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Rix's Creek Continuation of Mining Project

Agricultural Impact Statement



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Agricultural Impact Statement for Rix's Creek Continuation of Mining Project

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Executive Summary

Rix's Creek Mine (the Mine) of Rix's Creek Pty Limited, is owned and operated by Bloomfield Collieries Pty Limited (Bloomfield). The Mine is an open cut coal mine approximately 5 km north-west of Singleton in the Hunter Valley Coalfields of NSW.

The Project seeks to extend the life of the existing open cut mining operation at Rix's Creek until approximately 2037. The continuation of mining operations will extend in a north-westerly direction and require a modification to Mine Lease 1432 for an out of pit dump. A lease extension area (Mine Lease Application 487) is land currently owned by Bloomfield Collieries Pty Ltd.

This Agricultural Impact Statement is related to the current and potential impact on agricultural production, referring to the lease extension (Mine lease Application 487), an area of approximately 170 ha. An agricultural Impact statement is not required for the current mining lease. "

- The land has previously and is currently used for agriculture. It is grazing land, running beef cattle on predominantly native pastures. Traditionally and currently the land supports a cattle breeding enterprise producing 'weaner' cattle with stocking rates of 5 D.S.E. per hectare, though with good seasonal conditions and increased fertiliser application and seed sowings, this could increase to 7 D.S.E. per hectare. This is a common cattle enterprise in the Hunter valley and Singleton district.
- Grazing will be continued on the land until the out of pit dump is formed (potentially 2017). Of the 170 ha lease extension area, 78 ha will be disturbed by the project and grazing excluded, while 92 ha will not be disturbed and will remain as native pasture (allowing potential continuance of grazing).
- Grazing will recommence on the sown rehabilitated land once the pastures have shown to be stable and approved for grazing.
- The economic impact from the loss of production from grazing during the period of disturbance and rehabilitation is relatively small. With the current carrying capacity and enterprise conducted on the land, the annual income from the total 170 ha removed from agriculture is between \$20,000 and \$30,000 per annum. With higher inputs and more intensive management potentially an income of \$45,000 per annum may be possible (but with higher inputs and risk).
- The land capability pre-mining has been assessed as classes IV and V, - land that is suitable for grazing but not capable of cultivation for crops. Site characteristics such as slope and soil limitations such as shallowness, poor structure and low fertility limit its potential productivity and land use. There is no qualifying Biophysical Strategic Agricultural Land (BSAL) within the lease extension area (Mine Lease Application 487).
- Rehabilitation of the disturbed land will re-instate the land to the same land capability class as prior to disturbance (Class IV; 121ha and Class V; 49 ha).
- Pasture will be sown on the rehabilitated land for a post mining land use of grazing. Current research undertaken examining beef cattle production on rehabilitated pastures compared to natural pastures, indicate that equivalent or higher production is possible on the rehabilitated sown pasture.

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1.0 Introduction

1.1 Overview

Rix's Creek Mine (the Mine) of Rix's Creek Pty Limited, is owned and operated by Bloomfield Collieries Pty Ltd (Bloomfield). The Mine is an open cut coal mine approximately 5 km north-west of Singleton in the Hunter Valley Coalfields of NSW. The Mine currently produces approximately 1.5 million tonnes per annum (Mtpa) of product coal from its existing operations.

Bloomfield is seeking approval for the Rix's Creek Continuation of Mining Project (the Project), which relates to the continued operation of the existing open cut coal mine. The Project would allow the Mine to continue to operate as an open cut mine, accessed via its existing infrastructure facilities.

The Project seeks to extend the life of the existing open cut mining operation at Rix's Creek until approximately 2037. The continuation of mining operations will extend in a north-westerly direction and require a modification to Mine Lease 1432 for an out of pit dump. The continuation of operations will utilize the existing mine access, Coal Handling and Preparation Plant (CHPP), coal stockpiling and rail facilities.

1.2 Proposed Development

The Rix's Creek Continuation of Mining Project seeks to continue the existing mining operation at the Mine and to mine up to 4.5Mtpa ROM coal per year. Mining methods will be the same as those currently employed at the Mine, being multi-seam bench open cut techniques. Run of mine (ROM) coal will continue to be processed onsite at the existing CHPP which has capacity to accept the proposed increase in throughput. Product coal will then be transported by rail to the Port of Newcastle. It is estimated that the Mine could yield a total of 32 million saleable tonnes of coal at an overburden ratio of approximately 10.5:1 before coal seams are exhausted.

The components of the proposed development comprise:

- The ongoing use of, and future additions to, the existing mine fleet;
- Use of the existing mine infrastructure facilities including the CHPP;
- Continuation of operating hours - 24 hours a day 7 days a week;
- Use of existing and new rejects and tailings emplacements;
- Rail transport of product coal to the Port of Newcastle;
- Mine closure and rehabilitation; and
- Environmental management.

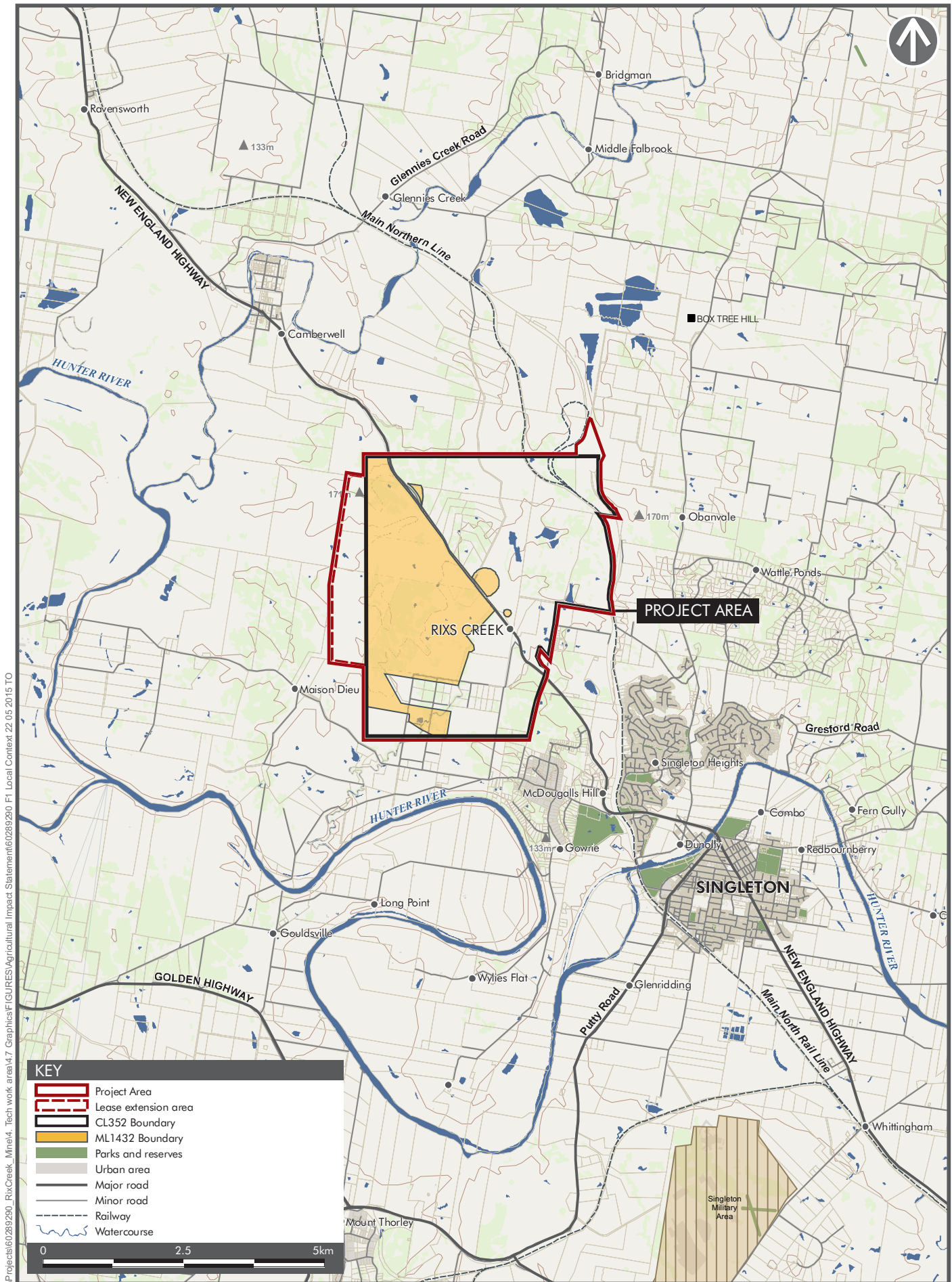
A lease extension area (Mine lease Application 487) which will allow out of pit overburden dump is located adjacent to the mine lease (**Figure 1**).

1.3 Proposed Operations Relevant to the Agricultural Impact Statement

This Agricultural Impact Statement is related to the current and potential impact on agricultural production, referring to the lease extension (Mine lease Application 487), an area of approximately 170 ha. An agricultural Impact statement is not required for the current mining lease.

The following issues will be considered in assessing the agricultural impact of the project:

- Identification of agricultural resources within the lease extension area;
- Current agricultural production from the area, impacts on production during mining and post mining agricultural productivity; and
- Potential impacts on the mine lease extension area, surrounding locality and post mining land use.



1.4 Purpose of the report

1.4.1 Director-General's Requirements

The Rix's Creek Continuation of Mining Project Environmental Impact Statement has been prepared in accordance with Division 4.1, Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) which ensures that the potential environmental effects of a proposal are properly assessed and considered in the decision-making process.

In preparing this Agricultural Impact Assessment, the Director-General's Requirements (DGRs) issued for the Rix's Creek Continuation of Mining Project (SSD 13_6300) on 3 March 2014 have been addressed as required by Clause 75F of the EP&A Act. The key matters raised by the Director-General for consideration in the Agricultural Impact Statement are outlined in **Table 1** along with a reference to where the requirements are addressed in the report.

Table 1 Director General Requirements applicable to the Agricultural Impact Statement

	Director Generals Requirement	Section Addressed
Agricultural Productivity	A description of the agricultural resources (especially soils and land capability used for agriculture) and agricultural enterprises in the locality.	Section: 2.1, 2.2, 3.1.7 Section: 3.1, 3.2
	Agricultural productivity of the assessed area	Section: 3.0, 3.2.1
	Water Resources – including use of water and impacts on existing surface water and flood assessment.	Section: 3.1.4
	Identification of any regionally or state significant agricultural resources in the locality. Assessment of the impacts of the proposal on strategic agricultural land, having regard to the gateway criteria in the Upper Hunter Strategic Regional Land Use Plan.	Section: 1.3.2, 1.3.3, 2.2
	Justification for any significant long term changes to agricultural resources and post-mining agricultural land use options.	Section: 4.3.1
	Assessment of potential impacts on land capability pre and post mining	Section: 2.2, 2.4

1.4.2 Strategic Regional Land Use Plan – Upper Hunter

The *Strategic Regional Land Use Plan – Upper Hunter* (SRLUP) (DP&I, September 2012) is a component of the broader Strategic Regional Land Use Policy, which consists of various initiatives to manage land use conflicts in regional areas, in relation to agriculture, coal mining and coal seam gas. The plan defines areas of Biophysical Strategic Agricultural Land (BSAL) and Critical Industry Clusters (CIC), including clusters for the equine and viticulture enterprises.

A component of the SRLUP is the Gateway Process, which applies to State significant mining and coal seam gas proposals that extend beyond an existing mining lease or petroleum production lease area and are located on strategic agricultural land. A Development Application for such a proposal cannot be lodged unless a Gateway certificate has been obtained or the land has been verified as not containing strategic agricultural land. Fulfilling the requirements of the Gateway Process, involves a proposal being assessed against the Gateway criteria.

1.4.3 Biophysical Strategic Agricultural Land

The Strategic Regional Land Use Plans for the Upper Hunter represent the Government's framework aimed at supporting growth, protecting the environment and responding to competing land uses, whilst preserving key regional values over the next 20 years. Under these plans, state significant mining proposals are required to undertake a verification process to determine if the site is biophysical strategic agricultural land (BSAL). BSAL is

land with a combination of natural resources highly suitable for agricultural production. These lands have suitable landforms, soil and water resources which are capable of sustaining high levels of productivity.

This Gateway process includes an assessment of the land according to specific BSAL criteria, including access to reliable water supply, inherent general fertility and land and soil capability. On a property scale, the verification criteria include specific measurements of slope, rock outcrop, surface rock fragments, soil fertility, the effective rooting depth to a physical or chemical barrier, soil drainage, soil pH and soil salinity.

The BSAL study and assessment of the project land disturbed by the Rix's Creek Continuation of Mining Project determined the area does not qualify as Biophysical Strategic Agricultural Land.

1.4.4 Related Studies & Reports

The studies which are to be read in conjunction with this assessment include the following:

- Rixs Creek Biophysical Strategic Agricultural Land Verification Assessment, (SLR 2014);
- Rixs Creek Continuation of Mining Project Soils and Land Impact Assessment, (SLR 2015);
- Rixs Creek Mine – Continuation of Operation, Rehabilitation Strategy, (AECOM 2015);
- Surface Water Study for Rixs Creek Continuation of Mining, (JP Environmental 2014);
- Rix's Creek Continuation Project – Economic Assessment, (KPMG 2015) ;
- Rix's Creek Continuation of Mining Project Groundwater Impact Assessment, (RPS 2014); and
- Ecology Report for the Continuation of Rix's Creek Mine , Singleton LGA, (East Coast Survey 2014).

2.0 Assessment of Agricultural Resources & Production

2.1 Overview

The land within the lease extension area has been assessed in detail in the Rix's Creek Biophysical Strategic Agricultural Land Verification Assessment (BSAL) undertaken by SLR Consulting (SLR, 2014). The land and soil was assessed in accordance with the Interim Protocol for BSAL.

A detailed soil survey was conducted of an area more extensive than but inclusive of the Lease Extension Area addressed in this agricultural impact statement. The assessed area was defined in that report as the proposed Overburden Emplacement Area (OEA) totaling approximately 245.4 ha. It included the mining lease extension area (170 ha), as well as a required 100 m buffer, which resulted in a total area of 245.4 ha.

Two distinct soil types were found: (Subnatric Brown Sodosol (173.9 ha) and Eutrophic Brown Chromosol (71.5 ha). The Subnatric Brown Sodosol failed the fertility criteria within the BSAL protocol.

The Eutrophic Brown Chromosol soils were excluded either on greater than 10% slope or because they were only isolated pockets of less than 20 ha and therefore not considered BSAL.

Additional analysis of topsoil samples collected during the BSAL assessment for organic carbon and available phosphorus was conducted to improve assessment of these soils for agricultural productivity. The low fertility of these soils is evident from the results.

2.2 Soils

The detailed soil survey and assessment conducted by SLR Consulting found two distinct soil types: (Subnatric Brown Sodosol and Eutrophic Brown Chromosol.

The survey included 34 sites with detailed assessment including profile assessments and soil analyses.

Table 2 Soil Analyses Conducted

SRS Laboratory Analyses	Additional Analyses (Samples in Lease Extension Area 0-10cm depth)
- Electrical conductivity (EC) - pH (1:5) - Exchangeable cations - Cation exchange capacity (CEC) - Particle size Analysis* - Colour - Emerson Aggregate Test	- Organic carbon - Available phosphorus (bray test)

2.2.1 Major Soil Types

Subnatric Brown Sodosol

The Subnatric Brown Sodosols were identified as the dominant soil in the area. They were located on the creek-lines, flats, lower slopes, midslopes and on the ridgeline in the north. These soils are common in Singleton and Muswellbrook Shires. The soils have a shallow topsoil depth (0.1m - 0.3m). The sodic, poorly structured subsoil's predispose these soils to structural degradation and potential erosion once disturbed. These soils are not suitable for cropping and are grazing lands managed with no or minimal disturbance.

These soils have low natural fertility levels. The topsoil's are generally moderately acidic and non-saline, with moderate cation exchange capacity. Subsoil's are moderately alkaline, sodic, imperfectly drained and can be saline. Soil analyses (Appendix 1) show that topsoil organic carbon levels are low –moderate (under permanent native pasture).

Typically the topsoil's of these Subnatric Brown Sodosol's have a poor balance of cations, with the calcium/magnesium ration being low – very low and exchangeable sodium levels elevated.

Available soil phosphorus levels in the topsoil's are low. This limits the productivity of these soils and the types of pastures that can persist at these fertility levels.

These soils have low topsoil fertility and poor quality subsoil's, resulting in limitations for agriculture. Low intensity grazing of permanent pastures is common on these soils.

Soil analyses of topsoil samples from the lease extension area show soil available phosphorus levels to be low (moderate in one sample only) (Appendix 1).

Eutrophic Brown Chromosols

Eutrophic Brown Chromosols were located within the steeper mid to upper slopes and ridgelines. They are limited to pockets of less than 20ha and are not contiguous.

These soils are of moderate fertility. The topsoil's are shallow in depth and slightly acidic. They have moderate Cation Exchange Capacities and are non-saline and non-sodic, with moderate Organic Carbon levels. The subsoil's are mildly – moderately alkaline, heavy clay's with strong structure and high cation exchange capacity. They are sodic and imperfectly drained.

This soil type is potentially more productive for grazing enterprises than the more common subnatric brown sodosol's, though the available phosphorus in the topsoil is still low.

Soil analyses are compiled in Appendix 1. Full profile descriptions are provided in the report by SRS; Rixs Creek Biophysical Strategic Agricultural Land Verification Assessment, 2014.

2.2.2 Potential of the Soils for Agriculture

The soil types identified by the detailed soil descriptions in the BSAL study are of low quality for agriculture. They have severe limitations for agricultural use other than grazing. The shallow nature of the topsoil and poor structure and sodicity of the subsoil risks structural degradation if cultivated. Erosion risks are high if subsoils are exposed, with the potential for erosion and long term soil damage. Grazing utilizing permanent pastures is a sustainable agricultural enterprise for these soil types.

Much of the beef cattle grazing enterprises in the Hunter Region are conducted on soil types not suited to cropping or more intensive agricultural enterprises. Native pastures often form the permanent base on these soils, with productivity strongly related to soil fertility levels (particularly available phosphorus level).

Many soils used for grazing within the Hunter region are typically phosphate deficient. Whilst the dominant pasture types can indicate the typical productive potential of a site, the level of phosphate (P) in the soil is the key determinant of pasture productivity across most of the Hunter Region. It also provides insight on the potential to increase productivity (Blackwood, et.al. 2006).

Since 1990 most of the region has only been fertilized spasmodically, partly due to drought (1990-1991, 1994 and 2001-05) and low cattle prices. Previous owners of the land have not applied fertiliser for over 5-6 years. Soil analyses indicate that the available phosphorus levels are low. Low phosphorus levels result in sub-optimal productivity of the grazing enterprise.

The available soil phosphorus levels analyzed are in the low category (**Table 3**).

Table 3 DPI Interpreting Soil Fertility Tests (Blackwood, et. al. 2006)

Soil Analysis Level - Bray Test (mg/kg)	Phosphorus Level
Less than 10	Low
10-20	Medium
Greater than 20	High

- Low = very responsive to subsequent fertiliser application;
- Medium = moderately responsive to subsequent fertiliser application; and
- High = marginally responsive to subsequent fertiliser application.

2.3 Land and Soil Capability Assessment

The Land and Soil Capability Classification (LSC) is used to describe land categories according to their capability for particular land uses and the treatment required to sustain those uses without land degradation.

This classification uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. There are eight classes, which classify the land based on the severity of long-term limitations. The LSC classes are described in **Table 4** and their definition has been based on two considerations:

- The biophysical features of the land to derive the LSC classes associated with various hazards;
- The management of the hazards including the level of inputs, expertise and investment required to manage the land sustainably.

The eight hazards associated with these biophysical features that are assessed by the scheme are:

- 1) Water erosion;
- 2) Wind erosion;
- 3) Soil structure decline;
- 4) Soil acidification;
- 5) Salinity;
- 6) Water logging;
- 7) Shallow soils and rockiness; and
- 8) Mass movement.

Table 4 Land and Soil Capability Classes

Class	Land and Soil Capability
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)	
1	Extremely high capability land: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	Very high capability land: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	High capability land: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	Moderate capability land: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialized management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	Moderate-low capability land: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)	

Class	Land and Soil Capability
6	Low capability land: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation
Land generally incapable of agricultural land use (selective forestry and nature conservation)	
7	Very low capability land: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	Extremely low capability land: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation

An assessment of the land and soil capability of the lease extension area was conducted by SLR Consulting Australia Pty Ltd (SLR 2015). The Lease Extension Area has no land of high capability for agriculture (Class I, II or III), the topography and soil characteristics limiting potential agricultural uses. The land in the 170 ha, is a mix of class IV and V, suitable for grazing but not capable of high-impact land uses such as cropping. Careful management of limitations is required to prevent long-term degradation.

Seventy two percent of the land is classified as Land Capability IV and twenty eight percent land capability class V.

Table 5 Pre-disturbance Land and Soil Capability

Land Capability	Pre Mining Land and Soil Capability in Lease Extension Area		Post Mining Land and Soil Capability in the Lease Extension Area	
Class	ha	%	ha	%
I	0		0	
II	0		0	
III	0		0	
IV	121.1	72	74.7	44
V	48.4	28	94.8	56
VI	0			
VII	0			
VIII	0			
Total	169.5	100	169.5	100

Post mining the land capability is 74.7 ha Class IV being forty-four percent of the area and 94.8 ha Class V or fifty-six percent of the lease extension area.



AECOM

PRE MINING LAND AND SOIL CAPABILITY
Rix's Creek Continuation of Mining
Environmental Impact Statement

2.3.1 Biophysical Strategic Agricultural Land Verification

A Biophysical Strategic Agricultural Land verification assessment was undertaken by SLR Consulting Australia Pty Ltd for the proposed disturbance area defined as the Rix's Creek proposed continuation of mining disturbance area (SAR, 2015). The study also included a 100m buffer surrounding the area in accordance with BSAL protocol (a total of 245.4 ha).

The BSAL assessment indicated:

- The area had adequate rainfall to satisfy the BSAL requirement for access to reliable water supply;
- Approximately 53.5 ha of the land assessed was greater than 10% slope (considered excessive to BSAL);
- Of the two distinct soil types identified in the area. The Subnatric Brown Sododol's (173.9 ha) failed the fertility criteria within the BSAL assessment and were considered Non-BSAL;
- The second soil type (Eutrophic Brown Chromosol's) was identified on 71.5 ha of the land. Some of this soil type occurred on land greater than 10% slope and an effective root depth to physical barrier less than 0.75m and is therefore did not meet the BSAL criteria.
- Areas of the Eutrophic Brown Chromosol's on land of 0-10% slope, with a deeper profile, satisfied the 12 criteria within the BSAL protocol. However, these areas were isolated pockets of less than 20ha and therefore are not considered BSAL.

Overall, the study concluded that there is no qualifying BSAL within the Assessment area. The historical agricultural land use of weaner cattle enterprises on the low natural fertility soils of this land supports this assessment.

2.4 History of Agricultural Enterprises within the Project area

The land within the project area has a traditional use for grazing. Following settlement, the land has been grazed by sheep and cattle, with sheep being phased out as wool returns declined. This trend occurred throughout Singleton Shire, with cattle grazing becoming the alternative agricultural enterprise.

The previous long term owners of the land have conducted cattle grazing enterprises on the land since 1976. Prior to that, grazing enterprises were conducted by previous members of that family since ownership in 1890. There is no record of any cropping being conducted on the land.

Grazing has been conducted on predominantly native pastures. The pastures are typical of much of the Singleton district with a varying seasonal abundance of naturalized exotic species such as paspalum, and some sown species (e.g. subclovers) occurring where fertility levels are higher (e.g. stock camps etc). Kikuyu has been introduced and persists in stock camps and some drainage lines.

Fertiliser (super-phosphate) and pasture seed (subterranean clover and white clover) have been broadcast applied to the existing native pastures in the past to increase pasture productivity. However, it has been some time (5-6 years) since fertiliser has been applied to the land due to poor seasonal conditions and low cattle prices.

The persistence of the sown species has been poor, particularly since fertiliser application ceased. Current soil analyses indicate phosphorus levels are generally low, reducing the growth and persistence of most of the introduced 'improved' pastures (Appendix 1).

Beef cattle are currently grazed on the land which is leased by the previous owner. This is likely to continue until the land is required for the out of pit dump.

The current carrying capacity is 5 D.S.E. per hectare. This is a typical for the local district, where some fertiliser has been applied in the past. It fits within the range of estimated carrying capacities for such pastures in the Hunter Region provided by NSW DPI (Blackwood, et.al. 2006).

2.5 Location and Area to be Temporarily Removed from Agriculture

The lease extension area comprises approximately 170 ha of land of capability class V and VI. The current use of the land for grazing will be continued on the land until the out of pit dump is formed (potentially as early as 2017). Of the 170 ha lease extension area, 78 ha will be disturbed by the project and grazing excluded, while 92 ha will not be disturbed and will remain as native pasture (allowing potential continuance of grazing).

The post mining land use will be grazing and the rehabilitation will reinstate the land to similar land capability classes as prior to disturbance. The land inside the disturbance area will be returned to land capability class IV (12%) and class V (88%). This is similar to the land capability outside the disturbed area which will remain as native pasture area. Overall, there will be little change from the pre-mining to post-mining land capability.

With the rehabilitated land returned to a grazing land use, it is likely that the productivity levels from grazing will be similar to those pre-mining. Early data from local research shows cattle grazing rehabilitated pastures are performing as well or better than cattle grazing undisturbed pastures.

Grazing will recommence on the sown rehabilitated land once the pastures have shown to be stable and approved for grazing. Some grazing may be maintained on the undisturbed area of the Lease Extension Area where infrastructure (fencing, stock water supply, etc.) allows.

Table 6 Post Mining Land Capability; Lease Extension Area (170 ha)

Post mining LSC Rix's Creek Lease Extension Area				
Land and Soil Capability	Outside Disturbance area		Inside Disturbance Area	
Class	ha	%	ha	%
4	65.7	72	9.2	12
5	25.9	28	68.8	88
TOTAL	91.6	54 %	78.0	46%

2.6 Location and Area to be returned to Agriculture

The whole of the lease extension area (including rehabilitated land) will be returned to a grazing land use. A perennial pasture (comprising perennial tropical grasses, and legumes will be sown (AECOM, Rehabilitation Strategy, 2015) on rehabilitated land after establishing the appropriate soil substrate. The area is then sown and fertilized with the selected grass and/or tree seed mixes. These works are undertaken shortly after spreading the topsoil to avoid loss in activity of pre-existing micro flora, it also minimizes the loss of topsoil due to wind and rain action

The focus of the pasture sowing is to establish a vegetation cover that ensures surface stability, the resultant reduction in the risk of soil erosion whilst also providing a pasture that can sustainably provide productive beef cattle grazing.

Figure 2 shows the location of the land indicating the area of rehabilitated pastures and areas remaining as existing native pasture.

2.7 Land not returned to agriculture including biodiversity offsets

The land disturbed by the out of pit dump in the lease extension area will be rehabilitated to pasture, with some tree plantings. The tree plantings will be integrated with the pasture sowings to provide shade and shelter belts while also having ascetic value along a ridgeline.

There is no other infrastructure that will impact agricultural use of the land post project.

Biodiversity Offsets

The approach to be taken regarding 'biodiversity offsets' is a strategy covered under the Upper Hunter Strategic Assessments – a joint initiative of the NSW and Commonwealth governments. It ensures that important mining biodiversity issues are properly identified and funded. This puts the onus on Rix's Creek Mine to contribute to a

pool of funds which the NSW Office of Environment and heritage draws from to progress broad local environmental initiatives under the Upper Hunter Biodiversity Plan.

Agricultural land on the site will not be utilized for biodiversity offsets.

2.8 Agricultural Enterprises undertaken on Buffer Lands during the project

Buffer areas adjoining the mine are mostly of land capability class 4 and 5, dominated by native grasses. These are suitable for grazing with beef cattle, which is achieved through lease arrangements. Undisturbed areas of natural pastures within the project area will continue to be grazed and managed as agricultural enterprises where infrastructure allows (e.g. fencing and stock water supply). Some cattle have been introduced into previously rehabilitated pastures at the mine site.

3.0 Agricultural Resources & Enterprises

3.1 Agricultural Resources within the Locality

3.1.1 Soil Characteristics

The soil landscapes that occur within and surrounding the lease extension area cover large areas of the Singleton and Muswellbrook areas. These soil landscapes units have been mapped by the former NSW Department of Land and Water Conservation, incorporating the NSW Soil Conservation Service (now part of the DPI), at the scale of 1:250,000 (Kovac & Lawrie, 1991). The soil landscapes are:

- Roxburgh Soil Landscape, covering the majority of the area and adjacent land. The Roxburgh unit soils are primarily Yellow Podzolic soils (Chromosols) on upper to midslopes with Red Solodic soils (Sodosols) and Brown Podzolic soils on upper concave slopes, and Lithosols (Rudosols/Tenosols) on steeper slopes. They are generally considered low fertility with known Phosphorus deficiencies. They are relatively shallow soils that are often imperfectly drained and characterized by poorly structured subsoils, which are often sodic with mottling that indicates poor internal drainage. They have a moderate to high erosion hazard and due to their high structural degradation hazard are used for grazing on native pastures.
- Sedgefield Soil Landscape, covering a smaller area of land in the lease extension area but being common further east of Rix's Creek Mine. The Sedgefield soils landscape consists of undulating low hills with elevations from 60-170 m. The soils are dominated by Yellow Soloths (Kurosols/Sodosols) on upper to midslopes and Yellow Solodic Soils on lower slopes and drainage lines (Sodosols). Black Soloths also occur in seepage areas on slopes. Limitations to this unit include; low soil fertility, high soil salinity, severe gully and sheet erosion and highly dispersible subsoils. These soils are also considered only suitable for grazing enterprises and remain dominated by native pastures.
- Alluvial soils occur on some small creek flats and the Hunter River floodplain some 5 km distant.

3.1.2 Topography

Rix's Creek Mine is located in the Hunter Valley region of NSW. It is located within the Hunter River residual subcatchment. The topography is typical of the area, with rounded, undulating low hills with elevation through the region ranging from 20-to 330 m.

Figure 2 shows the surrounding landscape of the project.

3.1.3 Agricultural Support Services & Infrastructure

The cattle enterprise being conducted on the land has a relatively low input demand. Little machinery is required as there is no cultivation and contracting is often relied on for many farm operations such as cattle transport, fertiliser spreading, etc).

The agricultural support services in Singleton include:

- Veterinary Services;
- Livestock Equipment & Suppliers;
- Stock and Station Agents (x 3);
- Livestock Transport Services;
- Rural Supply Stores (3) (Livestock feed, animal health, produce and farm equipment stores);
- Singleton Regional Saleyards;
- E.C. Throsby Abattoirs (Singleton);
- Hunter Local Land Services district office 2.0 personnel in Singleton) (Office Staff and Biosecurity officer).

3.1.4 Water Resources & Extraction Locations

The water resources of the lease extension area is limited to the current earthen dams that provide both water for stock and act as sediment and erosion management systems and the natural drainage systems. There is no irrigation or water supply externally to the agricultural area to be disturbed.

An un-named catchment drains the lease extension area to the west and eventually into the Hunter River catchment.

The un-named streamline catchment in which the lease extension area occurs has a total catchment of some 1,402 ha before reaching the Hunter River. The area is at the top of the westerly flowing catchment. Water from the catchment provides water for grazing stock in numerous dams downstream before entering the Hunter River. The stream is ephemeral, functioning as a lower order stream.

A full study on surface water for the Rix's Creek Continuation of Mining Project has been conducted by JP Environmental.

The site is not affected by Hunter River flooding.

3.1.5 Vegetation

The bulk of the project area supports derived native grassland across landscapes formerly forested by Ironbark (*Eucalyptus crebra*), and which have been used for grazing over many decades, East Coast Flora Survey (Bell, 2014). The vast majority of the land supports native and naturalized grasses with some exotic sown species, with widely scattered trees, providing habitat principally for woodland and grassland birds, as well as shade and shelter for livestock.

The native pastures have been extensively modified over many years of grazing and clearing. Several grass species dominate the pasture and few native herbs and forbs survive. Exotic species have either intentionally been introduced or have invaded the grasslands.

Weeds

Weeds do not have a large impact on current grazing productivity. By maintaining a permanent pasture base (native pastures) weed invasion is significantly reduced especially on the natural low fertility of the soils. Where soil is disturbed, weed population intensifies.

Woody weeds such as African Boxthorn and African Olive are mostly spread as seed by birds and being woody weeds require regular spraying in a control program.

Common Pear (*Opuntia stricta*) and Tiger Pear (*Opuntia aurantiaca*) are occasional species only and controlled using biological control or spot spraying with herbicide. The biological control agent moth (*Cactoblastis cactorum*) is prevalent in the area and often active in restricting the growth of the common pear. Other insects (e.g. *Cochineal spp.*) can also be used for common and tiger pear control.

Fireweed is a common winter/spring weed in the area. The seasonal significance of the weed depends on pasture competition in the autumn and winter. Pasture species that maintain high levels of ground cover during these periods restrict fireweed growth. Fireweed has been declared a locally controlled noxious weed, with restriction on its propagation and distribution via hay etc.

Projects\60289290_RixCreek_Mine\4_Tech work area\4.7 Graphics\FIGURES\Agricultural Impact Statement\60289290_F3 Post Mining Landform 18 08 2015 TO



AECOM

POST MINING LANDFORM
Rix's Creek Continuation of Mining
Environmental Impact Statement

FIGURE 3

The following **Table 7** lists some of the weeds occurring in the lease extension area.

Table 7 Weeds Occurring within the Lease Extension Area

Common Name	Botanical Name	Weed Declaration	Current Level of Infestation	Control Methods
African Boxthorn	<i>Lycium ferocissimum</i>	Noxious, Class 3	Occasional Plants	Mechanical, Herbicide
Fireweed	<i>Senecio madagascariensis production</i>	Noxious, Class 4	Seasonally Widespread	Pasture Management/Competition
Prickly Pear-Common Pear	<i>Opuntia stricta</i>	Noxious, Class 4	Occasional Plants	Biological /Herbicide
Prickly Pear Tiger Pear	<i>Opuntia aurantiaca</i>	Noxious, Class 4	Occasional Plants	Biological /Herbicide
Spear Thistle	<i>Cirsium vulgare</i>	Nuisance	Common but of low impact.	Herbicide/Mechanical
Paddys Lucerne	<i>Sida rhombifolia</i>	Nuisance	Common but of low impact.	Mechanical/ Pasture Management
Saffron Thistle	<i>Carthamus lanatus</i>	Nuisance	Minor Infestations	Herbicide/Pasture Management
Marsh Mallow	<i>Malva parviflora</i>	Nuisance	Minor Infestations	Herbicide/Pasture Management
African Olive	<i>Olea europaea subsp. africana</i>	Environmental/Nuisance	Occasional Plants (Fence-lines etc)	Mechanical, Herbicide

3.1.6 Climate

Rainfall is recorded at various stations in the locality of the project. These include a number the Bureau of Meteorology (BOM) rainfall recording stations (locations for records have changed over time) as well as the Rix's Creek Mine weather station.

Extremes in the climate are typical in the Upper Hunter Valley. Extremely dry conditions can result from periods related to persistent El Nino type events. Recent drought periods such as 1991- 1997 and 2002 – 2006 were difficult years for agriculture. Extreme rainfall events are also typical of the region with periods in late 1998, 2007 and 2015 resulting in high intensity rain falls and flooding of low lying areas.

Rix's Creek mine lies mainly in the upper drainage lines of Rix's Creek catchment (entering the Hunter River Downstream) and in the headwaters of Station Creek and an unnamed tributary to the Hunter River flowing west. The mine is not affected by flooding of the Hunter River floodplain.

This climatic information is provided in the Surface Water Study (courtesy JP Environmental, 2014).

Table 8 shows the mean monthly rainfalls for relevant nearby rainfall stations.

Table 8 Rainfall and Evaporation from Nearby Bureau of Meteorology (BOM) recording stations & Rix's Creek Mine weather station.

Statistics			Mean Monthly Rainfall (mm)					Mean Daily Evaporation (mm)		
Station	Jerrys Plains Post Office		Scone SCS		Singleton Water Board	Singleton STP	Singleton Army Base	Rixs Creek Mine	Jerrys Plains PO	Scone SCS
	(061086)		(061090)		(061086)	(061398)	(061276)	N/A	(061089)	
Period	1889 -	1980 - 2010	1950 - 2014	1981 - 2010	1991 -	2002 -	1969 - 1990	1999 -	1957 - 1972	1965 -
Record Length	128 yr	30 yr	65 yr	30 yr	11 yr	13 yr	21 yr	13 yr	10 yr	45 yr
January	77.1	71.8	81.3	63.9	70.2	50.8	94.3	46.5	7.1	7.1
February	73.1	86.8	76.9	67.5	107.6	105.1	88.9	111.2	6	6.2
March	59.7	55	52.9	49.6	75.1	66.1	72.7	94.0	5	4.9
April	44	45.9	38.8	38.7	38.3	43	58.4	53.7	4	3.5
May	40.7	41.3	46	40.6	35.4	28.5	59.7	36.5	2.9	2.2
June	48.1	43.1	45.3	40.2	31.7	69.8	37.9	66.6	2	1.6
July	43.4	43.6	36.5	44.3	41.7	26.8	28.2	27.6	2.3	1.8
August	36.1	37.2	38.3	36.6	27.6	30.9	37.1	30.6	2.6	2.7
September	41.7	46.3	38.3	41.4	44.1	39.4	45.3	35.9	3.7	4
October	51.9	56.9	57.8	55	32.8	45.6	69.1	46.2	5.3	5.1
November	61.9	76.4	63.5	68.5	59.2	89.1	68.3	85.4	6.5	6.1
December	67.5	73.8	67.2	78	86.6	63.7	63	58.1	6.6	7.1
Annual	645	678	642	624	645	661	720	661	4.5	4.4

Courtesy JP Environmental

Note: The Mean monthly values are based on different observation periods.

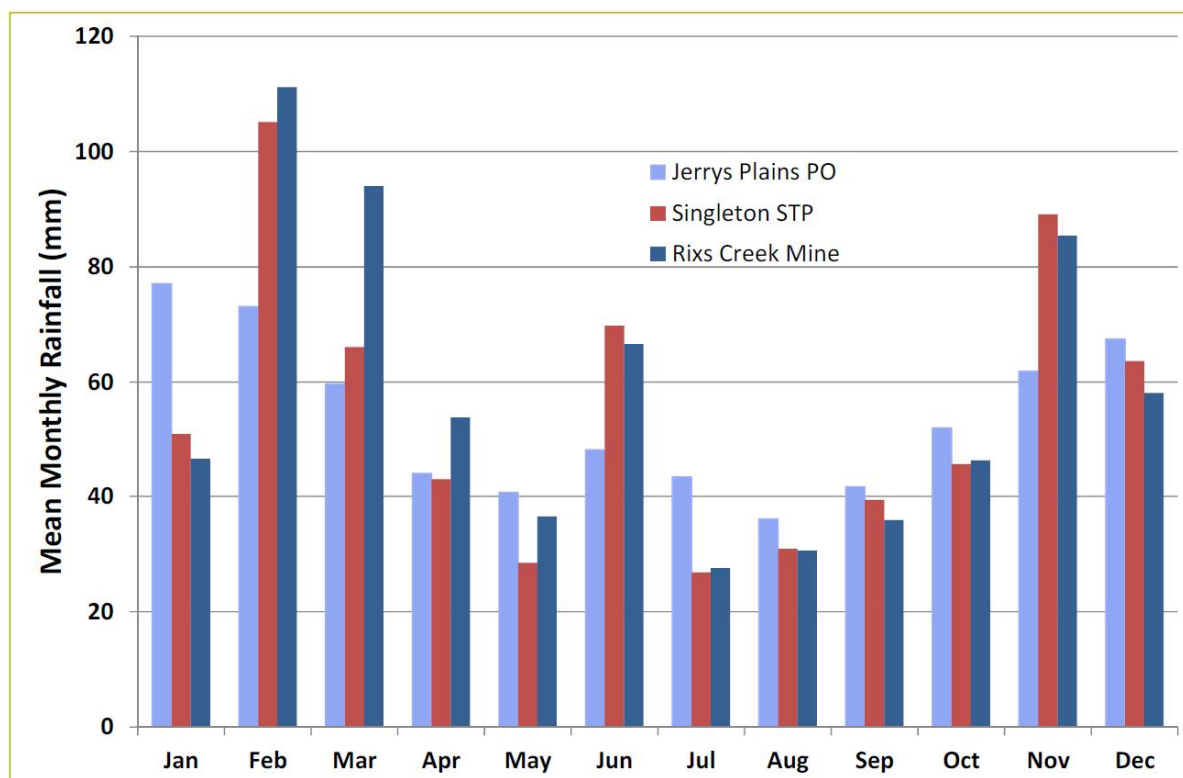
Records from the BOM stations and Rix's Creek Mine records vary according to the periods over which the records were taken and locations. The mean annual rainfall recorded by BOM in the project area ranges from 645 to 720 mm (Jerrys Plains 128 year history and Singleton Army Base 21 years records), with rainfall recordings at Rix's Creek Mine (13 year history) of 661 mm per annum.

The comparison of rainfall records (**Figure 3**) shows a predominance of rainfall in the summer months. The maximum monthly rainfall occurs in the months of January or February. Lower recordings occur during the winter months, with July/August having the lower rainfall readings.

The rising mean daily evaporation in November, December and January is related to summer temperatures. Mean annual evaporation at Jerrys Plains is 1643 mm, which is more than double annual rainfall at that BOM station.

The highest evaporation occurs in summer with December and January having the highest levels. Minimum daily evaporation occurs mid-winter (June and July). Mean evaporation is similar to mean rainfall in the winter months, but substantially exceeds rainfall for the remainder of the year.

Figure 4 Comparison of Rainfall figures for Three Recording Stations
(Jerrys Plains PO (BOM), Singleton Sewerage Treatment Plant (BOM) & Rix's Creek Mine weather station)



(Courtesy JP Environmental)

3.2 Current Agricultural Production

The current agricultural value for the disturbance area is based on the value of livestock currently produced from the lease extension area.

The current and historical agricultural production on the land is cattle grazing. The Bloomfield Group is the current owners of the land and currently has leased the land to the previous owners to continue their cattle grazing enterprise on the land. Grazing will be continued on the land until the out of pit dump requires the land.

The current cattle grazing enterprise consists of a predominantly Angus breeding herd producing 'weaner' cattle which are marketed locally through Singleton Regional Saleyards. This form of production is common in the Singleton district and the Hunter Valley Region. The main market is other graziers that will grow the weaners to heavier weights and either sell them to feedlots for fattening or pasture fatten to export cattle weights. Weaners are marketed at two times of the year, namely targeting December and April each year.

Weaner cattle weights vary with seasonal and pasture conditions but generally weigh 270 -280 kg when sold. Sales are made either through the regular fat stock auction markets or at special store sales conducted at Singleton Regional Saleyards. Most heifer weaners are retained as potential future breeders. Culling is a continuous process up until joining at 24 months of age. Once calved, selected heifers take their place in the breeding herd. Cull stock (aged cattle or cows/heifers culled for other reasons) are also sold at Singleton Regional saleyards but in smaller numbers and irregularly through the year.

The cattle are grazed on natural pastures. These pastures include predominantly native grasses with additional exotic species varying in abundance seasonally. Rotational grazing has been a management practice which allows some pasture to rest and recover after grazing to help maintain pasture persistence over a range of seasonal conditions.

Pasture management has included fertiliser (super-phosphate) application, though it has been some time (5-6 years) since fertiliser has been applied to the land impacted by the proposed out of pit dump. Exotic pasture

species have been broadcast with fertiliser including paspalum and a range of clovers, however native grasses remain the major components of the pasture.

The current stocking rate is 5 D.S.E. per hectare, though with good seasonal conditions and increased fertiliser application and seed sowings, this could increase to 7 D.S.E. per hectare. This is comparable to the carrying capacities estimated by NSW DPI for similar pasture types within the Hunter Region. (Blackwood, et.al. 2006).

3.2.1 Value of Agricultural Production

Cattle are a commodity whose price fluctuations are strongly determined by seasonal conditions both locally and across the state. Long term historical cattle values are more strongly represented by prices similar to 2012. However, currently (May 2015) cattle prices are at an all-time high.

The Eastern Young Cattle Indicator (EYCI) provides the trend in cattle prices (as measured by MLA). The EYCI has been steadily increasing over the past year resulting in higher returns to cattle producers. The EYCI has reached 487.50c/kg HCWT (carcase weight), compared to 328 c/kg HCWT (carcase weight) in May 2014. MLA market analysts predict slight gains in prices to continue and long term forecasts are favorable for these price levels to continue at least in the short term.

The value of agricultural production from the area has varied considerably over the past year as a result. The following figures provide a year (2014) more typical of long term production and a value from May 2015 indicating the large gain in the market in the past twelve months.

Table 9 Range of Agricultural Production within Lease Extension Area

Year	Enterprise	Number Animals Sold*	Gross Value of Production	Net Value of Production
2014	Weaner production	46	\$22,598	\$15,737
2015	Weaner production	46	\$32,767	\$22,818
2014	Weaner production	65	\$31,475	\$21,919
2015	Weaner production	65	\$45,639	\$31,782
• Includes culled breeding stock				

The total value of production from the area of disturbance varies considerably year by year, depending on market influences and weather conditions determining pasture availability.

The current productivity levels of 56 breeding units (cows, calves, replacements, etc) (NSW DPI Inland Weaner Budgets) are average for the district where breeders are grazing natural pastures. The total number of animals sold from a breeding enterprise at this level would be 46 head.

The value of this production would be \$20,048 per annum on average prices (2014 prices) or \$30,072 at current record 2015 prices.

Where higher inputs are and production increases to 84 cows, the number of animals sold would be predicted to increase to 70 per annum. This would be an annual production of \$30,072 per annum (2014 prices) or \$45,108 at current record 2015 prices.

Risk, labour requirements and expenses/investment increases with increasing stocking rates.

Table 10 Value of Total Annual Agricultural Production Impacted and Outputs

Enterprise	Rixs Creek Lease Extension Area	Hunter Region	NSW	Australia
Beef slaughtering	\$0.02 -0.04 M	\$ 95.5 M	\$ 1,487.6 M	\$ 6,550.5 M
Total agricultural production	\$0.02 -0.04 M	\$ 311.7M	\$ 8,359.2 M	\$ 39,645.1 M

Source: ABS, 2008; ABS 2011

4.0 Assessment of Impacts

4.1 Impacts on Agricultural Resources

The post mining land use will be grazing and the rehabilitation will reinstate the land to similar land capability classes as prior to disturbance. The land inside the disturbance area will be returned to land capability class IV (75%) and class V (25%). This is similar to the land capability outside the disturbed area which will remain as native pasture area. Overall, there will be little change from the pre-mining to post-mining land capability.

With the rehabilitated land returned to a grazing land use, it is likely that the productivity levels from grazing will be similar to those pre-mining.

4.1.1 Vegetation & Ecology

The bulk of the project area supports derived native grassland across landscapes formerly forested by Ironbark (*Eucalyptus crebra*), and which have been used for grazing over many decades. The vast majority of the land supports native and naturalized grasses with some exotic sown species, with widely scattered trees, providing habitat principally for woodland and grassland birds, as well as shade and shelter for livestock.

An ecological study conducted by Eastcoast Flora Survey (Bell, 2014), concluded that the proposal to disturb lands adjacent to the existing mining activities of Rix's Creek and to extend the life of the current mine, will have negligible impacts on the ecology of the area. Surveys revealed the presence of two threatened communities (Central Hunter Grey Box-Ironbark Woodland; Hunter Lowlands Redgum Forest) totaling 1.5 hectares, one threatened fauna species (Squirrel Glider), and no threatened plants.

4.2 Impacts on Water for Agriculture

A full study on surface water has been conducted by JP Environmental. The conclusions for the whole mining project include:

- The Rix's Creek West pit disturbance footprint is located outside of the 100 year ARI flood extent of both the Hunter River and Rix's Creek.
- Surplus rainwater from mining and coal handling areas will be contained on site and directed to the CHPP and dust suppression for re-use during dry periods.
- The modelling presented by the JR Environmental report, indicates that imported water is required for only 10 out of 28 years of the project life, with an average use of 36 ML p.a. over the 28 years of modelling. This will have little effect on water use from the Hunter River and will not cause excessive competition for water with local Hunter River irrigators.

The JR Environmental Surface Water Report outlines the construction of two sediment control dams; additional to existing stock water and soil conservation dams in the lease extension area. These sediment dams are planned to be constructed by 2017. By 2023, when a drainage line has been constructed additional sediment dams and soil conservation works will be constructed and will remain as part of the water management system infrastructure

Operational Impacts (Water)

- Flooding: Neither the Lease extension area or the mining area is on an active floodplain, nor are they exposed to flooding.
- Loss of Catchment Flows: The western edge of the mine pit runs along the boundary of the Un-named tributary and Rix's Creek catchment. The level of disturbance will vary as disturbance and subsequent rehabilitation proceeds until 2026, then increases to the maximum area of 142ha in 2042. The majority of the future catchment loss is due to catchment diversions resulting from the reconstructed landform rather than impacts for the mining pit. The proportion of catchment loss at the completion of open cut mining is 10%. This may have some impact on one other licensed water user on the Un-named tributary impacted by the reduction in catchment flows.
- The project will have insignificant impact on Hunter River flows. Under mining conditions the project will reduce the catchment draining to the Hunter River at Singleton by less than 0.1%. Rix's Creek mine holds WAL's that can be surrendered at the completion of mining to compensate for the permanent loss of catchment in Rix's Creek and the Un-named Tributary at the completion of mining.

- The water management system developed for the continuation of mining project includes a sediment and erosion management system to ensure runoff from disturbed areas is separated from clean run-off and collected in sediment dams for treatment and release. Saline water will be contained on-site without off-site discharges.
- The project will not impact on off-site water quality. Current water management and planning systems are effectively preventing spills from mine water dams. Modelling suggests spillages from the mine water dams can be avoided during mining, with only Dirty Water Dam 2 having a low probability of spilling up to 0.6 ML over the life of the project.
- Land disturbance associated with mining may adversely affect the quality of surface run-off downstream, if not managed adequately. Considerable planning has been undertaken to prevent off-site movement of low quality water. Surplus rainwater from mining and coal handling areas will be contained on site and directed to the CHPP and dust suppression for re-use during dry periods.

4.2.1 Groundwater

A groundwater impact assessment has been conducted by RPS, 2014. The conclusions include:

- The study found no Groundwater Dependent Ecosystems in the vicinity of the project.
- Taking into account all mining influences (cumulative impacts) no drawdown impacts within the regolith/alluvial are predicted outside the coal lease boundary.
- Groundwater impacts (drawdown of up to 10m) are predicted outside of the lease boundary to the north of the project. The predicted drawdown impact is considered to be within the Permian hardrock. The mine to the north (Integra Mine) forms the only identified groundwater user within the predicted extent of groundwater drawdown.
- Due to the low outflows from the pit void and hence the marginal contribution the void water will make to the surrounding groundwater system, the risk of adverse impacts to water quality is considered to be negligible.
- The potential impacts to the Hunter River Alluvium are also considered to be negligible.

4.2.2 Potential Competition with Agriculture for Water

While there is no external water demands for the lease extension area, operational mine water demand can be competitive with other agricultural industries downstream. Under the proposed water management system, dewatered mine groundwater and run-off from the Rix's Creek Mine catchments can supply all water requirements up to 50th percentile dry conditions at Rix's Creek South over the life of the project (JP Environmental, 2014).

For drier conditions imported water will be available from existing Water Access licenses currently owned by the Mine. The majority of offsite demand occurs in the first half of the project. The modelling presented by the JP Environmental report, indicates that imported water is required for only 10 out of 28 years of the project life, with an average use of 36 ML p.a. over the 28 years of modelling. This will have little effect on water use from the Hunter River and will not cause excessive competition for water with local Hunter River irrigators.

4.3 Socio- Economic Impacts

Over the life of the project the expected incremental cost associated with foregone agricultural production from the 170 ha is expected to be \$0.2 million (in present terms). Based on forecast coal prices, the incremental revenue benefit of the continuation of mining at Rix's Creek mine is estimated to be \$997.5 million (in present terms) (KPMG, 2015).

4.3.1 Agricultural Support Services

Singleton is well serviced by cattle markets and the processing industry. Singleton Regional saleyards provide weekly cattle sales as well as periodic special store sales. Other saleyards include Scone and Maitland, each have weekly cattle sales. The previous owner of the land marketed his cattle mostly through Singleton Regional Saleyards. Other producers use a combination of Singleton Saleyards, other nearby saleyards or direct sales to abattoirs. Abattoirs including; EC Throsby at Singleton, Hunter Valley Premium Meats at Scone or abattoirs further afield such as Cargill Meats at Tamworth or Wingham Beef Exports, Wingham. These markets are more specific on the types of animals required, whereas saleyards provide a flexible market for most cattle categories.

The local abattoir at Singleton (EC Throsby P/L) specializes in manufacturing and primal beef cuts, offals, meat meal and tallow. It processes mostly cows and bulls from which it exports 98% of its production to the USA, Southern Asia and the Middle East. The majority of cattle to suit this market are sourced from other parts of the state and interstate, with local cattle forming a minor part of the supply.

The small number of livestock (46 cattle) produced in the area to be disturbed by this mining project, will not have a significant effect on the Singleton abattoir or Singleton local saleyard throughput.

The beef enterprise run by the previous owner (and most beef cattle graziers in the district) is a low input pasture system. Farm machinery is usually very limited as there is no need for cultivation equipment, large tractors or specialized harvesting equipment. This is reflected by the limited agricultural machinery sales support in Singleton.

This project will have minimal effect on local agricultural support services.

4.3.2 Landscape & Tourism Infrastructure

There are no farm stays or agriculture based tourism activities in the area.

4.3.3 Local and Regional Employment

The management of the lease extension area (170 ha) is conducted as part of lease arrangement. The labour requirement to manage the low intensity cattle enterprise on the land is small and only constitutes part-time employment. Additional part time labour or contractors may be utilized for specific jobs such as weed spraying, fertiliser spreading or some stock work.

The size of this enterprise does not justify full time employment; off farm employment or additional income from other agricultural enterprises would be necessary.

The small area of the land is typical of many beef cattle holdings in the Hunter Region (Blackwood, et.al. 2006). The loss of the small amount of employment in running a beef enterprise on 170ha is not significant. There would be no effect on regional employment for the lease extension area to be removed from agriculture for the period of mining development. Management of land across the Mine including buffer land surrounding the site will provide some additional employment eg. weed control, fencing and where grazing occurs.

An economic assessment of the overall Rix's Creek Continuation of Mining project by KPMG 2015, estimated that the total average annual employment supported by the project to be over 375 jobs within the Hunter Valley region.

4.3.4 Critical Mass Thresholds

Beef cattle production is a common enterprise throughout Singleton Shire and the Hunter Region. It is a very flexible industry that can be conducted on a wide range of landscapes, soil types and climates around NSW. The beef enterprise conducted on this land (weaner production) is described by NSW DPI as 'a common, basic beef enterprise in the Hunter Region' (Blackwood, et.al.,2006). It is not an enterprise specific to the area or to the region, with most areas where beef production occurs in NSW able to produce weaners as the basic beef enterprise. Some areas with lower soil fertility may require greater inputs or lower stocking rates to achieve weaners of this weight but weaner production is transferable over most of the beef cattle production areas.

This is not a specialist enterprise type and supply varies considerably with demand and cattle market prices. Current market price increases have led to increased sales of all classes of beef cattle including sales of cattle prematurely (at younger age and lower weights) than normal to take advantage of the strongest cattle market demand for many years, indicating the flexibility of producers to meet this enterprise market.

Cattle numbers marketed at the Singleton Regional Saleyards reflect seasonal conditions and market demand. The interruption to grazing during the project will only affect a small number of cattle and would have an insignificant effect on cattle numbers at Singleton Regional Saleyards.

The potential production from the area not grazed each year while the project is developed is listed in **Table 11**.

Table 11 Annual Cattle Sales, Singleton Regional Saleyards

Enterprise	Project Area	Singleton Regional Saleyards (2013)	Percentage of Cattle
Cattle Numbers	46 - 65	43,392	0.11% - 0.15%

The land surrounding the mine supports beef cattle enterprises, coal mining or the Maison Dieu industrial area to the south east. There is no economic impact on other agricultural industries in the area.



5.0 Mitigation Measures

5.1 Project Alternatives

The project has been developed to seek approval to allow a continuation of mining which will utilize the existing mine infrastructure, including Coal Handling & Preparation Plant, coal stockpiling and rail facilities. It aims to maintain productivity and access to the coal resource with minimal additional impacts. A modification of mine lease 1432 for an out of pit dump will be the main impact on agriculture. Other alternatives increase the potential impacts.

5.2 Monitoring

Monitoring of impact and progress of rehabilitation is an on-going process that is conducted to allow prompt action if required to note any problems or trends that need maintenance or treatment. The assessment program is designed to collect sufficient appropriate data to ensure monitoring not only meets industry requirements but also provides some performance indicators. Monitoring results will ultimately be used to assess compliance against the agreed completion criteria.

The Rix's Creek Rehabilitation Strategy (AECOM, 2015) provides a table of Objectives, Performance Indicators, Measures and Criteria for rehabilitation.

All rehabilitated areas are inspected regularly, with monitoring and assessment designed to provide data for remedial work if required and data to provide regular reporting.

The Mining Operations Plan (MOP) and other legislation provide criteria to be met during the development and operation of the project. These include:

- Landform establishment (minimization of rehabilitated lands with greater than 10% slope);
- Erosion minimization and control;
- Water monitoring, with any water leaving the site meeting EPL criteria;
- Soil testing of soil growing media chemical properties (pH, EC and nutrient levels);
- Land capability (to meet land and soil capability as per final land use design);
- Sustainable vegetation cover to be established on rehabilitated land (>70% cover), with surface letter layer present at 75% of monitoring sites;
- Noxious weeds and pest animals controlled in accordance with legislative requirements;
- Vegetation management to limit bush-fire risk, with bush fire plan in place;
- Carrying capacity and stocking rates comparable to that of surrounding lands (assessment of herbage mass, composition and feed quality); and
- Recording of stocking rates and weight gains.

5.2.1 Vertebrate pests

A vertebrate pest animal management and control program will be undertaken during the development of the project and during and post rehabilitation. Close liaison and communication with adjoining land users and Hunter Local Land Services will ensure a coordinated approach to pest management.

5.2.2 Weed management

Weeds will be controlled in consultation with the Upper Hunter Weeds Authority and Hunter Local Land Services. African olive will be targeted across the site due to its potential as a threatening process to the Central Hunter Grey Box-Ironbark Woodland and Hunter Lowlands Redgum Forest.

Potential Weed Threats

Pasture removal and soil disturbance increases the potential of weed growth. Revegetation of disturbed areas as soon as possible is the most effective means of reducing weed infestation. A stable and well established pasture is important in reducing the potential for major weed outbreaks. A strong growth of pasture on rehabilitated land is the best strategy to control weeds. Tropical grass species are very effective in reducing weed infestations.

Potential weed threats include:

- Spread of African Boxthorn from neighboring areas;
- African/Wild Olive seed spread by birds from infestations along public roadsides ;
- Invasive perennial grasses such as Coolatai Grass (*Hyparrhenia hirta*) and African Lovegrass (*Eragrostis curvula*) which currently occur along roadsides in the locality;
- Galenia (*Galenia pubescens*) which is a weed common in disturbed soil situations in the Hunter. It is a common weed on mine sites, where soil disturbance and lack of pasture cover can enable establishment and growth.

Ongoing weed management will include a range of integrated control measures including herbicide application, mechanical control, biological control and preventative measures such as timely revegetation of disturbed areas and the maintenance of high ground cover levels.

5.3 Trigger Response Plans

The criteria, measures and indicators which provide the framework for the rehabilitation strategy are those that have been developed for the MOP and are underpinned by a range of documents which relate to land management and site rehabilitation. These include industry standards, Rix's Creek Mine Standards and Procedures. The ongoing development of these documents will provide the basis for the periodic review of the MOP with resultant amendments being recorded in the Annual Environmental Management Report.

The rehabilitation strategy outlines many of these initiatives (AECOM, 2015).

5.4 Mitigation Measures, Management and Monitoring

The rehabilitation strategy (AECOM, 2015) outlines the management and monitoring conducted in the mining, disturbed land and buffer areas. All rehabilitated areas are inspected on a general basis to note any problem areas (such as bare patches, failed vegetation, drainage structure failure, significant erosion or significant weed infestation) requiring maintenance or further treatment. Remedial works will then be scheduled to address these areas. The assessment program is designed to collect sufficient data to compare the results of rehabilitation against the agreed completion criteria.

The assessment program consists of three components:

- The annual maintenance inspections;
- Scheduled rehabilitation monitoring; and
- The review of inspection/measurement data over time to assess rehabilitation performance.

Representative monitoring sites will be established in newly rehabilitated areas to enable measurements along transects, photographic recording and vegetation establishment. Details are provided in the rehabilitation strategy report (AECOM, 2015).

5.4.1 Biodiversity Approach

A biodiversity strategy has been developed under the Upper Hunter Strategic Assessments – a joint initiative of the NSW and Commonwealth Government's – which ensures that the important mining biodiversity issues are properly identified and funded. The mine will contribute to a pool of funds which the NSW Office of Environment and Heritage draws from to progress broad local environmental initiatives under the Upper Hunter Biodiversity Plan.

5.5 Demonstrated Capacity for Rehabilitation of Disturbed Land

The final land use for the disturbed area is grazing. Rix's Creek mine has been developing rehabilitation programs for many years. Rix's Creek has been proactive in developing rehabilitation techniques and striving for best practice. While erosion, sediment control and landform stability still remain important factors there has been a strong progress towards achieving a positive land use outcome.

In 1994 Rix's Creek co-operated in an Australian Coal Association Research Program (ACARP) which investigated the use of biosolids as a natural fertiliser source of both nutrients and organic matter. Biosolids have been used in Rix's Creek rehabilitation as an additive to improve soil structure ever since.

A study undertaken in August 2013 on land being rehabilitated to pasture at Rix's Creek, has compared treatments of chemical fertilizers, biosolids and compost at varying rates on land being rehabilitated, to provide data on the effects of the different nutrient sources and the long term effects on rehabilitated pastures which will have a grazing end use.

To date, Rix's Creek mine has successfully established rehabilitation on 375 ha across the mine site. By the end of 2014, the Rix's Creek rehabilitation program was around 50 ha ahead of the scheduled mine plan.

Despite a long history of rehabilitation to a pasture base, there is limited documented evidence as to the productivity of rehabilitated mining land for beef cattle grazing. Early trials conducted by Department of Agriculture NSW in 1980 were not well documented. The Upper Hunter Mining Dialogue has involved the community and stakeholders in evaluating the sustainability and productivity of grazing as a post mining land use. In response to this, recent scientifically analyzed comparisons of the performance of cattle on rehabilitated pasture land compared to undisturbed land have been commenced in the Hunter Valley.

The Australian Coal Association Research Program (ACARP) has also funded a study of the sustainability and profitability of grazing on mine rehabilitated land in the Upper Hunter (ACARP Project No: 53259). This study is being conducted by NSW DPI on two different mine sites. Preliminary results presented to the Mine Rehabilitation conference in Singleton (March 2015) indicate that at both mine sites, cattle grazing rehabilitated pastures have consistently gained more weight than cattle on native pasture analogue areas.

Similar results have been recorded in the Glencore Grazing trials where over 18 months cattle weight gains have been higher on rehabilitated pasture than undisturbed native pasture. An additional weight gain of 20% has been achieved on the rehabilitated pasture areas, leading to significantly higher economic returns from the rehabilitated pasture.

While these trials are still being conducted, indications are that rehabilitated land can be grazed and provide a productivity that is equal to or higher than native pastures, resulting in higher economic returns.

Bloomfield Collieries Pty Ltd has a demonstrated commitment to best practice in environmental performance. It has developed a comprehensive Environmental Management System that has enabled the two mines it operates, to operate close to the suburban areas of East Maitland and Singleton. Numerous environmental awards have been won by the company over years of operation, and it enjoys an excellent compliance record.

5.6 Planning for Progressive Rehabilitation

Land management practices that will be implemented to achieve a soil which is capable of supporting a sustainable plant community will consider the chemical, physical and biological properties of the media and take into account any specialist requirements (e.g. soil ameliorants) required.

A progressive rehabilitation plan is outlined in the Rix's Creek Rehabilitation Strategy (AECOM, 2015). This will include:

- Overburden characterization to identify materials suitable for vegetation growth and any ameliorant required;
- Identification of any material that may have potential for contamination of surface or ground water; and
- Identify any propensity for spontaneous combustion.

Erosion control is achieved by minimizing the time prior to establishing vegetation.

Land management practices that are implemented at the Site relating to the handling of growing media include:

- Progressive rehabilitation of final landforms as soon as practicable after completion of mine-related disturbance activities;
- Weed management prior to stripping the area to be cleared;
- Topsoil and subsoil material that is deemed as not requiring treatment to address issues such as sodicity are stripped using a dozer or grader and moved using front end loader and trucks. When the situation allows this material is placed directly onto final shaped overburden or stored in stockpiles not > 3m in height;

- Subsoil material requiring treatment will have soil ameliorants (gypsum/lime) added prior to stripping;
- All stockpiled materials will be seeded with a suitable cover crop;
- Any stockpiled material will be assessed in terms of suitability as a growing media and if required soils ameliorants (gypsum, lime, organic matter) will be added. Stockpiled material will also be assessed in terms of weed infestation. Stockpiled material is managed for weeds on a regular basis;
- An inventory of available soil is to be maintained to ensure adequate topsoil materials are available for planned rehabilitation activities; and
- Keep vehicular traffic to a minimum on the soils to be stripped. Exclude all traffic from soils that are sensitive to structural degradation.

Full details are described in the Rehabilitation Strategy (AECOM, 2015).

6.0 Stakeholder Consultation

The stakeholder engagement program for the Project and this assessment included consultation with local, state and federal government agencies, neighbouring landowners and industries, and the wider local community.

Rix's Creek has an ongoing commitment to further consultation. This includes briefings and dialogue with the Rix's Creek Consultative Committee, Singleton Council and numerous government agencies.

7.0 Conclusion

- The economic impact from the loss of production from grazing during the period of disturbance and rehabilitation is relatively small. With the current carrying capacity & enterprise conducted on the land, the annual income from the total 170 ha removed from agriculture is between \$20,000 and \$30,000 per annum. With higher inputs and more intensive management potentially an income of \$45,000 per annum may be possible (but with higher inputs and risk).
- The loss of the small amount of employment in running a beef enterprise on 170ha is not significant. There would be no effect on regional employment for the lease extension area to be removed from agriculture for the period of mining development.
- The land capability pre-mining has been assessed as classes IV and V, - land that is suitable for grazing but not capable of cultivation for crops. Site characteristics such as slope and soil limitations such as shallowness, poor structure and low fertility limit its potential productivity and land use.
- There is no qualifying Biophysical Strategic Agricultural Land (BSAL) within the lease extension area (Mine Lease Application 487).
- Rehabilitation of the disturbed land will re-instate the land to the same land capability class as prior to disturbance (Class IV; 121ha and Class V; 49 ha).
- The post-mining land use will be grazing. Grazing will recommence on the sown rehabilitated land once the pastures have shown to be stable and approved for grazing.
- Current research undertaken examining beef cattle production on rehabilitated pastures compared to natural pastures, indicate that equivalent or higher production is possible on the rehabilitated sown pasture.
- Impacts of the proposal on agriculture will be small.

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GLOSSARY OF TERMS

Term	Definition
Abattoir	A plant or factory where cattle are slaughtered for food and other meat by products.
Biophysical Strategic Agricultural Land (BSAL)	Land with high quality soil & water resources, capable of sustaining high levels of productivity. If land is mapped as BSAL, state significant mining proposals need to undertake a verification process & agricultural impact statement.
Breeding Unit (cow)	Based on the average feed requirement of a cow plus followers. Assigns a proportion of the necessary animals for a breeding enterprise (e.g. Bull, un-weaned progeny, retained heifers etc.) to the cow as a breeding unit.
Carcase	The body of an animal after being dressed (removal of head, feet, hide and internal organs). A plant or factory where cattle are slaughtered for food and other meat by products.
Cow	Mature female bovine, used for breeding with 8 permanent incisor teeth (a measure of age).
Domestic Market	The market for cattle consumed in the country they are produced in. Generally this is younger and lighter cattle compared to the export market.
Dry Sheep Equivalent (DSE)	A standard unit to compare the feed requirements of different classes of stock. One DSE represents the amount of feed required by a 50 kg merino wether (sheep) to maintain its weight. 1 DSE = 7.6 MJ per day.
Eastern Young Cattle Indicator (EYCI)	A general cattle market benchmark used by Meat & Livestock Australia to provide trends in cattle prices. Often used as a general cattle market benchmark.
Groundwater	Water located within an aquifer, which is, held in the rocks and soil beneath the earth's surface.
Heifer	Female bovine that has not produced a calf and is under 42 months of age.
Hot Standard Carcase Weight (kg)	Used to describe the weight of an animal when at the abattoir as a carcase, prior to being dissected into meat cuts. Common description of an animal's carcase weight when sold direct to abattoirs (over the hooks) as c/kg Carcase weight.
Saleyard	A physical auction market where buyers and sellers trade cattle and other livestock.
Steer	Castrated male cattle.
Surface Water	Water flowing in streams or held in streams, rivers and other wetlands in the landscape.
Liveweight (kg)	Weight of cattle (live) at sale after curfew. Sale prices often reported in price per kilogram liveweight (c/kg/Lwt)
Proposed development	Extension of open cut coal mining and associated activities at Rix's Creek Mine within the Project Area. Referred to as The Rix's Creek Continuation of Mining Project (The Project).
Rehabilitation	The return of disturbed land to a stable, productive and self-sustaining condition, after taking into account beneficial uses of the site and surrounding land.
Revegetation	Direct seeding or planting (generally with native species) within an area in order to re-establish vegetation that was previously removed from that area.
Store Cattle	Cattle (generally steers and heifers) that are not fat enough to sell for slaughter. Store cattle usually sold to other graziers/feedlots to fatten to meet domestic or export market specifications.
Vealer	Female or castrated male cattle with no evidence of permanent incisor teeth. Not weaned for more than 7 days.
Weaner	Young cattle of either sex that have been weaned from their mother's milk and are consuming pasture or other feed supplements.

ACRONYMS

Acronym	Term/ Definition
ACARP	Australian Coal Association Research Program
BOM	Bureau of Meteorology
BSAL	Biophysical Strategic Agricultural Land
cfa	Cast for age (culled due to age)
DPI	NSW Department of Primary Industries
DSE	Dry Sheep Equivalent
EPL	Environmental Protection License
EYCI	Eastern Young Cattle Indicator.
ha	hectare
HSCW	Hot Standard Carcase Weight
Lwt	The weight of live cattle (as opposed to carcase weight once the animal is slaughtered). Cattle are generally on a live weight basis at saleyards.
mL	Megalitre of water
MLA	Meat & Livestock Australia
MOP	Mining Operations Plan
NLIS	National Livestock Identification Scheme
NLRS	National Livestock Reporting Service
mg/L	Milligrams per litre
$\mu\text{g}/\text{m}^3$	microgram per square meter
mL	Millilitre
ML	Mining Lease
Mtpa	Million tonnes per annum
pH	A measure of acidity or alkalinity of a solution. The potential of hydrogen.

Appendix 1 - Soil Analyses

Subnatric Brown Sodosol

Sample ID	Lab. No.	Sample Depth	Organic Carbon	Phosphorus	pH (CaCl2)	Aluminium	Calcium	Potassium	Magnesium	Sodium	Cation Exchange Capacity	Calcium/ Magnesium Ratio	Aluminium Saturation	Exchange-able Calcium	Exchange-able Potassium	Exchange-able Magnesium	Exchange-able Sodium (ESP)
	Unit	cm	Walkey & Black %	Bray (mg/kg)		cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg		%	%	%	%	%
Proposed Overburden Emplacement Area																	
Site1, 6	4036	0-10	2.62	4	5.2	< 0.1	7.5	0.91	9.8	1.1	19	0.76	<0.5	39	4.7	50	5.7
Site 7, 15	4045	0-10	2.73	14	5.1	0.14	9.2	0.79	4.5	0.47	15	2.0	0.90	61	5.2	30	3.1
Site 8, 19	4049	0-10	2.80	3	4.9	<0.1	8.2	0.71	5.1	0.44	14	1.6	<0.7	56	4.9	35	3.0
Site 12, 23	4053	0-10	2.50	2	4.9	<0.1	6.9	0.87	7.4	0.77	16	0.93	<0.6	43	5.4	46	4.8
Undisturbed Area																	
Site 1, 1	4031	0-10	2.15	2	5.3	<0.1	8.4	0.24	4.9	0.86	14	1.7	<0.7	58	1.6	34	5.9
Site 15, 30	4060	0-10	1.69	8	4.8	<0.1	3.3	0.56	1.4	0.19	5.6	2.3	<1.8	59	10	25	3.4
Site 16, 33	4063	0-10	2.17	2	5.1	<0.1	5.3	0.47	2.1	0.15	8.0	2.6	<1.2	66	5.8	26	1.8
Site 17, 37	4067	0-10	3.04	3	4.9	<0.1	7.4	0.96	3.9	0.26	13	1.9	<0.8	59	7.6	31	2.0
Site 20, 42	4072	0-10	2.55	5	4.9	<0.1	6.9	0.54	5.2	0.58	13	1.3	<0.8	52	4.1	39	4.4

Eutropic Brown Chromosol

Sample ID	Lab. No.	Sample Depth	Organic Carbon	Phosphorus	pH (CaCl2)	Aluminium	Calcium	Potassium	Magnesium	Sodium	Cation Exchange Capacity	Calcium/ Magnesium Ratio	Aluminium Saturation	Exchange-able Calcium	Exchange-able Potassium	Exchange-able Magnesium	Exchange-able Sodium (ESP)
	Unit	cm	Walkley & Black %	Bray (mg/kg)		cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg		%	%	%	%	%
Proposed Overburden Emplacement Area																	
Site10, 21	4051	0-10	2.58	3	5.9	<0.1	13	1.3	8.6	0.69	24	1.5	<0.4	56	5.3	36	2.9
Site 14, 27	4057	0-10	3.05	4	5.4	<0.1	11	1.1	3.5	0.13	15	3.0	<0.7	69	7.1	23	0.83