Ivanhoe North

Centennial Coal

Annual Environmental Management Report

2013

Ivanhoe North Lagoon Rehabilitation Works Completed (2013)

Name of mine	Ivanhoe North Colliery		
Titles/Mining Leases	ML1627		
MOP Commencement Date	17/03/2012	**MOP Completion Date**	17/03/2019
AEMR Commencement Date	01/01/2014	**AEMR End Date**	31/12/2014
Name of Leaseholder	Ivanhoe Coal Pty. Ltd.		
Name of mine operator (if different)			
Reporting Officer	Tom Hollis		
Title	Environment and Community Officer		
Signature	.....		
Date			

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1. Introduction

The area within Ben Bullen State Forest on which Mining Lease (ML) 1627 is located, has been the subject of previous coal mining, and mining related operations. This includes 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 (**Plan 2**).

The Cullen Main West open cut was a contour mining operation which operated shortly after World War II. The open cut which is situated immediately to the northwest of Ivanhoe Colliery's No.2 underground workings was abandoned following the cessation of mining in the early 1950s. Ivanhoe Coal Pty Limited has used approximately 20% (2.0 ha) of the abandoned open cut for mine ventilation for the Ivanhoe Colliery and placement of coarse reject generated by the Ivanhoe and Invincible Collieries. The ventilation fan has subsequently been removed.

Centennial obtained development consent to extract the remaining coal reserves and rehabilitate the old mining areas on ML 1627. The project commenced on 8th July 2009 and was completed in May 2012. The project represents the utilisation of an available coal resource while at the same time providing an opportunity to rehabilitate an otherwise derelict mine site.

Coal extraction ceased on 26 March 2012 and the last coal was transported off site on 26 April 2012.

The INRP targeted the coal remaining between the remnant high wall of the Cullen Main West open cut and the underground workings of Ivanhoe Colliery No. 2. In recommencing mining operations from the abandoned open cut, Ivanhoe Coal Pty Ltd inherited responsibility for the rehabilitation of the previous disturbance within the mining lease. Rehabilitation obligations for the majority of the mining-related disturbance (80% or 11.4 ha) previously resided with the NSW Government.

The Project included:

- Construction of all surface infrastructure including a site access road and intersection with the Castlereagh Highway, Coal Crushing Area, Facilities Area, and water storage and water management structures;
- Land preparation including vegetation clearing and soil stripping;
- Removal of overburden and interburden materials to expose the Irondale, Lidsdale and Lithgow Coal Seams;
- Mining of the exposed coal of the Irondale, Lidsdale and Lithgow seams;
- Crushing of the mined coal to reduce the size of the coal;
- Progressive backfilling, profiling and rehabilitation of mined out sections of the open cut using the overburden and interburden previously removed; and
- Transportation of the crushed coal via the mine access road and Castlereagh Highway. Based on the proposed production of 300 000 tonnes of coal per year, an average of 35 trucks would be despatched each day, although this is expected to vary between 0 and approximately 50 per day, to complement the campaign crushing operations.

This Annual Environmental Management Report (AEMR) relates solely to the INRP and covers the reporting period 1 January 2014 to 31 December 2014.

The project has now commenced final closure rehabilitation activities.

This AEMR details the final mining activities prior to completion and rehabilitation activities for the INRP during the reporting period.

1.1 Consents, Leases and Licences

Ivanhoe Coal Pty Limited own and operate the Ivanhoe North Rehabilitation Project (INRP), which commenced operation in 8th July, 2009. The Project operates under the Environmental Protection Licence (EPL 13063) and Development Consent (DA_05_0103) (**Appendix 2).**

A meeting was held with the EPA regarding modifications to the EPL and discussions will be ongoing during the coming reporting period. No modifications were made to the EPL during the reporting period.

The Project Approval (05_0103) was granted by the then Department of Planning on 11 April 2007. A Modification to the Project Approval (05_0103) was sought under Section 75W of the Environmental Planning and Assessment Act 1979 (EP&A Act). The modification allowed for an extension of the Project Approval from 2 February 2012 until 2 May 2012 to complete mining and trucking operations in a safe and efficient manner. The approval for the continuation of mining operations was received on 19 January 2012.

Open Cut Mining is permissible under ML 1627 which incorporates MPL 79 in its entirety, creating a single mining tenure. MPL 79 is a previous Ivanhoe Coal Pty Limited surface lease of 12.2 ha.

The current MOP covers the final rehabilitation of the project for the period ending 17 March 2019.

Ivanhoe Coal Pty Ltd holds Environmental Protection Licence (EPL) 13063 under the Protection of the Environment Operations Act 1997 (**Appendix 2**). The licence has an Anniversary date of the 24th of April each year and covers 3 surface water discharge points and 3 dust monitoring points.

The Stream 3 Restoration Management Plan was approved by the NSW Office of Water on 1 March 2011.

In addition to the current MOP the site operates under a Rehabilitation and Mine Closure Plan which was completed in consultation with Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) and Office of Environment and Heritage (OEH), and approved by the Department of Planning and Infrastructure (DP&I).

Table 1. Ivanhoe North Colliery Licences, Consents and Approvals

Licence/Approval/Consent	Approval/Number	Approval Authority	Date Granted-Expiry/Renewal Date
Development Consents			
Original Development Consent	DA_05_0103	Department of Planning & Infrastructure	Approved 11/04/2007
Development Consent Modification	DA-05_0103	Department of Planning & Infrastructure	Approved 19/01/2012
Licences			
Environmental Protection Licence	EPL13063	Environment Protection Authority	02/07/2013-Renewed Annually 24th of April
Consolidated Coal Lease	CCL712	Department of Trade and Investment, Regional Infrastructure and Services	18/06/1989-Perpetuity
Mining Lease	ML1627	Department of Trade and Investment, Regional Infrastructure and Services	17/03/2009-17/03/3030
Mining Purposes Lease	MPL79	Department of Trade and Investment, Regional Infrastructure and Services	21/07/1994-21/07/2015
Mining Operations Plan			
Mining Operations Plan	N/A	Department of Trade and Investment, Regional Infrastructure and Services	17/03/2012-17/03/2019

1.2 Mine Contacts

Table 2. Contact Details for Key Mine Personnel

Name	Title	Phone
Bob Miller	Mine Manager	02 63592101
Tom Hollis	Environment and Community Officer	02 6355 9810

1.3 Actions Required at Previous AEMR Review

The 2013 AEMR was reviewed by relevant government agencies and an onsite inspection was completed on 22 July 2014 with DTIRIS, OEH, Lithgow City Council and Centennial representatives. No other correspondence was received from DTIRIS

2. Operations During the Reporting Period

2.1 Exploration

No exploration was carried out for the INRP during the reporting period. The coal resource geology is well understood and it is not anticipated that any exploration will be undertaken during the term of the Project.

2.2 Land Preparation

No mining was undertaken during the reporting period therefore no land preparation occurred. There was minor earth moving activities during the reporting period mainly associated with surface water diversion for erosion and sediment control purposes.

2.3 Construction

No construction work was required during the reporting period.

2.4 Mining

There was no mining production or waste generation during this reporting period.

2.5 Mineral Processing

Coal processing infrastructure was removed and the area rehabilitated during the 2012 reporting period.

2.6 Waste Management

The mine did not produced any coal or reject material during the reporting period.

2.7 Product Stockpiles

No run-of-mine (ROM) or product coal stockpiles remain onsite.

2.8 Water Management

The Site Water Management Plan prepared by GHD in 2010 has been implemented. The primary aim of the plan is the effective separation of clean and dirty water. This included the construction of clean water diversion channels and ponds as well as appropriate dirty water containment structures as described in the following sections. These structures will remain until rehabilitation work is self-sustaining and the landform considered stable, and therefore no longer required.

There are three clean catchments which are controlled upstream of the mine area. Water from these catchments is directed via channels and embankments into three clean water dams (**Plan 6**). Drainage from the now rehabilitated mine area is directed into sediment ponds as described below:

- *Dirty water* - this generally comprises stormwater runoff generated in disturbed areas such as the previous open cut and overburden emplacement and rehabilitated areas. This water has the potential for contamination from sources such as sediment and coal fines; and
- *Clean water runoff* - this comprises runoff from undisturbed parts of the surrounding catchments.

All attempts are made to capture and divert clean water runoff around the site to avoid contamination and reduce pressure on the dirty water management system. The volume of dirty water to be treated is therefore minimised by both limiting the contamination of

clean water and through maximising the re-use of dirty water for dust suppression and other water requirements as necessary.

2.8.1 Stored Water

The stored water at the beginning and end of the reporting period are presented in **Table 3.** It should be noted that these values are estimates only.

Table 3. Stored Water

	Volumes held (ML)		
	Start of Reporting Period	At end of Reporting Period	Storage Capacity
Clean Water			
CWD 1	0.35	0.15	0.5
CWD 2	0.15	0.05	0.25
CWD 3	0.30	0.05	1
Dirty Water			
SD 1-A	2.10	0.5	2.25
SD 1-B	0.1	0.1	1.0
SD 2	0.45	0.2	1.2
SD 3	0.15	0.1	0.25
Contaminated Water	0	0	

2.9 Hazardous Material Management

No hazardous materials have been stored on site since site has moved into the rehabilitation stage.

3. Environmental Management and Performance

This section summarises environmental management throughout the 2014 reporting period at Ivanhoe North Colliery.

3.1 Rainfall

Meteorological data is sourced on site from a weather station located at SD-3.

. Total annual rainfall for 2014 was 789.5mm (**Table 4**).

Table 4. Monthly Rainfall

Month	Rainfall (mm)
January	7.5
February	100
March	168
April	55
May	17.5
June	37
July	30
August	60
September	27
October	42
November	43.5
December	202
Total	**789.5**

3.2 Air Quality

Deposited dust levels are required by EPL 13063 to be monitored monthly at three dust deposition gauge monitoring sites.
The EPL monitoring sites are:

- INDD-C: located approximately 460 m northwest of the closest activities on the mine site;
- INDD-G: located 1200 m southwest of the closest activities on the mine site; and
- INDD-K: located approximately 420 m north of the closest activities on the mine site.

Dust monitoring first commenced at the site in June 2009.
Dust depositional results indicate average dust levels remained low across all sites with results only 2 results at INDD-G recording two elevated results in July and August. INDD-C and INDD-K results remained low during the 2013 reporting period. Dust results show monthly dust levels were generally below the 4g/m2/month at all gauges with the exception of INDD-G as mentioned above. Long term dust depositional gauge monitoring results indicates the site is producing minimal dust, with annual averages at all Dust Monitoring sites all well below 2 g/m2/month (**Table 5**)

Table 5. Dust Deposition Monitoring 2014

Date Collected	INDD-C (g/m²/month)	INDD-G (g/m²/month)	INDD-K (g/m²/month)
Jan-14	0.3	2.8	1.6
Feb-14	0.6	0.5	0.2
Mar-14	BD	0.3	BD
Apr-14	0.2	0.6	0.5
May-14	5.1	BD	0.1
Jun-14	0.8	0.4	0.1
Jul-14	0.4	0.4	0.1
Aug-14	0.4	0.2	0.3
Sep-14	7.5	0.1	0.5
Oct-14	22.0	2.3	BD
Nov-14	2.8	2.9	20.7
Dec-14	2.0	2.5	0.4
Annual Average	**3.8**	**1.2**	**2.5**

3.3 Erosion and Sediment Management

Erosion and sediment is managed at the INRP through the Erosion and Sediment Control Plan, which forms part of the Revised Site Water Management Plan (Revised SWMP). The Erosion and Sediment Control Plan is a requirement of Schedule 3, Condition 10 of DA 05_0103, and is in accordance with the guideline document "Managing Urban Stormwater: Soils and Construction Manual 2004".

During the reporting period preliminary sediment dam upstream of SD3 was installed to safeguard omply with Blue Book Type D/F Basin Standards (3.5ML total capacity) and incorporates a small diversion and gentle spill way directing the water away from existing erosion areas and into established grass lands before the water enters in to Lilley's Dam.

- Management of soil resources as per the erosion and sediment control guidelines (e.g. correct soil stripping);
- All internal roads have been constructed to ensure surface drainage is optimised and stabilised, thereby reducing roadside erosion and sedimentation;
- Clean water dams and diversion works have been established;
- Dirty water capture from disturbed areas;
- Maintenance of erosion and sediment control structures such as silt fences and hay bales; and
- Use of flocculation in select sediment dams.

3.4 Surface Water Quality

Surface water monitoring is undertaken in accordance with the sites Surface Water Monitoring Program. This forms part of the Revised SWMP.

Ivanhoe North has three licensed surface water discharge points.

- LDP001 (point 1) – Overflow from Sediment Dam 1 (SD-1);
- LDP002 (point 2) - Overflow from Sediment Dam 2 (SD-2); and
- LDP006 (point 6) – Overflow from Sediment Dam 3 (SD-3).

3.4.1 Monitoring and Performance Criteria

Ivanhoe North monitors surface water discharge from its licenced discharge points LDP001, LDP002 and LDP006 (**Plan 4**) according the conditions set out in Environmental Protection Licence (EPL) 13063 (**Appendix 2**). The criteria for discharge water quality are outlined in **Table 7**.

Table 6. LDP001, LDP002 and LDP006 EPL Limits

Parameter	EPA Licence Limit
pH	6.5-8.5
Total Suspended Solids (mg/L)	30
Oil and Grease (mg/L)	10

3.4.2 Results LDP001, LDP002 and LDP006

Nil water discharged from the discharge dams during the reporting period.

Figure 1. Contour bank structure installation during the reporting period

Figure 2. Preliminary Sediment Dam 1B: resizing work during the reporting Period

3.5 Ground Water Quality

As reported in previous AEMRs the project had a low risk of impacting groundwater and no groundwater dependent ecosystems were identified during the original environmental assessment process. Now that that coal extraction and processing has ceased, the ongoing rehabilitation activities have an even lower risk.

There are no hydrocarbon storages on site and no specific groundwater controls or protection measures are required.

3.6 Threatened Flora and Fauna

Current and future rehabilitation activities within the Ivanhoe Colliery sites will promote a positive impact on local flora and fauna including improving habitat value and diversity and overall biodiversity.

With all mining complete and rehabilitation continuing to improve, no adverse impacts are predicted to threatened flora or fauna.

3.7 Weeds

The Ivanhoe North Environment and Community Coordinator inspects the land holding for any noxious weeds such as Blackberry, St Johns Wort, Spear Thistle, Cudweed and Catsear. The site rehabilitation work is low in weed distribution and abundance. Weeds are actively managed as detected and recorded upon site inspections and are dealt with accordingly. Weed control measures for the INRP include:

- Weeds are recorded as part of monthly inspection and an annual weed management survey is completed; and
- Minor weed spraying is completed.

3.9 Blasting

With operations completed at Ivanhoe North Colliery, there has not been any blasting activities during the reporting period.

3.10 Operational Noise

Noise generation at the Ivanhoe North Colliery has been minimal during the reporting period, as the mine has remained on care and maintenance. Noise produced is usually limited to the occasional use of light vehicles during regular inspections of the mine and the use of equipment to update the sites erosion and sediment control system. Work has only been completed on a Monday to Friday and during daylight hours basis.

3.11 Visual or Stray Light

All operations are completed at Ivanhoe North Colliery, therefore visual and stray light is not considered a problem.

3.12 Aboriginal Heritage

OzArk Environmental and Heritage Management Pty Limited (Ozark) was commissioned to identify any artefacts or sites of Aboriginal heritage significance on the project site for the 2006 EA.

A search of the Aboriginal Heritage Information Management System (AHIMS) – Aboriginal Sites Register within a 10 km square area centred on the project site identified a total of 71 recorded sites. No Aboriginal artefacts or sites were identified during a field survey by OzArk's archaeologists and the Bathurst Local Aboriginal Land Council representative.

As no Aboriginal sites or artefacts were identified on the project site, no specific safeguards or management practices were proposed. However, site employees and contractors were advised of their responsibilities under the National Parks and Wildlife Act 1974 to immediately cease work in the vicinity of any identified or suspected site or artefact until such time as the management of the site/artefact has been discussed with a NSW Office of Environment and Heritage archaeologist, and a representative of the Bathurst Local Land Aboriginal Council.

As part on the induction process, all employees were required to undertake cultural awareness training to understand their responsibilities in regard to aboriginal artefacts.

3.12.1 European Heritage

There are no identified items of European heritage within the mining lease.

3.13 Spontaneous Combustion

There were no issues of spontaneous combustion during the reporting period.

3.14 Bushfire

The project site is characterised by open forest and woodland vegetation, dominated by Eucalyptus tree species and a relatively open sub-strata of shrubs and grasses. A bushfire hazard exists due to the vegetation type, with this hazard increasing during the warmer summer months and decreasing over the cooler winter months.

A Bushfire Management Plan has been developed and approved for the site by Forests NSW. The Bushfire Management Plan outlines:

- Emergency procedures and numbers;
- Firefighting equipment;
- Management of flammable materials;
- Training; and
- Water Sources for firefighting.

There was a small bushfires within the mining lease during the reporting period. The fire started during a storm when lightning caused a small fire to start and continue to smoulder in the Ben Bullen State Forest to the south of Ivanhoe North. Rural Fire Trucks accessed the fire via entry through Ivanhoe North. A helicopter was brought in to control the small blaze and filled from a neighbouring farm dam as dam levels at Ivanhoe North did not suffice.

3.15 Mine Subsidence

No subsidence has been identified during the reporting period. Any subsidence identified during inspections will be recorded and appropriately remediated.

3.16 Contaminated Land Management

3.16.1 Phase 1 Environmental Site Assessment

A Phase 1 Environmental Site Assessment (ESA) was completed in 2010 at Ivanhoe North. The report considered potential moderate to low risk of contamination at Ivanhoe North, although no contamination was identified. Further investigations will occur prior to lease relinquishment.

3.17 Methane Drainage

Not applicable.

3.18 Public Safety

The following controls have been implemented for the INRP to manage public safety:

- Access to the mining lease is restricted to authorized personnel only. Security gates have been installed near the Castlereagh Highway intersection and are locked at all times;
- Security/warning signs on security gates;
- Employee inductions in safe working practices and regular follow-up safety meetings and reviews will be undertaken;
- All mobile equipment are compliant with the Mine Design Guideline (MDG) 15 fitted with appropriate safety and fire suppression equipment; and
- All mining lease, project approval and licence conditions will be strictly complied with.

Fences were installed at site following consultation with the neighbouring land owner and Forests NSW. This includes:

- Four strand barb-wire stock proof fence along the western boundary of the mine site adjoining the land of neighbour); and
- Six foot security fencing along the eastern boundary of the mine site (adjoining the Castlereagh Highway).

3.19 Other Issues and Risks

3.19.1 Risk Management

Environmental Management for the INRP is undertaken through a risk driven methodology. Assessing risk against predetermined consequence and probability criteria allows for site resources to be efficiently deployed toward high risk or high consequence issues.

A risk assessment was carried out as part of the MOP preparation. The completed assessment is summarised in **Table 9.**

The identification and assessment of environmental risks at the mine allowed management plans and procedures to be developed to minimise the potential risk on the environment and community. Management controls are required for all items which have been assessed as either high or medium risk.

Table 7. Risk Identification Matrix

Issue	Exploration	Land preparation, vegetation and topsoil stripping.	All construction activities including earth moving.	Mine development and mining, surface and underground.	Use/maintenance of roads, tracks and equipment.	Waste rock emplacement management.	Mineral processing facilities and infrastructure.	Ore/product stockpiling and handling.	Tailings impoundment management	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	2	2	2	2	2	2	2	n/a	1	1	n/a	2	2	2
Erosion/ sediment minimisation	n/a	2	2	1	2	2	1	2	n/a	2	n/a	n/a	n/a	2	2
Surface water pollution	n/a	2	2	1	2	2	1	2	n/a	2	2	n/a	2	2	2
Groundwater pollution	n/a	n/a	n/a	1	n/a	n/a	n/a	n/a	n/a	1	1	n/a	n/a	n/a	n/a
Contaminated or polluted land*1	n/a	1	1	1	1	1	1	1	n/a	1	2	n/a	1	2	2
Threatened flora protection	n/a	1	1	n/a	n/a	n/a	n/a	n/a	n/a	1	1	n/a	n/a	1	1
Threatened faun/a protection	n/a	2	1	n/a	n/a	n/a	n/a	n/a	n/a	1	1	n/a	1	1	1
Weed control and management	n/a	2	1	n/a	1	n/a	n/a	n/a	n/a	1	n/a	n/a	1	2	2
Operation/al noise	n/a	2	1	2	2	2	2	2	n/a	n/a	1	n/a	1	1	n/a
Vibration from 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	1	1	1	1	1	1	1	n/a	1	1	n/a	1	1	1
Aboriginal heritage	n/a	1	n/a	n/a	1	1	n/a	n/a	n/a	1	n/a	n/a	n/a	1	1
Natural heritage conservation *2	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
Spontaneous combustion	n/a	n/a	n/a	1	n/a	n/a	1	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bushfire	n/a	2	1	1	2	1	1	1	n/a	1	2	n/a	n/a	1	2
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	1	1	1	1	1	1	1	n/a	1	2	n/a	1	1	1
Methane drain/age/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 *3	n/a	2	2	2	2	2	2	2	n/a	1	2	n/a	1	2	2

1 = Low Impact 2 = Moderate Impact 3 = Catastrophic Impact n/a = not applicable

Note 1: No existing contaminated or polluted land has been identified within the mine site to date.
Note 2: The area of disturbance does not contain items of natural heritage significance.
Note 3: All activities carry some form of risk to public safety, however, there will be no public access to these activities

4. Community Relations

Centennial seeks to keep open communication channels with the local community. With the Ivanhoe Colliery sites on long-term care and maintenance, it is unlikely that any issues should arise in terms of complaints, incidents or environmental issues.

4.1 Environmental Complaints

During the reporting period there were no community complaints registered. Centennial has never received any community complaints for the Ivanhoe North Colliery.

4.2 Community Liaison

Although mining activities have ceased at the Colliery, Ivanhoe North representatives undertake community engagement through planned and unplanned activities outlined below.

Environmental issues associated with the rehabilitation and maintenance works are unlikely to result in impact on the surrounding community and associated complaints. Centennial manages these potential issues through implementing the various controls identified in the MOP.

4.2.1 Celebrate Lithgow

Centennial participated in the annual Celebrate Lithgow activities held in November 2013. Centennial had an information stall set up in the street fair. Representatives from each of Centennials Western Operations and Projects were available to provide information regarding operations and environmental management at each site (**Figure 3**).

Ivanhoe North provided information regarding the recent rehabilitation activities undertaken.

4.2.2 National Aboriginal and Islander Day Observance Committee (NAIDOC) Celebrations

Centennial supplied representatives to run the BBQ during Lithgow NAIDOC celebrations held in September 2013 (**Figure 3**). The 2013 NAIDOC celebrations organized by Mingaan Aboriginal Corporation included Wiradjuri dance, Koori Sports, the Taronga Zoo mobile as well as information stalls, displays and activities.

Consultation will continue during the rehabilitation phase of the project. This is particularly important as the rehabilitation monitoring program will be used to verify the achievement of the objectives of the program and the ongoing involvement of key stakeholders is an essential component of this process.

Figure 3. Centennial Representatives at NAIDOC Celebrations

5. Rehabilitation

5.1 Buildings

No buildings or infrastructure remain within the Ivanhoe North Colliery.

5.2 Rehabilitation of Disturbed Land

The RMCP divides rehabilitation and closure tasks into the following procedures:

Clearing and Seed Collection Procedures

- Seed collection;
- Vegetation Clearing;
- Fauna Management;
- Salvage and Reuse of Material; and
- Conserving Soil Resources.

Rehabilitation Procedures

- Landform Preparation;
- Seeding Procedures;
- Water Management; and
- Rehabilitation Management.

Closure Procedures

- Removal of infrastructure and roads; and
- Disconnection of services.

The formation of the final landform ensured that large bulky material and rocks were kept well below the surface to prevent exposure and disturbance of the surface whilst the process of final surface preparation and revegetation was undertaken.

The final landform was created through the replacement of overburden within the completed open cut. The landform incorporated the revegetated spoil dumps of the Cullen Main West open cut and recreated the natural slope of the land prior to mining related disturbance. The final slopes vary from approximately 6^{o} at the southern end of the final landform to approximately 14^{o} at the northern end. No slopes exceed 18^{o} (approximately 1V:3H). Natural drainage lines that currently traverse the abandoned Cullen Main West open cut were reinstated and the entire site revegetated with native woodland species endemic to the local area. Stream 3 was reinstated in the previous reporting period.

The conventional method of direct seeding was employed. This involved the direct application of a mix of native tree, shrub and understorey species over the surface of the prepared landform. This method involved contour ripping the surfaces as detailed above. On profiling the backfilled landform, the previously stripped top-layer material will 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 principal objective of the RMCP is to create a stable landform which will pose no long-term environmental hazard. It was 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 to be undertaken.

Seed from adjacent bushland will help facilitate rehabilitation around the fringe of the land disturbed by the open cut mining process. Seed was purchased for Ivanhoe North to compensate for the shortage from seed collection at site.

The species list used reflects the native species found on the mining lease and surrounding Ben Bullen State Forest. The seed mix included a mixture of grasses, mid storey and upper storey species to create a woodland/ grassland habitat.

The major rehabilitation activities associated with the INRP are outlined in the RMCP. Rehabilitation results in areas of the southern blocks were below expectations and the investigation findings are outlined in **Section 5.4.2.**

There was no rehabilitation work undertaken during the reporting period. A rehabilitation summary and record of maintenance activities on rehabilitated land is shown in **Table 8** and **Table 9.**

Table 8. Rehabilitation Summary

MINE LEASE AREA	Area Affected/Rehabilitated (hectares) To Date	Last Report	Next Report (estimated)	
A1: Mine Lease(s) Area	80.2			
B: Disturbed Areas				
B1: Infrastructure area (other disturbed areas to be rehabilitated at closure including facilities, roads)	4.2	0	0	
B2: Active Mining Area, (excluding items B3-B5 below)	13.7	0	0	
B3: Waste emplacements (active/unshaped/in or out-of-pit)	7.6	0	0	
B4: Tailings emplacements, (active/unshaped/in or out-of-pit)	0	0	0	
B5: Shaped waste emplacement (awaits final vegetation)	6.7	0	0	
ALL DISTURBED AREAS	28	28	28	F1
C: REHABILITATION PROGRESS				
C1: Total Rehabilitated Area (except for maintenance)	17.6	17.6	17.6	F2
D: REHABILITATION ON SLOPES				
D1: 10 to 18 degrees	11.1	0	0	
D2: Greater then 18 degrees	4.1	0	0	
E: SURFACE OF REHABILITATED LAND				
E1: Pasture and grasses	0	0	0	
E2: Native forest/ecosystems	17.6	0	0	
E3: Plantations and crops	0	0	0	
E4: Other (include non vegetative outcomes)	0	0	0	

Table 9. Maintenance Activities on Rehabilitated Land – Ivanhoe North

NATURE OF TREATMENT	Area Treated (ha)		Comment/control strategies/ treatment detail
	Report Period	Next Period	
Additional erosion control (drains re-contouring, rock protection)	1.6	0.5	Installation of mid-slope contour banks and extra sediment dam capacity
Re-covering (detail-further topsoil, subsoil sealing etc)	0	0	nil
Soil Treatment (detail-fertiliser, lime, gypsum etc)	0	5	Bio solid and mulch trial
Treatment/Management (detail-grazing, cropping, slashing etc)	0	0	
Re-seeding/Replanting (detail-species density, season etc)	1.6	0.5	Re seeding over new contour banks and sediment dam walls
Adversely Affected by Weeds (detail-type and treatment)	0	0	NIL
Feral animal control (detail – additional fencing, trapping, baiting etc)	0	0	NIL

5.3 Rehabilitation Monitoring

Annual rehabilitation monitoring is undertaken at Ivanhoe North as a way to track, document and report on the success and performance of rehabilitation activities against the overall rehabilitation objectives for the site.

The monitoring programme involved the utilisation of the CSIRO developed Ecosystem Function Analysis (EFA) tool (Tongway & Hindley, 2004), vegetation monitoring components, and the AECOM developed Visual Monitoring Tool.

The EFA methodology created indices based on simple field indicators that reflect the measured variables of stability, water infiltration and nutrient cycling, in turn monitoring the functional status of the landscape. Utilising the EFA method, scientifically robust data is provided on the base sites, which when compared to the data collected from analogue sites, accurately reflects if the site is on a trajectory towards a sustainable ecosystem.

The purpose of the analogue sites is to represent as close as possible the proposed vegetation characteristics of the revegetation areas. The analogue site also provides data on the long-term goal for the revegetation area. Assessing the analogue sites is an integral part of monitoring rehabilitation and is used to generate a “band” of values depending on seasonal effects as well as stochastic events like storms, droughts and fire. In addition, data recording the response and recovery dynamics to stochastic disturbances of the analogue site would provide a test of the resilience of a rehabilitated site (rate of recovery of function after specified disturbance).

In 2014 rehabilitation monitoring continued to be undertaken by AECOM.

The monitoring program currently includes seven transects, comprising four transects in rehabilitated areas and three analogue transects.

The existing four monitoring transects (IVN A1, IVN A2, IVN A3 and IVN R1) were re-surveyed during the 2014 monitoring event.

Table 10. Study Transects of Rehabilitation Monitoring Program

Transect	Type	Established
Transect 1 (IVN R1)	Rehabilitation	2013
Transect 2 (IVN R2)	Rehabilitation	2013
Transect 1 (IVN R3)	Rehabilitation	2013
Transect 2 (IVN R4)	Rehabilitation	2013
Analogue 1(IVN A1)	Analogue	2010
Analogue 2(IVN A2)	Analogue	2010
Analogue 3(IVN A3)	Analogue	2012

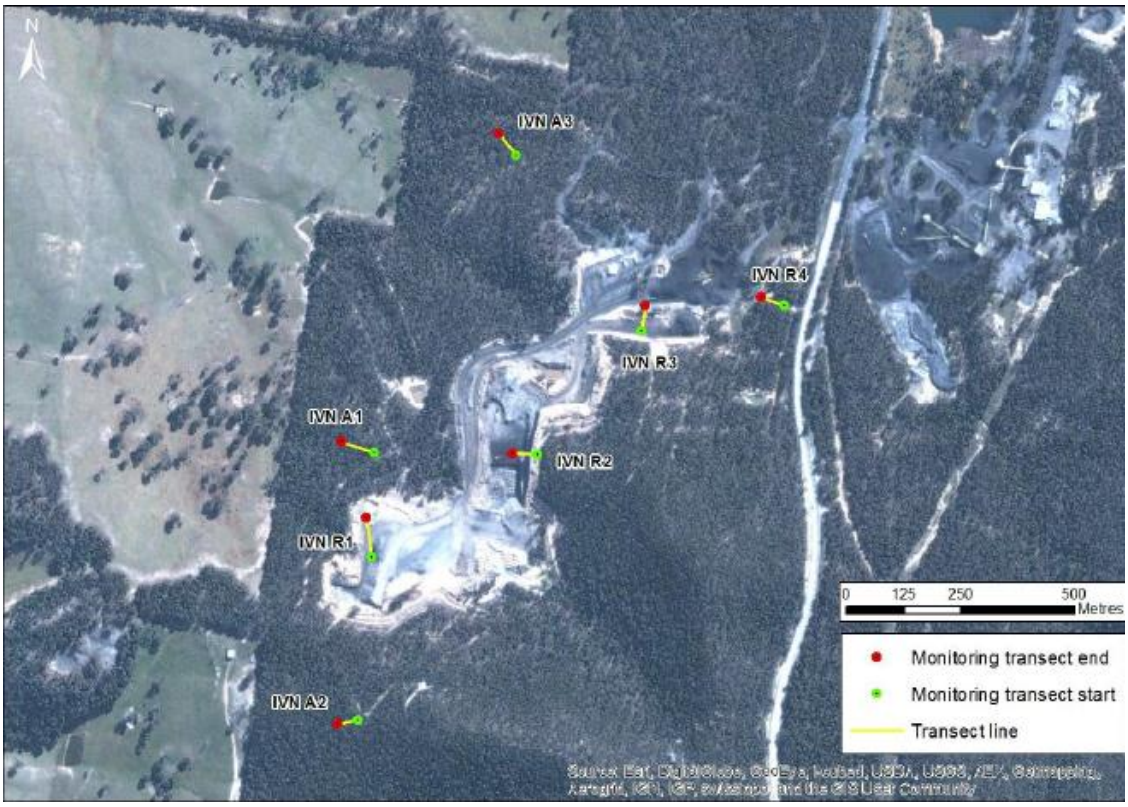

Figure 4. Monitoring Transect Locations at Ivanhoe North Colliery

5.3.1 Landscape Function Analysis

5.3.1.1 Landscape Organisation

Landscape function performance – as reflected by the generated indices was generally very consistent for all rehabilitation monitoring sites across Ivanhoe North (IVN R1, IVN R2, IVN R3 and IVN R4).

All LOIs and PAIs were very poor (i.e. values lower than 30%, refer to **Table 11**), usually reflecting high amount of bare ground and low ground obstructions. However, the IVN R1 results differentiated from the IVN R2, IVN R3 and IVN R4 results.

- IVN R1 showed a marked increase in LOI/PAI scores from last year, promoted by the strong growth in woody vegetation (see further below); and
- In contrast, the LOI/PAI scores at IVN R2, IVN R3 and IVN R4 have all decreased from last year. This is explained by the increasing severity and of rill erosion in these areas, breaking through the contour banks and reducing the capacity of the 'troughs' to trap and retain resources which can leak through the breaks in the banks created by the rills. This has led to shorter and narrower patches being recorded during the LFA procedure and subsequently a decrease in index scores.

For all sites the soil stability index was satisfactory (i.e. index comprised within 40-45% **Table 11**) and the infiltration and nutrient cycling indices were poor (i.e. indices <20%). The poor performance in terms of infiltration and nutrient cycling is largely explained by the lack or very low levels of ground cover (basal cover and litter) and of woody vegetation across the rehabilitated landform.

All SSCIs have remained relatively stable at IVN R1 form last year despite the evident growth in woody vegetation. Indeed, it will take some time for the root structures of the woody vegetation to

develop and affect the structure of the soil profile which will eventually be reflected in the SSCIs scores.

The stability indices at IVN R2, IVN R3 and IVN R4 have all increased since last year, while their infiltration indices have decreased and nutrient cycling indices have remained relatively unchanged. It is anticipated that infiltration and nutrient cycling properties of the soils at Ivanhoe North should improve after woody vegetation has established and developed.

Table 11. Landscape Function Analysis Results 2014 – Ivanhoe North

Index	IVN R1	IVN R2	IVN R3	IVN R4	IVN A1*	IVN A2*	IVN A3*
Landscape Organisation Index (LOI)	0.23	0.23	0.21	0.20	1.00^	1.00^	1.00^
Patch Area Index (PAI)	0.19	0.15	0.16	0.16	1.00^	1.00^	1.00^
Stability Index	45.1	44.6	41.1	45.6	70.4	63.1	77.6
Infiltration Index	18.1	19.1	21.4	18.2	40.2	41.1	48.4
Nutrient Cycling Index	12.1	12.7	12.7	12.0	28.9	33.4	41.3

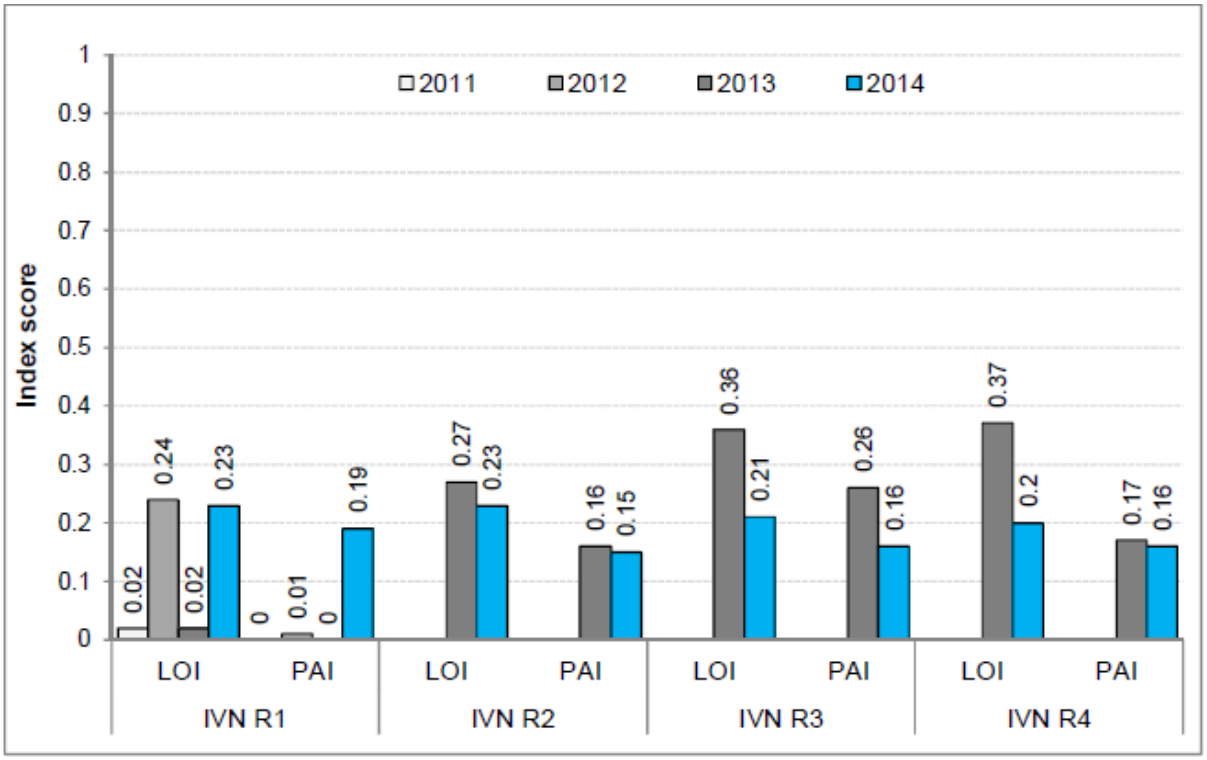

Figure 5. Landscape Function Indices (2011-2014) – Ivanhoe North Rehabilitation Sites

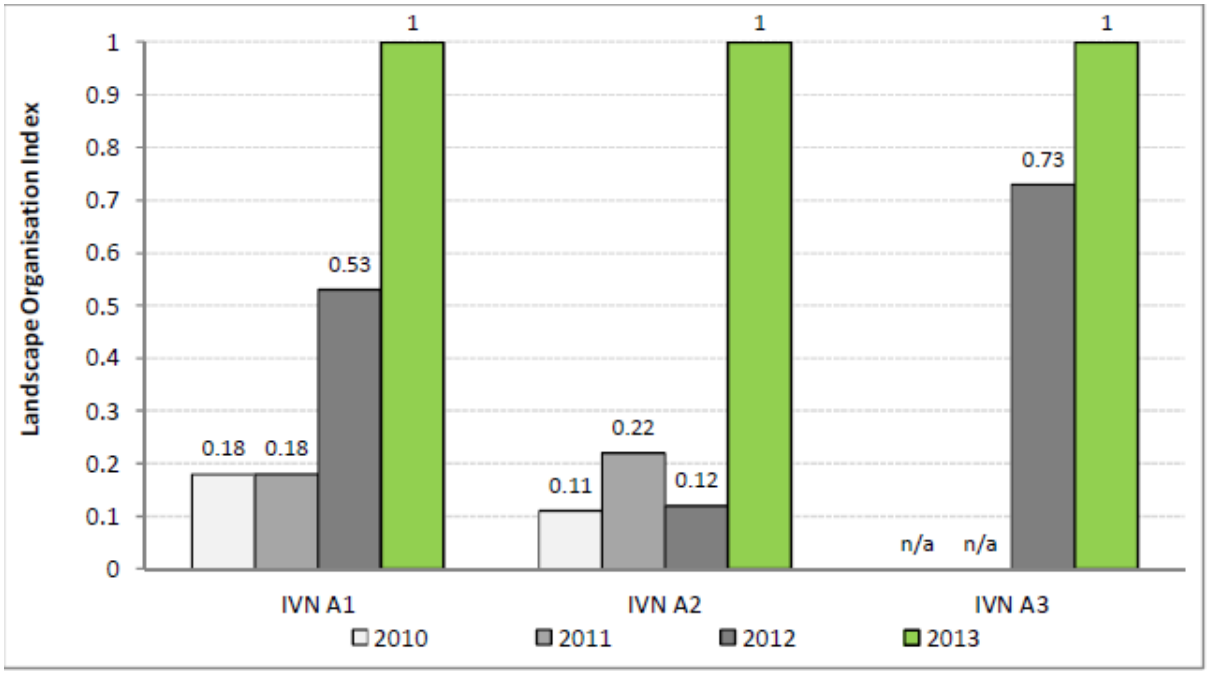

Figure 6. Landscape Organisation Indices (2010-2013) – Ivanhoe North Analogue Sites

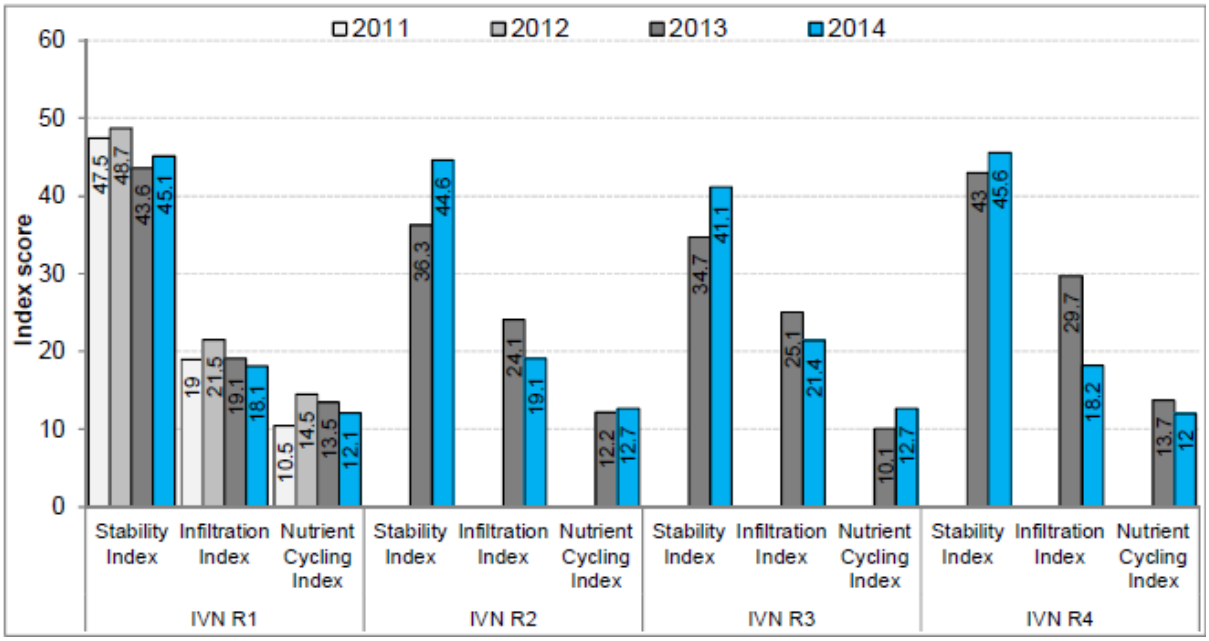

Figure 7. Soil Surface Condition Indices (2011-2014) – Ivanhoe North Rehabilitation Sites

5.3.1.2 Soil Surface Condition

Active rill erosion occurs throughout the site on the rehabilitated slopes, and has worsened and is more severe than what was observed in 2013. The failure of ground cover and woody vegetation to establish during the last year means that there are no root structures in the soil profile providing much needed soil stabilisation.

Table 12. Rill Surveys Results 2014 – Ivanhoe North

Contour transect location	No. of rills intersecting transect	Total rills per 90m	Average rill width	Average rill depth	Average rill cross section area*
IVN R2					
0 m	3	12	47.1 cm (±33.9stdev)	8.6 cm (±4.1stdev)	492 cm^2 (±603.2stdev)
20 m	4				
40 m	5				
IVN R3					
0 m	4	17	27.4 cm (±19.5stdev)	10.2 cm (±5.2stdev)	248 cm^2 (±211.7stdev)
20 m	13				
50 m	0				
IVN R4					
0 m	4	45	25.0 cm (±13.9stdev)	12.1 cm (±6.9stdev)	321 cm^2 (±292.5stdev)
20 m	28				
50 m	13				

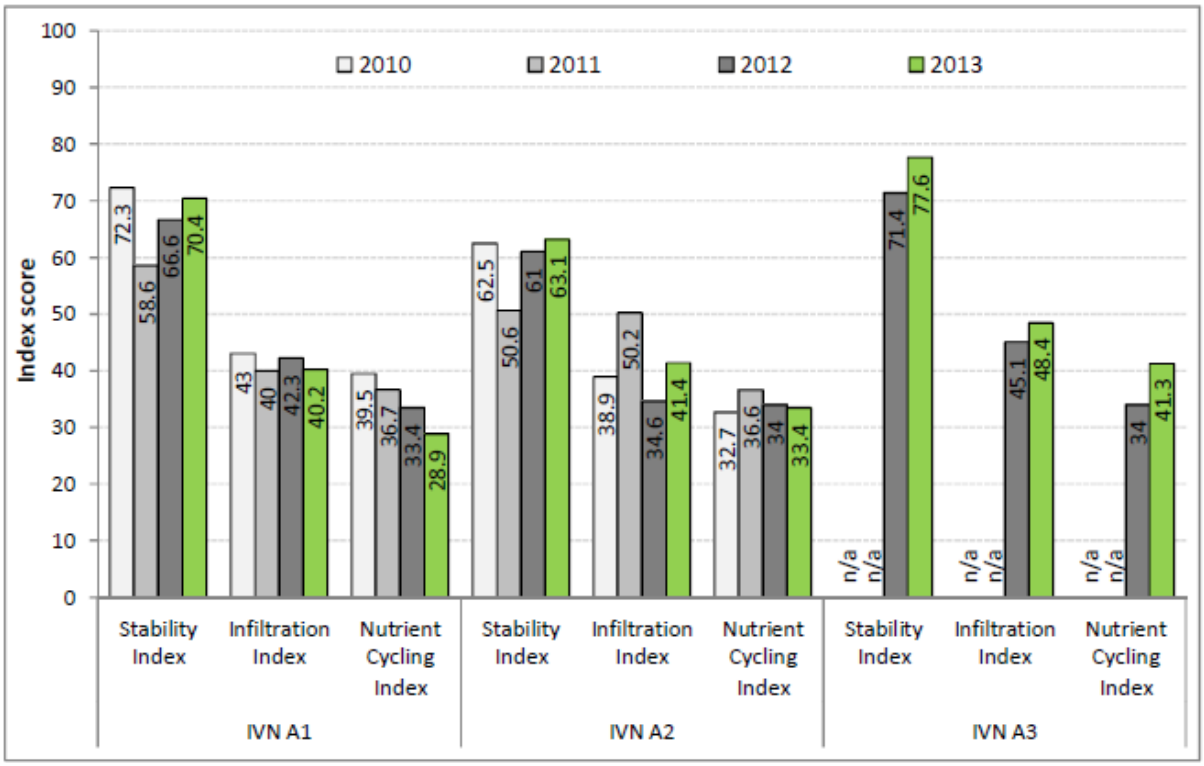

Figure 8. Soil Surface Condition Indices (2010-2013) – Ivanhoe North Analogue Sites

5.3.2 Vegetation Dynamics

Table 13. Vegetation Dynamics Monitoring Results 2014 – Ivanhoe North

Indicator		IVN R1	IVN R2	IVN R3	IVN R4	IVN A1*	IVN A2*	IVN A3*
Lower stratum cover (%)	Basal cover	18.8	21.8	25.5	51.0	51.0	7.1	71.5
	Leaf litter	0.0	0.0	0.0	46.0	46.0	78.5	26.3
	Bare Ground	75.0	72.3	62.7	3.0	3.0	14.4	2.2
	Woody debris	2.4	0.5	4.1	-	-	-	-
	Rocks (≥20mm)	3.8	5.4	7.7	-	-	-	-
Woody plants density	Stratum 1	119	5	6	121	121	148	112
	Stratum 2	58	0	0	18	18	31	17
	Stratum 3	7	0	0	26	26	43	22
	Stratum 4	0	0	0	-	-	-	-
	Stratum 5	0	0	0	-	-	-	-
Canopy cover (%)		0	0	0	0	70	70	60
Woody species richness		6	3	2	4	7	10	9

5.3.3 Disturbance

Disturbance has increased for all sites with disturbance factors consistent throughout the entire Ivanhoe North rehabilitated area. Given their higher capacity to establish in shallower and poorer soils and colonise disturbed areas, weeds are prevalent throughout the site. Species present include Cape weed (Arctotheca calendula), Sifton bush (Cassinia arcuata), Flax leaf fleabane (Conyza bonariensis), Skeleton Weed (Chondrilla juncea), Scotch thistle (Cirsium vulgare), Inkweed (Phytolacca octandra) and Silverleaf Nightshade (Solanum elaeagnifolium).

Evidence of vertebrate pests was again observed at the site including feral goats (footprints), rabbits (observed) and feral dogs (footprints). The impact of feral pests was discussed in last year's report (AECOM, 2013). Particularly, the impact of rabbits and goats may be an important factor limiting the successful establishment of vegetation across the site, in turn encouraging soil erosion.

The recent land shaping activities that have been undertaken at the site have led to tracked and wheeled disturbance across the site, however this impact is limited and only short term.

Finally and as discussed above, erosion is active throughout the site and has increased since last year with common rilling impacting the slopes, as well as sheet erosion throughout. Future monitoring will be essential to track the evolution and condition of the rills, ensuring that they do not turn in to more sever gully erosion. This should be helped by the newly created contour bank, and will also largely depend on vegetation successfully establishing across the site.

Disturbance results are presented below in **Table 14.**

Table 14. Disturbance Scores 2014 – Ivanhoe North

Disturbance factor	IVN R1	IVN R2	IVN R3	IVN R4	IVN A1*	IVN A2*	IVN A3*
Mining Activity							
Wheel	Freq.: 1 Int.: 1	Freq.: 1 Int.: 1	Freq.: 1 Int.: 1	Freq.: 1 Int.: 1	0	0	0
Non-Mining Activity							
Grazing	0	0	0	0	Freq.: 1 Int.: 1	Freq.: 1 Int.: 1	Freq.: 1 Int.: 1
Weeds & Vertebrate pests							
Weeds	Freq.: 3 Int.: 1	Freq.: 2 Int.: 2	Freq.: 2 Int.: 1	Freq.: 2 Int.: 1	0	0	0
Feral animals	Freq.: 3 Int.: 1	Freq.: 2 Int.: 1	Freq.: 2 Int.: 1	Freq.: 2 Int.: 1	Freq.: 1 Int.: 1	Freq.: 1 Int.: 1	Freq.: 1 Int.: 1
Erosion							
Water	Sheet/Rill /Gully: 2	Sheet/Rill /Gully: 2	Sheet/Rill /Gully: 2	Sheet/Rill /Gully: 2	0	Subs.: 1	0
Disturbance status	**12**	**11**	9	9	**4**	**5**	**4**

6. Activities Proposed in the Next AEMR Period

The activities proposed for the next reporting period are generally in accordance with the MOP and existing approvals and include:

- Continuation of rehabilitation monitoring at Ivanhoe North Ongoing using the LFA assessment tool;
- Continue site maintenance (weed spraying, erosion and sediment controls);
- Organic fertiliser and bio solid trials in 2012 rehab area;
- Continue consultation with stakeholders regarding rehabilitation and mine closure at Ivanhoe North; and
- Continued consultation with OEH and EPA regarding modifications to the MOP and EPL.

Ivanhoe North Rehabilitation Project AEMR Plans

Appendix 1

Environment Protection Licence No. 13063- Ivanhoe North

Appendix 2


Centennial Coal