabella		*Lomandra filiformis ssp. coriacea*	
Casuarina cunninghamiana	River Oak	*Mentha satureioides*	Native Mint
Centuarea erythraea		*Microlaena stipoides*	Weeping Meadow Grass
Cheilanthes sieberi		*Monotoca scoparia*	
Cirsium vulgare	Spear Thistle	*Opercularia aspera*	
Cymbopogon lawsonianus	Bear's Ear	*Opercularia diphylla*	
Cynoglossum suaveolens		*Panicum simile*	Two-colour Panic
Daviesia leptophylla		*Patersonia longifolia*	Purple Flag Iris
Desmodium varians		*Pinus radiata*	Monterey Pine
Dianella longifolia		*Plantago debilis*	
Dianella revoluta		*Poa sieberiana var. cyanophylla*	Blue-leaved Snow Grass
Dichelachne micrantha	Plume Grass	*Poa sieberiana var. sieberiana*	Snow Grass
Dichelachne parva		*Podolobium ilicifolium*	Mountain Holly
Echinopogon ovatus	Hedgehog Grass	*Pomax umbellata*	
Eucalyptus blakelyi	Blakely's Red Gum	*Prunella vulgaris*	Self-heal
Eucalyptus bridgesiana	Apple Box	*Pteridium esculentum*	Bracken Fern
Eucalyptus dalrympleana	Mountain Gum	*Pterostylis sp.*	Greenhood Orchid
Eucalyptus dives	Broad-leaved Peppermint	*Pultenaea microphylla*	
Eucalyptus goniocalyx	Long-leaved Box, Bundy	*Rubus ulmifolius*	Blackberry
Eucalyptus macrorhyncha	Red Stringybark	*Senecio quadridentatus*	
Eucalyptus melliodora	Yellow Box	*Senecio species E*	
Eucalyptus macropolyanthemos	Red Box	*Themeda australis*	Kangaroo Grass
Eucalyptus pauciflora	Snow Gum	*Veronica plebeia*	
Eucalyptus praecox	Brittle Gum	*Viola betonicifolia*	
Eucalyptus rossii	Western Scribbly Gum	*Viola hederacea*	Native Violet
Eucalyptus rubida	Candle Bark	*Vittadinia cuneata*	

6.2.3 Water Management Following Rehabilitation and Closure

Once extraction works are complete, the land surface will be constructed in accordance with the final landform levels and progressively rehabilitated. At this time, the natural drainage lines will be reinstated to their original position and rehabilitated to a relatively stable condition.

The four 1st order drainage lines disturbed by the mining of Ivanhoe North will be progressively reinstated following the backfilling and profiling of the open cut. Initially, the drainage line will be formed as part of the landform profiling activities, ie. a very shallow gradient towards the original alignment of the four drainage lines will be created. Although originally planned to remove dams and diversion channels, Forests NSW

(landholder) have indicated that these structures be left after rehabilitation. An example of the final treatment of Stream 3 is provided as Plate11.

Plate 11 – Rehabilitation Treatment of Stream 3

6.2.4 Other Infrastructure

No infrastructure will remain following completion of rehabilitation works.

6.2.5 Rehabilitation Trials and Research

The rehabilitation methodologies described in this document have been used successfully in rehabilitating other mine sites with similar

environmental conditions in the Western Coalfields. No trial methods or research will be required to create a final stable landform.

Centennial is however investigating the potential to trial the use commercial mulch or lime amended biosolids at other sites in the Western Coalfield as a means of assisting fertility of the surface topdressing layer. This is largely a result of the lack of any existing top soil materials that can be generated.

6.3 Summary of Rehabilitation and Program

The proposed rehabilitation program is provided in the following tables. The program will be updated and revised as appropriate in each AEMR during this MOP period. Key milestone dates for the rehabilitation work are:

- Completion of coal extraction and overburden shaping for the final mining block – April 2012
- Removal of remaining coal reject from workshop and shaping final void – June 2012
- Revegetation of final areas – October 2012
- EFA monitoring – Annual during the term of this Mop or until the
- Erosion assessment/ correction- August 2013.
- Water to be diverted away from areas of active erosion where possible.
- Contour ripping in areas subject to active erosion to allow infiltration and encourage vegetation growth- August 2013.
- Reseeding areas of poor ground cover- September 2013
- Maintenance and review of all erosion and sediment structures- October 2013.
- Maintenance and review of all erosion and sediment structures- October 2014.
- Reseeding areas of poor ground cover- September 2014
- Ongoing monitoring of erosion and sediment control structures and general maintenance during the remaining MOP period or until final signoff of rehabilitation works.

Table 6.2: Rehabilitation and Mine Closure Implementation

Domain	Area	Process Step	Comment/ Proposed Action	Date/ Status of Action	Responsibility
Domain 1 - Infrastructure Areas	Workshop Area	Disconnect and terminate services		June 2012	Big Rim
		Onsite contaminated material remediation (Not expected to be contamination)		May 2012	E & C Coordinator Contamination consultant Contractor
		Final trim, rock rake & deep rip		May 2012	E & C Coordinator Demolition contractor
		Source, cart and spread topsoil		May 2012	E & C Coordinator Contractor
		Spoil amelioration and supply and spread seed and fertiliser.	Investigate what seed has been collected (quantities + species) and assess what may be required in the immediate future to undertake the required rehabilitation. Consult with suppliers to ensure revegetation commitments outlined in the EA can be met	June 2012	E & C Coordinator Contractor
			Commence monitoring of the completed rehab areas to check the progress of the site and identify issues	Following initial rehabilitation	E & C Coordinator Contractor
			Review the current rehabilitation success criteria in the EA and investigate what amendments are required to suit specific site needs. Ensure that the revised Rehabilitation and Closure Plan includes any outcomes from the process, and consult with the I & I NSW on any changes as may be appropriate.	Criteria reviewed for this document.	N/A
	Administration Buildings	Disconnect and terminate services		June 2012	E & C Coordinator Contractor
		Remove Concrete pads and footings			
	Access Roads and tracks (external to mining footprint)	Remove carbonaceous material from roadways (coal / rejects spillage)	Complete an assessment of the chitter composition for inclusion in the closure data suite.	June 2012	E & C Coordinator Laboratory
			Identify through consultation what roads are to be retained post closure (consult with Forests NSW)	June 2012	E & C Coordinator Mine Manager

Domain	Area	Process Step	Comment/ Proposed Action	Date/ Status of Action	Responsibility
		Rehabilitation of access roads and tracks	Undertake reshaping of the haul roads and tracks to an appropriate landform design that is compatible with the surrounding topography. The main access road would be retained and the haul truck roads would be rehabilitated.	Following completion of mining	E & C Coordinator Contractor (excavation and transport)
	General	Removal of the diesel tanks - refuelling / oiling facilities		June 2012	
		General rubbish removal		July 2012	
Domain 2 - Active Mining Area	Unshaped Overburden dumps (minor reshaping required)	Minor pushing, final trim, rock rake & deep rip			
		Structural works, banks, rock lined waterways	Ensure post closure water management plan is revised with the Mine Closure Plan to ensure relevance at mine closure.	Site Water Management Plan revised	N/A
		Source, cart and spread topsoil.			
		Spoil amelioration and supply and spread seed and fertiliser.	Investigate what seed has been collected (quantities + species) and assess what may be required in the immediate future to undertake the required rehabilitation. Consult with suppliers to ensure revegetation commitments outlined in the EA can be met	April 2011	E & C Coordinator Contractor
			Commence monitoring of the completed rehab areas to check the progress of the site and identify issues	Following initial rehabilitation	E & C Coordinator Contractor
			Review the current rehabilitation success criteria in the EA and investigate what amendments are required to suit specific site needs. Ensure that the revised Rehabilitation and Closure Plan / closure plan includes any outcomes from the process, and consult with the I & I NSW on any changes as may be appropriate.	Complete and approved	N/A
	Unshaped Overburden Dumps (major earthworks required) - this excludes Low walls	Major bulk pushing to achieve grades nominated in the MOP (i.e. < 18°)		June 2011	
		Rehabilitation to the approved landform design outlined in the EA		June 2011	

Domain	Area	Process Step	Comment/ Proposed Action	Date/ Status of Action	Responsibility
	Access Roads and Haul Roads (internal to operation footprint)	Rehabilitation of the internal haul roads	Complete an assessment of the coal chitter composition for inclusion in the closure data suite Identify through consultation what roads are to be retained post closure.	June 2011	E & C Coordinator
			Include the reshaping of the haul roads and tracks to an appropriate landform design that is compatible with the surrounding topography. The main access road would be retained and the haul truck roads would be rehabilitated.	Following final landform shaping.	
Domain 3 – Previously Disturbed Areas (Army boxcut spoil)	Unshaped Overburden dumps (minor reshaping required)	Minor pushing, final trim, rock rake & deep rip		April 2011	
		Structural works, banks, rock lined waterways	Ensure post closure water management plan is revised with the Mine Closure Plan to ensure relevance at mine closure.	Complete for SWMP	N/A
		Source, cart and spread topsoil.		April 2011	
		Spoil amelioration and supply and spread seed and fertiliser.	Investigate what seed has been collected (quantities + species) and assess what may be required in the immediate future to undertake the required rehabilitation. Consult with suppliers to ensure revegetation commitments outlined in the EA can be met	April 2011	E & C Coordinator Contractor
			Commence monitoring of the completed rehab areas to check the progress of the site and identify issues	Following initial rehabilitation	E & C Coordinator Contractor
			Review the current rehabilitation success criteria in the EA and investigate what amendments are required to suit specific site needs. Ensure that the revised Rehabilitation and Closure Plan / closure plan includes any outcomes from the process, and consult with the I & I NSW on any changes as may be appropriate.	Complete and approved	N/A
		Interaction with the current mining operation	Ensure post closure Water Management Plan is revised with the Mine Closure Plan to ensure relevance at mine closure.		E & C Coordinator
		Maintenance of rehabilitation areas (Erosion and Sediment control and weed spraying)			
Domain 4 - Water Management	Surface Water Management	Clean water dams to be retained after mine closure - ensure these are safe through minor earthworks.	Ensure post closure water management plan is revised with the Mine Closure Plan to ensure relevance at mine closure.	Site Water Management Plan revised Water management revised in RMCP.	N/A
		Dirty Water Dams (Drain and remove sediments to make dam clean water)		April 2012	
		Reinstatement of original drainage lines following closure		April 2012	

Domain	Area	Process Step	Comment/ Proposed Action	Date/ Status of Action	Responsibility
Non - Domain	Stakeholders	Stakeholders & Consultation	Ensure that reference to stakeholder consultation is included in the RMCP	Complete	N/A
			Continue Consultation with the stakeholders (as appropriate) during and beyond closure of the site. (note: method of consultation will be specific to site requirements)	Ongoing	E & C Coordinator Mine Manager
	Resources	Project Management and financial resources required to manage the project		Completed but ongoing	

7. Rehabilitation Monitoring and Ongoing Maintenance

Following rehabilitation of Ivanhoe North, Centennial will undertake rehabilitation monitoring and maintenance. The monitoring program will be designed to demonstrate that the completion criteria have been met. This period will also provide for remedial action where monitoring demonstrates completion criteria are unlikely to be met. Centennial have implemented the rehabilitation monitoring methodology Ecosystem Function Analysis (EFA) at other sites in the Lithgow region and undertook initial EFA monitoring in 2010 at INRP.

7.1 Landscape Function Analysis

An outline of the methodology is provide din Table 7.1 below.

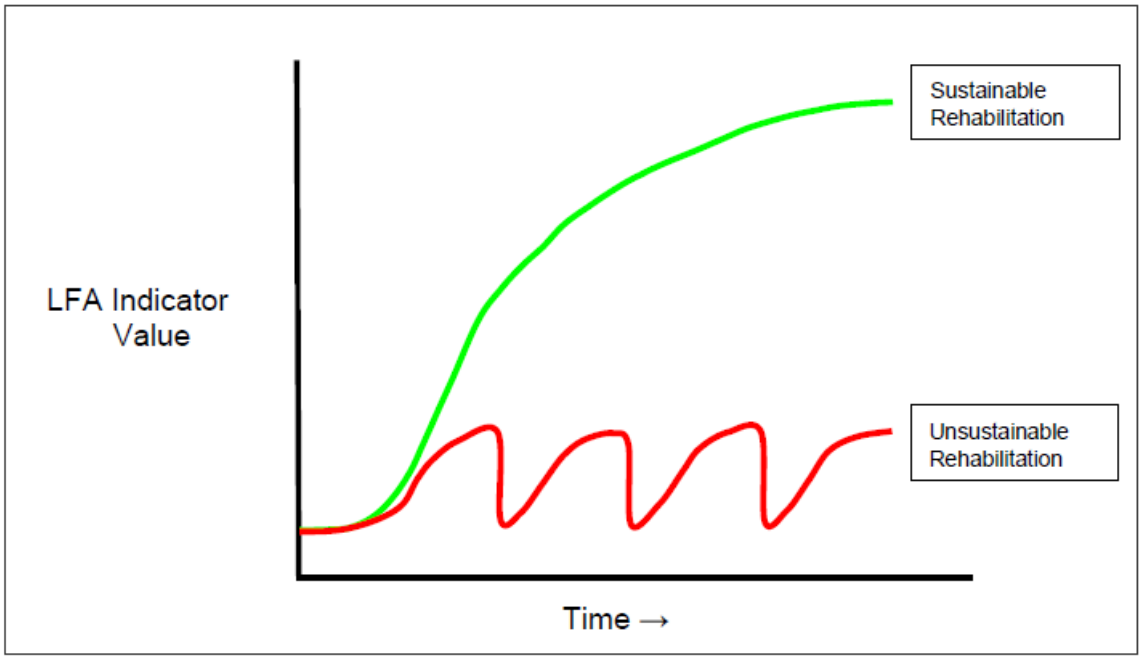
Table 7.1 - LFA/EFA Methodology for Ivanhoe North

Rehabilitation Element	Indicator	Methodology
Soil Assessment (LFA)	*Soil Stability*	• Rainsplash protection – assess the degree to which physical surface cover and project plant cover ameliorate the effect of raindrops impacting on the soil surface • Slake Test – assess the stability of natural soil fragments to rapid wetting
	Nutrient Cycling	• Perennial vegetation cover – estimate the 'basal cover' of perennial grass and/or the density of canopy cover of trees and shrubs • Litter – access the amount, origin and degree of decomposition of plant litter • Cryptogram Cover – assess the cover of cryptograms visible on the soil surface
	Water Infiltration Capacity	• Crust brokenness – assess to what extent the surface crust if broken, leaving loosely attached soil material available for erosion • Texture – to classify the texture of the surface soil, and relate this to permeability
	Erosion Potential	• Soil Erosion type and severity – assess the type and severity of recent/current soil erosion • Deposited Materials –assess the nature and amount of alluvium transported to and deposited on the query zone • Soil surface roughness –assess the surface roughness for its capacity to capture and retain mobile resources such as water, propagules, topsoil, and organic matter • Surface nature (resistance to disturbance) – assess the ease with which the soil can be mechanically disturbed to yield material suitable for erosion by wind or water
Vegetation Data (EFA)	*Vegetation Dynamics*	• Density of plants per unit area for each life form • For grasses, basal area m^2 per unit area • For trees and shrubs - Canopy area - Canopy volume, an index of growth - Horizontal cross sectional area in height classes –

Rehabilitation Element	Indicator	Methodology
		an index for wind amelioration
Habitat Complexity (EFA)	*Vegetation Dynamics*	Extended EFA focusing on how 'complex' the environment is – i.e. monoculture or sterile, corridors of animal movement etc Not as broadly acceptable as LFA
	Vegetation Dynamics	Habitat complexity is assessed on the basis of five features: • Canopy cover • Shrub cover • Ground vegetation cover • Amount of litter, fallen logs and rocks • Free water availability

The goal will be to demonstrate LFA/EFA criteria in the rehabilitation sites are trending towards criteria outlined in analogue sites. The expected trend of an ecosystem approaching stability and functionality are for LFA values to improve over time resulting in a parabolic trend toward pre-disturbance and/or analogue conditions (shown in the graph below). The response curve provides quantitative feedback to the regulators and may be used to justify full/partial security bond return applications.

Values should initially increase rapidly due to establishing vegetation and succession however the increase in values will likely slow over time as the vegetation community stabilises. Sites that are not improving or are declining would indicate that the site is not approaching a stable state and may require further remediation to achieve ecosystem functionality. In this instance, Centennial will reassess areas of rehabilitation failure and complete further rehabilitation works/ maintenance.



Graph 1: Using LFA to assess Ecosystem Functionality

Future monitoring of rehabilitation sites will give an indicative measure of how Ivanhoe North is tracking against the analogue sites and ultimately a self sustaining landscape.

In terms of landscape function, the preference is for:

- ❒ Landscape Organisation Index (LOI) to be close to 1.
- ❒ Stability Index score of 40-80%.
- ❒ Infiltration Index score of 18-70%.
- ❒ Nutrient Cycling Index score of 8-80%.

In terms of vegetation dynamics, an area that is on a trajectory to self sustainability would have:

- ❒ A low percentage of bare ground.
- ❒ High density of woody species.
- ❒ High average canopy cover.
- ❒ High species richness.

In terms of Habitat Complexity, an area that is on a trajectory to self sustainability would have:

- ❒ Tree and shrub canopy present.
- ❒ Ground cover of vegetation present.
- ❒ Presence of logs, rocks and woody debris.
- ❒ Presence of free standing water and/or soil moisture.

Centennial will continue the revegetation monitoring and maintenance program until such a time as the monitoring records demonstrate that the site is no longer contributing, nor has the potential to contribute, pollutants to the surrounding environment, and that rehabilitation has achieved a satisfactory stage of maturity and ground cover.

Until the mining lease is relinquished, regular field inspections will be undertaken of all rehabilitated areas, particularly waterways, banks and sediment control dams, and diversions. The inspections will assess signs of failure, sedimentation, erosion and any other areas that may require repair. The inspection will include the presence of noxious weeds with a weed spraying program to be implemented as required. The frequency of the field inspections may be reduced once it can be demonstrated that the vegetation is established and the landform is stable.

7.2 Relinquishment Program

The *Leading Practice Sustainable Development Program for the Mining Industry: Mine Closure and Completion (DITR)* outlines the process for mining lease relinquishment. Key steps included in the mining lease relinquishment process include:

1. Establishment of formal closure, sign-off and relinquishment mechanisms

Centennial will establish working arrangements with DRE that will outline the responsibilities, accountabilities, and proposed methodologies required to achieve successful sign-off. This may include the following:

- ❒ a RMCP (already approved);
- ❒ agreed performance criteria addressing environment, social and economic outcomes;
- ❒ monitoring and reporting requirements;
- ❒ self-assessment against the performance criteria as a precursor for the operator presenting close-out areas for handover; and
- ❒ a process for dealing with areas that fail to meet performance criteria, including corrective action.

2. Peer review of formal mechanisms prior to stakeholder assessment and approval

3. Sites that have successfully met the criteria are presented for relinquishing in a formal sign-off

- ❒ Centennial will develop a proforma / checklist in consultation with stakeholders that is applicable to each rehabilitated area presented for sign-off (expansion of current closure criteria);
- ❒ the proforma / checklist would be a record of the status of the rehabilitated area against performance criteria and any other agreements made between parties related to the area in question; and
- ❒ the proforma / checklist would require the signature of both parties to formalise the sign-off.

4. Acknowledgement from the relevant authority of areas that have been signed off as closed out

- ❒ Centennial may require a letter from the Minister for the DRE that details those areas that have been signed off and the lease relinquished; and
- ❒ the letter should advise the operator that the relevant government authority has accepted responsibility for the rehabilitated leases.

5. A process is established to deal with those sites that do not meet the performance criteria

- ❒ areas that do not meet performance criteria would be identified in an agreement with DRE and a corrective action plan developed to achieve the necessary performance criteria; and
- ❒ the plan will detail remedial works required to address the concern of the DRE.

6. Establishment of a financial instrument to provide for the ongoing maintenance of the rehabilitated areas

- ❒ Centennial may consider the establishment of a trust fund or other financial arrangement that would generate income for the ongoing management of rehabilitated areas. This mechanism may provide a means for early sign-off and hand over of the lease to government.

A letter or report will be produced by Centennial Coal when monitoring indicates the rehabilitation is self sustaining and the lease could be relinquished. Centennial Coal will consult with DRE prior to lease relinquishment.

Appendix A - Plans

Appendix B – Statutory Declaration

STATUTORY DECLARATION

New South Wales

STATUTORY DECLARATION

OATHS ACT 1900

EIGHTH SCHEDULE

I, Bob Miller of Lithgow in the State of New South Wales, solemnly and sincerely declare as follows:

1. I am the duly-appointed Manager Mine Engineering for Ivanhoe North Colliery operating in ML 1627.

2. I am authorised to make this Declaration on behalf of the Lease Holder, Centennial Coal Pty Limited,

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 LITHGOW
In the State of New South Wales this 26TH day of NOVEMBER in the year 2015

(sgd) Miller

before me (sgd) E Wyss Justice of the Peace
174688