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Agricultural Impact Statement

Bylong Coal Project
Agricultural Impact Statement

Scott Barnett & Associates
ABN: 30 073 854 912
Agricultural Business Management & Production Consultants
PO Box 78
SCONE NSW 2337
PHONE: 0428 461 566
EMAIL: scott.sba@bigpond.com

Bylong Coal Project
Agricultural Impact Statement

Report prepared for Hansen Bailey Environmental Consultants on behalf of WorleyParsons Services Pty Ltd (WorleyParsons)

Prepared by
Scott Barnett
BScAgr, MAppSc (Ag & Rural Dev), DipCDC, MAIAST
Principal
Scott Barnett & Associates
Agricultural Business Management and Production Consultants
Scone NSW
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Executive Summary

Scott Barnett & Associates was commissioned by Hansen Bailey Pty Ltd on behalf of WorleyParsons Services Pty Ltd to undertake an Agricultural Impact Statement for the Bylong Coal Project (the Project). The Project is owned by KEPCO Bylong Australia Pty Ltd. KEPCO Bylong Australia Pty Ltd has retained WorleyParsons Services Pty Ltd to manage the exploration activities, mine feasibility study planning, environmental approvals and ongoing environmental monitoring for the Project.

This assessment forms part of an Environmental Impact Statement being prepared by Hansen Bailey Pty Ltd to accompany an application for State Significant Development Consent for the Project under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979*, for the development of an underground and open cut coal mining operation and associated infrastructure.

The Project is located in the New South Wales Bylong Valley in the Central West region. It is situated approximately 55 kilometres north-east of Mudgee and 100 kilometres south-west of Muswellbrook within the Mid-Western Regional Council Local Government Area in New South Wales. The small settlement of Bylong Village is located adjacent to the Project Boundary. The majority of the Project Boundary contains cleared agricultural land with native vegetation, a section of the Bylong State Forest and other portions of Crown Land. The Goulburn River National Park and the Wollemi National Park border the eastern boundaries of the Project.

The Project is located within the Bylong River catchment, which covers an area of approximately 700 kilometres-squared. The river flows from south to north through the Project Boundary intercepting the Goulburn River approximately 8 kilometres north of the village of Bylong. There are several ephemeral minor creeks and streams that branch from the Bylong River, including Crow's Nest Creek, Cousins Creek, Lee Creek, Growee River and Dry Creek. The Bylong River and its associated tributaries and alluvial aquifers are regulated by the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009.

The Bylong Valley has a long history of rural land use, involving a variety of agricultural activities, including sheep and cattle grazing, thoroughbred horse breeding, and various cropping enterprises. The current dominant land uses within and adjacent to the Study Area includes cattle breeding and trading, opportunistic cropping and irrigated and dryland feed production.

At the time of drafting this report, KEPCO owned 5,394 hectares (or 52%) of the land that comprises the Study Area (10,317 hectares). KEPCO hold 7,835 hectares of freehold land within and directly adjoining the Study Area. A further 12% of land within the Study Area is made up of Crown Land and State Forest. There are 26 parcels of Crown Land located in the Study Area. The Bylong State Forest covers 6 % of land to the north-east of the Project Boundary. The Goulburn River and Wollemi National Parks border the eastern side of the Project Boundary.

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This Agricultural Impact Statement addresses the Secretary's Environmental Assessment Requirements and has been completed in accordance with the then Department of Planning and Infrastructure's Strategic Regional Land Use Policy Guideline for the preparation of an Agricultural Impact Statement (DP&I, 2012). It also addresses the Upper Hunter Strategic Regional Land Use Plan (DP&I, 2012a) and associated Gateway assessment criteria. A key component of the Upper Hunter Strategic Regional Land Use Plan is the identification and mapping of Strategic Agricultural Land. Strategic Agricultural Land is defined as "highly productive land that has both unique natural resource characteristics… as well as socio-economic value".

Two categories of Strategic Agricultural Land have been identified as occurring within the Study Area and surrounding locality:

- Biophysical Strategic Agricultural Land – Land with a rare combination of natural resources highly suitable for agriculture; and
- Critical Industry Clusters – Localised concentrations of interrelated productive industries based on an agricultural product that provides significant employment opportunities and contributes to the identity of the region. To date only two Critical Industry Clusters have been recognised in the Strategic Regional Land Use Plan (equine and viticulture).

The extent of Biophysical Strategic Agricultural Land within the Project Boundary has been assessed as part of the *Soils and Land Capability Impact Assessment* (SLR, 2015) completed for the Bylong Coal Project. A total of 2,366 hectares of Biophysical Strategic Agricultural Land was verified and mapped within the Study Area. Of this area, only 440.8 hectares of Biophysical Strategic Agricultural Land will be directly or indirectly impacted by the various components of the Project within the Project disturbance footprint.

Approximately 1,933 hectares of mapped Equine Critical Industry Cluster occurs within the Study Area. Of this approximately 700 hectares will be directly impacted by the Project. A total of 584 hectares is located within the Biodiversity Offset Areas, 117 ha of which lies within the Study Area. The Study Area accounts for 0.75 %, the Project Disturbance Boundary accounts for 0.27 % and the Biodiversity Offset Areas accounts for 0.23 % of the total Equine CIC mapped within the Upper Hunter Strategic Regional Land Use Plan. It is further noted that no intensive equine industry activities have occurred within the mapped Equine Critical Industry Cluster area to be disturbed for a considerable period of time.

The Strategic Regional Land Use Plan does not map any Viticulture Critical Industry Cluster within or in the locality of the Project Boundary. As such, the Viticulture CIC is not considered further in this Agricultural Impact Statement.

The current gross value of agricultural production from land within the Study Area is estimated to be $5,281,063 per annum and the net value of agriculture production is estimated to be $2,457,497.

An area of approximately 1,160 hectares will be lost from agricultural production for varying periods of time as a result of the Project, which includes 440 hectares of land verified as Biophysical Strategic Agricultural Land. As a worst case scenario assuming all land within the Project Disturbance Boundary is unavailable for agricultural production at the same time, the gross value of lost agricultural production is predicted to be $0.8 Million per annum.

An area of approximately 3,800 hectares will be lost from agricultural production for as a result of the Project's Biodiversity Offsets Strategy, which includes 486.25 hectares of land verified as Biophysical Strategic Agricultural Land, of which 109.44 ha falls within the cultivated lands and will continue to be managed for agricultural production. As a worst case scenario assuming all land within the 3,800 hectares of Biodiversity Offset Area is unavailable for agricultural production at the same time, the gross value of lost agricultural production is predicted to be $1.4 Million per annum.

The potential gross value of agricultural water per mega litre removed is $415 and the net value is $101. The maximum gross value lost from agriculture due to Project water requirements is $410,562 per annum and the maximum net value lost is $99,956 per annum during open cut operations (Project Years 3-6).

The current gross value of agricultural production (land and water) predicted to be removed from agricultural production is estimated to be $2.66 Million per annum. This represents 4.12% of the gross value of agricultural production in the Mid-Western Regional Council local Government Area, 0.02% of NSW and 0.005% of Australia.

As the overall agricultural contribution of the Project disturbance footprint is small when compared to the total agricultural production on a regional, state and national scale, the reduced availability and productivity of this land will have a minimal impact to the agricultural industry. In addition, the Project will not reduce the availability of land for agricultural purposes or affect the productivity of existing agricultural land outside the Project Boundary within the locality.

In reality this scenario will never occur as KEPCO is committed to returning appropriate areas within the Project disturbance footprint to agricultural land use practices as soon as possible following achievement of the stated rehabilitation goals.

To compensate for the direct and long-term impacts of the Project (associated with the open cut mining areas and OEAs) on Biophysical Strategic Agricultural Land, KEPCO has committed to progressively stripping and reinstating the Biophysical Strategic Agricultural Land (consistent with the mining schedule described in Volume 1 of the Environmental Impact Statement) as part of the rehabilitation strategy. Upon reinstatement, KEPCO will aim to adjoin or create connectivity with larger areas of in situ Biophysical Strategic Agricultural Land. These reinstated Biophysical Strategic Agricultural Land areas will be contiguous with other Biophysical Strategic Agricultural Land areas to enhance the total agricultural productivity of the non-disturbed areas within the Project Boundary. Soil stripping and handling protocols for BSAL are provided in the EIS Rehabilitation Strategy and BSAL Reinstatement Plan (SLR, 2015b).

It is proposed to establish a small trial area within the Class 4 and 5 rehabilitated lands to investigate the benefits of Natural Sequence Farming (or Soil Hydrology Management) that has been pioneered in the locality. This trial will be conducted in conjunction with local farming experience and expertise and may involve other organisations such as the Tom Farrell Institute centred at the University of Newcastle and the Outcomes Australia Soils for Life Program.

Other potential impacts on agricultural resources and enterprises in the locality, including air quality, noise, water usage, traffic and transport, and labour supply have been assessed as having minimal effect.

To maintain and where possible enhance the agricultural productivity of KEPCO owned land outside the Project disturbance footprint it is recommended that KEPCO:

- Develop and implement a weed and pest management plan to control the distribution of invasive species and feral animals over all KEPCO owned land;
- Minimise the time that disturbed areas are removed from agricultural production by progressively rehabilitating disturbed areas as soon as practical;
- Implement sustainable farming practices and management of land situated outside the Bylong disturbance footprint on all KEPCO owned agricultural land;
- Appoint a dedicated Farm Manager to ensure the long term productivity of KEPCO-owned agricultural lands; and
- Expand existing environmental monitoring network within the Project Boundary and in the locality to ensure that no unforseen environmental impacts occur that may deleteriously affect agricultural activities adjacent to the Project Boundary.

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1 Introduction

Scott Barnett & Associates was commissioned by Hansen Bailey Pty Ltd (Hansen Bailey) on behalf of WorleyParsons Services Pty Ltd (WorleyParsons) to undertake an Agricultural Impact Statement (AIS) for the Bylong Coal Project (the Project).

1.1 Project Background

In December 2010 KEPCO Bylong Australia Pty Ltd (KEPCO) acquired Authorisations (A) 287 and 342. Since this time, extensive exploration and mine planning work has been undertaken to determine the most socially and environmentally responsible and economically viable mine plan to recover the known coal resources within the two Authorisations.

In August 2014 KEPCO commissioned WorleyParsons to manage the Project exploration activities, mine feasibility study planning, environmental approvals and ongoing environmental monitoring for the Project.

The Project is located wholly within A287 and A342 which are located within the Mid-Western Regional Council (MWRC) Local Government Area (LGA). The closest regional centre is Mudgee, located approximately 55 km south-west of the Project Boundary. The Project is approximately 230 km by rail from the Port of Newcastle. **Figure 1** illustrates the locality of the Project within New South Wales (NSW). **Figure 2** shows the regional locality of the Project in relation to the neighbouring town centres, mining authorities, major transport routes and reserves.

KEPCO is seeking State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the development and operation of the Project. The State Significant Development Application will be supported by an Environmental Impact Statement (EIS) which is being prepared by Hansen Bailey.

1.2 Project Description

The Project life is anticipated to be approximately 25 years, comprising a two year construction period and a 23 year operational period, with underground mining operations commencing in Year 7. Various rehabilitation and decommissioning activities will be undertaken during both the course of, and following the 25 years of the Project. It is noted that further mineable coal resources exist within both A287 and A342.

The Project is to be developed on land within the Project Boundary as illustrated on **Figure 3**.

Key features of the Project are conceptually shown on **Figure 3** and include:

- The initial development of two open cut mining areas with associated haul roads and Overburden Emplacement Areas (OEAs), utilising a mining fleet of excavators and trucks and supporting ancillary equipment;
- The two open cut mining areas will be developed and operated 24 hours a day, 7 days a week over an approximate 10 year period and will ultimately provide for the storage of coal processing reject materials from the longer term underground mining activities;

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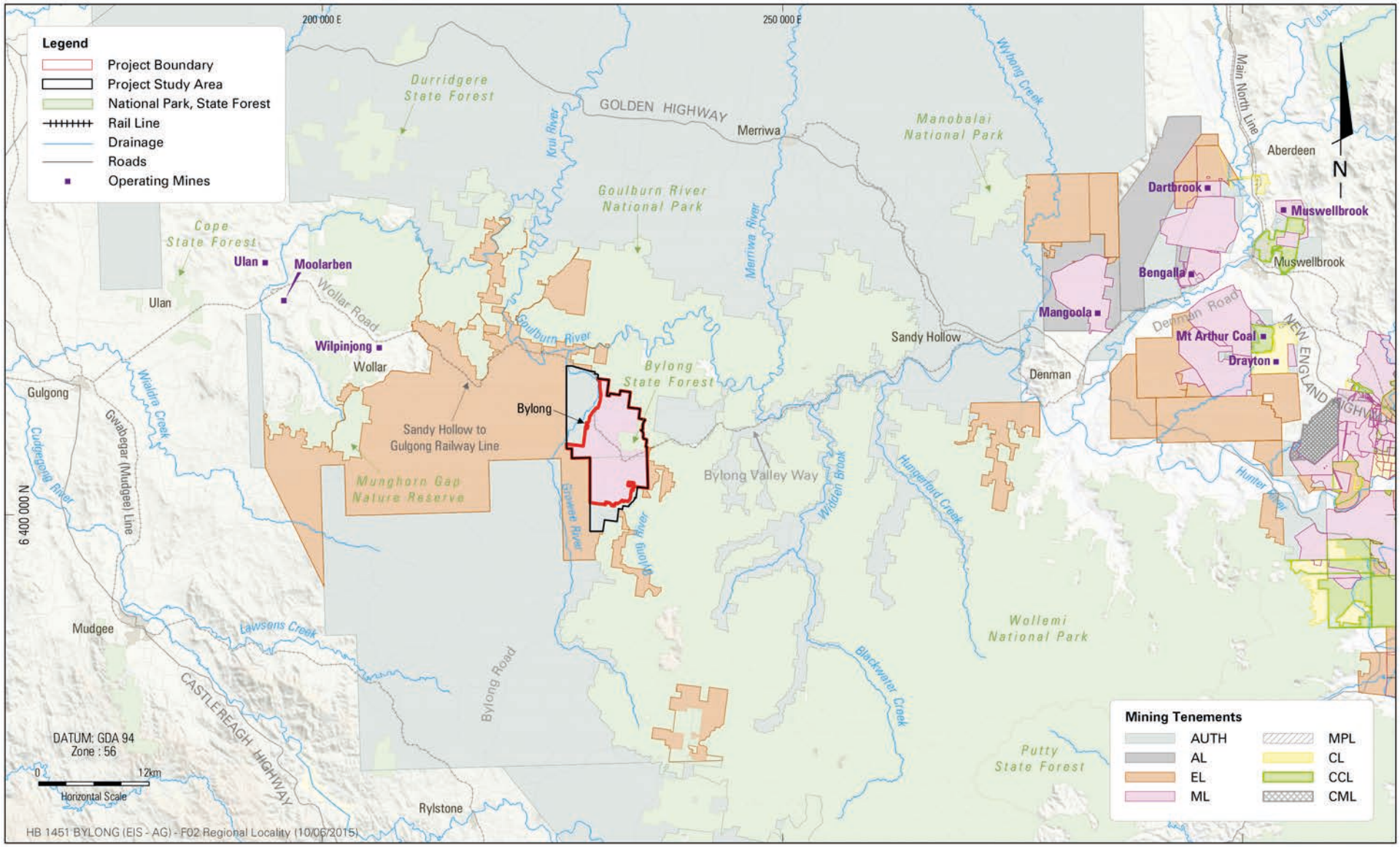
Locality Plan

FIGURE 1



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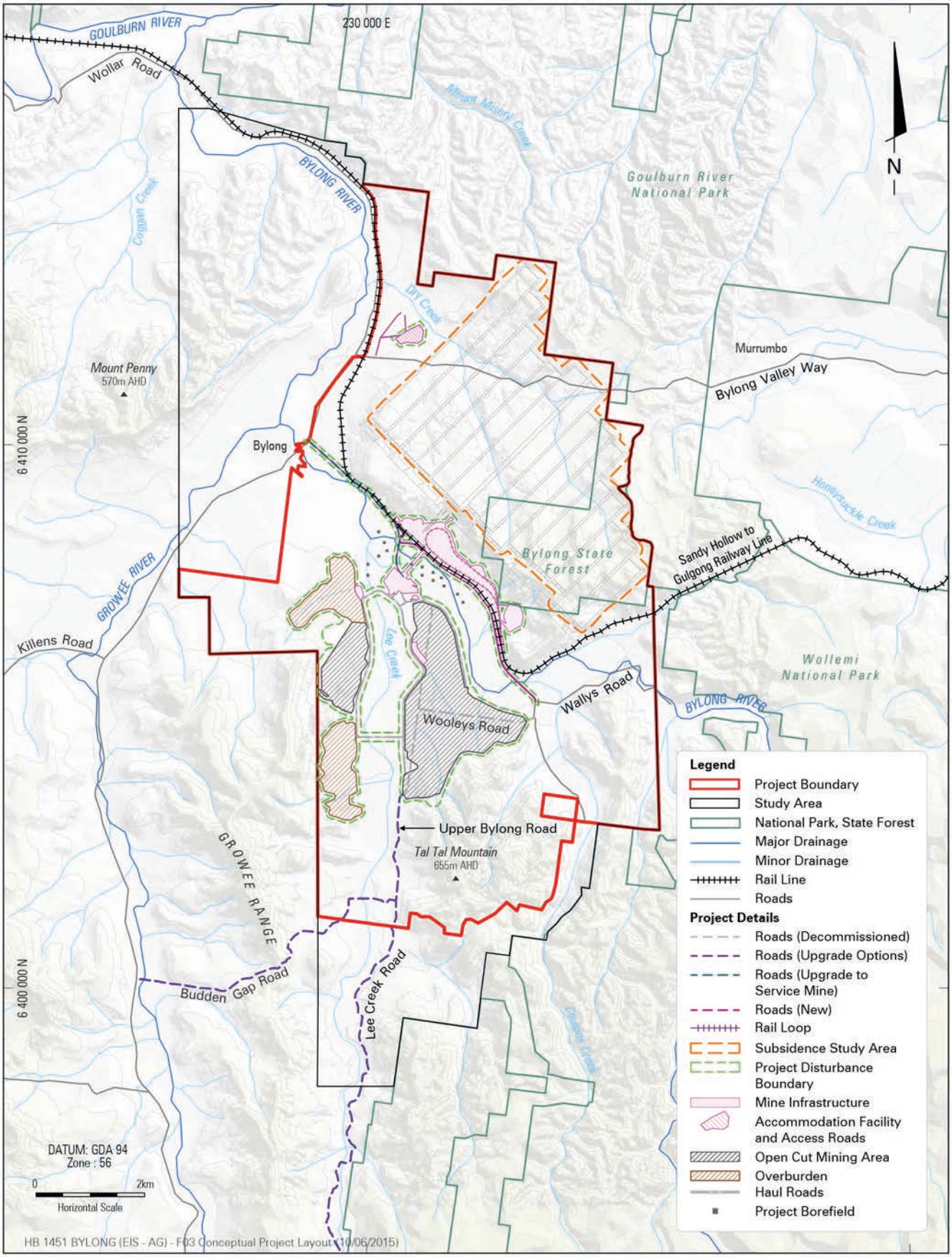
Regional Locality

FIGURE 2



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Conceptual Project Layout

FIGURE 3

- Construction and operation of administration, workshop, bathhouse, explosives magazine and other open cut mining related facilities;
- Construction and operation of an underground coal mine operating 24 hours a day, 7 days a week for a 20 year period, commencing mining in around year 7 of the Project;
- A combined maximum extraction rate of up to 6.5 Million tonnes per annum (Mtpa) Run of Mine (ROM) coal;
- A workforce of up to approximately 800 during the initial construction phase and a peak of 470 full-time equivalent operations employees at full production;
- Underground mining operations utilising longwall mining techniques with primary access provided via drifts constructed adjacent to the rail loop and Coal Handling and Preparation Plant (CHPP);
- The construction and operation of facilities to support underground mining operations including personnel and materials access to the underground mining area, ventilation shafts, workshop, offices and employee amenities, fuel and gas management facilities;
- Construction and operation of a CHPP with a designed throughput of approximately 6 Mtpa of ROM coal, with capacity for peak fluctuations beyond this;
- The dewatering of fine reject materials through belt press filters within the CHPP and the co-disposal of dewatered fine and coarse reject materials within OEAs and final open cut voids (avoiding the need for a tailings dam);
- Construction and operation of a rail loop and associated rail load out facility and connection to the Sandy Hollow to Gulgong Railway Line to facilitate the transport of product coal;
- The construction and operation of surface and groundwater management and water reticulation infrastructure including diversion drains, dams (clean, dirty and raw water), pipelines and pumping stations;
- The installation of communications and electricity reticulation infrastructure;
- Construction and operation of a Workforce Accommodation Facility (WAF) and associated access road from the Bylong Valley Way;
- The upgrade of Upper Bylong Road and the construction and operation of a Mine Access Road to provide access to the site facilities;
- Relocation of sections of some existing public roads to enable alternate access routes for private landholders surrounding the Project; and
- Infilling of mining voids, progressive rehabilitation of disturbed areas, decommissioning of Project infrastructure and rehabilitation of the land progressively following mining operations.

1.3 Assessment Objectives

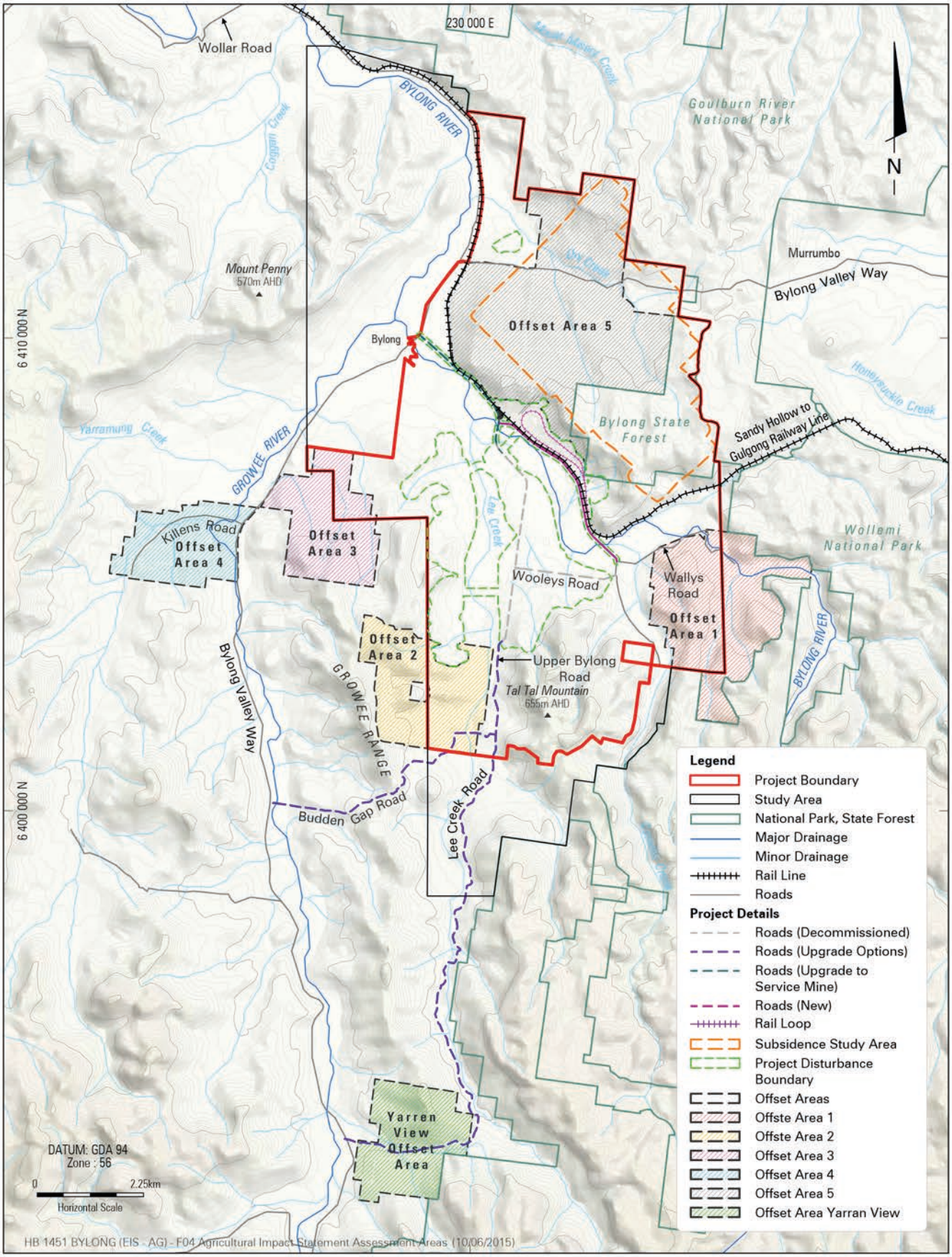
The scope of work completed by SBA for this assessment included:

- Addressing the Secretary's Environmental Assessment Requirements (SEARs) relating to agriculture, as issued on 23 June 2014 and subsequently modified on 11 November 2014;
- Addressing recommendations attached to the Conditional Gateway Certificate issued for the Project on 15 June 2014;
- Addressing relevant policies and plans relating to agriculture;
- Describing the agricultural resources and enterprises in the general locality, including identifying any State significant agricultural resources;
- Identifying the agricultural domains of the land within the assessment areas (as defined in **Section 1.4**);
- Assessing the current and maximum agricultural potential for each domain in terms of quantum, gross and net value of agricultural production;
- Assessing the loss of agricultural production from within the assessment areas during the life of the Project in terms of value of agricultural production and downstream activities within the value chain and support activities;
- Assessing the use of the unregulated water supply for the Project in comparison to it being used for agricultural purposes within the unregulated system;
- Assessing the impact of the Project on Strategic Agricultural Land (SAL) including the Upper Hunter Equine Critical Industry Cluster (Equine CIC) and Biophysical Strategic Agricultural Land (BSAL); and
- Providing recommendations for appropriate mitigation and management measures for any impacts identified.

1.4 Assessment Areas

The assessment areas (Agricultural Assessment Areas) for this AIS are illustrated on **Figure 4** and include the following:

- Land within the Study Area – defined as land included within A287 and A342 comprising 10,317 ha;
- Land within the Project Boundary – comprising 6,958 ha which falls entirely within the Study;
- Land within the Project Disturbance Boundary - associated with the construction and operation of infrastructure domains and open cut mining activities covering approximately 1,160 ha of land all within the Project Boundary;
- Land within the Project disturbance footprint which covers approximately 2,874.7 ha within the Project Boundary. The footprint includes the Project Disturbance Boundary and the Subsidence Study Area;



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Assessment Areas

FIGURE 4

- Biodiversity Offset Areas – comprising 4,802 ha including land located within a 10 km radius of the Project Disturbance Boundary, proposed to be conserved as part of the Project's Biodiversity Offset Package. Of this area 2,226 ha is located within the Study Area, and an additional 1,856 ha is located on land beyond the Study Area but within a 10 km radius of the Project Boundary (Cumberland Ecology 2015b); and
- Agriculture in the general locality, which is defined as the land within the Bylong Valley and in a 10 km radius of the Project.

1.5 Related Studies

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

- The EIS Soil, Land Capability and Strategic Agricultural Land Assessment (Soils Assessment) (SLR, 2015);
- The EIS Rehabilitation Strategy and BSAL Reinstatement Plan (Rehabilitation Strategy) (SLR, 2015b);
- The EIS Subsidence Impact Assessment (MSEC, 2015):
- The EIS Ecological Impact Assessment (Cumberland Ecology, 2015);
- The EIS Biodiversity Offsets Report (Cumberland Ecology, 2015b);
- The EIS Surface Water and Flooding Impact Assessment (WRM Water & Environment, 2015);
- The EIS Groundwater Impact Assessment (AGE Consultants, 2015);
- The EIS Air Quality and Greenhouse Gas Impact Assessment (PEL, 2015);
- The EIS Noise and Blasting Impact Assessment (PEL, 2015);
- The EIS Visual Impact Assessment (JVP Planning & Design, 2015);
- The EIS Traffic and Transport Impact Assessment (Parsons Brinckerhoff, 2015);
- The EIS Social Impact Assessment (Hansen Bailey, 2015);
- The EIS Mine Plan Justification Report (Mine Advice, 2015); and
- The EIS Economic Impact Assessment (Gillespie Economics, 2015).

2 Regulatory Framework

This chapter describes the regulatory framework relevant to the Project and this assessment.

2.1 Environmental Planning and Assessment Act 1979

The EP&A Act is the overarching planning legislation in NSW. This act provides for the creation of planning instruments that guide land use.

Upon the repeal of Part 3A of the EP&A Act on 1 October 2011, the *Environmental Planning and Assessment Amendment (Part 3A Repeal) Act 2011* inserted a new Division 4.1 in Part 4 of the EP&A Act. The Project will require planning assessment and determination under Division 4.1, regime for a State Significant Development (SSD). Section 78(8A) states that a development application for SSD must be accompanied by an EIS prepared in accordance with the *Environmental Planning & Assessment Regulation 2000* (EP&A Reg).

This AIS has been prepared in accordance with the SEARs under section 78A (8A) of the EP&A Act. **Table 1** provides a summary of the requirements relating to agriculture under the SEARs that are relevant to this assessment and indicates where specific issues have been addressed in this report.

Table 1
Secretary's Environmental Assessment Requirements

Specific issues	Where addressed in this document
Secretary's Requirements	
DP&E	
• An assessment of the likely agricultural impacts of the development, paying particular attention to the mapped equine critical industry cluster in the area;	Section 8
OASFS	
0AS&FS requests that an Agricultural Impact Statement (AIS) is included in the Environmental Impact Statement (EIS). Specific guidance on satisfying the requirements for the AIS should be taken from the Department of Primary Industries, Agricultural Impact Statement Technical Notes which are available at: http://www.dpl.nsw.gov.au/agriculture/resources/lup/development-assessment	*AIS Assessment*
The DGRs should specifically include: • The requirement of a comprehensive Agricultural Impact Statement using the guidelines described above, and • Detailed advice regarding rehabilitation, in particular the proposed rehabilitation of Biophysical Strategic Agricultural Land (BSAL), including the location of the activities, methodologies and time-frames for implementation.	Section 8.4
DRE	
Where an agricultural land use is proposed, the EIS should: • Demonstrate that the landscape will be returned to the Agricultural Suitability Class that existed before mining commenced or better; • Where the intended land use is likely to be grazing, the existing capacity in terms of Dry Sheep Equivalent or similar must be calculated and a timeframe from vegetation establishment be given for the return to agricultural production to at least the existing stock capacity; • Provide information on how soil would be developed in order to achieve the proposed stock capacity.	Section 8.2, Section 8.3 and Section 9.3

Specific issues	Where addressed in this document
Secretary's Requirements	
Rehabilitation And Mine Closure: • The Division of Resource & Energy's (DRE) role focuses on ensuring that mined land in NSW is effectively rehabilitated and returned to beneficial post mining land uses. This is undertaken by requiring mine operators to have strategies in place to ensure the rehabilitation of all mined land, and strategies for an orderly transition from a mining land use to an agreed stable and beneficial post mining use. At the EIS stage, the strategies may be conceptual in nature. Each of the following aspects of rehabilitation planning should be addressed in the strategy:	Rehabilitation Strategy (SLR 2015), Section 8.2 and Section 8.3
Post Mining Land Use: • The proponent must identify and assess post mining land use options and provide a statement of the preferred post mining land use outcome in the EIS. This should include a discussion of how the final land use(s) are aligned with relevant local and regional strategic land use objectives as well as the benefits of the post mining land to the surrounding environment, a subsequent landowner, the local community and the state of NSW.	Rehabilitation Strategy (SLR 2015), and Section 8.2 and Section 8.3
Mining & Petroleum Gateway Panel	
Using the Guideline for Gateway Applicants (September 2013) by Department of Planning & Infrastructure, provide a compliant and comprehensive assessment of the Project's potential impacts on the Equine CIC.	Section 8.5

2.2 Strategic Regional Land Use Plan – Upper Hunter

The *NSW Strategic Regional Land Use Policy* applies state-wide in areas, where there is high value agricultural land and aims to manage land-use conflicts in regional areas in relation to agriculture coal mining and coal seam gas. The plan defines strategic agricultural land as:

> "*…highly productive land that has both unique natural resource characteristics (such as soil and water resources) as well as socio-economic value (such as high productivity, infrastructure availability and access to markets).*" (NSW DP&I 2012a).

The Project Boundary falls within the area covered under the *Strategic Regional Land Use Plan – Upper Hunter* (SRLUP) (DP&I, September 2012). The SRLUP identifies assessment criteria and identifies potential areas of BSAL and CIC.

A component of the SRLUP is the Gateway Process, which applies to State Significant mining and coal seam gas proposals that are located on SAL. Under the Gateway process, these proposals are assessed by a panel of independent experts before a development application can be lodged. The EP&A Regulation (section 50A) requires that:

> *"..a development application for consent to a mining or petroleum development on certain identified land (including land shown on the Strategic Agricultural Land Map) must be accompanied by:*
>
> *(a) a gateway certificate, or*
>
> *(b) a site verification certificate that certifies that the land on which the proposed development is to be carried out is not biophysical strategic agricultural land."*

KEPCO identified that the Project contains areas of BSAL and Equine CIC mapped under the SRLUP. Therefore KEPCO proceeded directly to the Gateway process and included details of the verification of BSAL within the application. The Gateway Panel issued a Conditional Gateway Certificate on the 15 April 2014.

2.2.1 Biophysical Strategic Agricultural Land

An assessment of the potential impacts of the Project on BSAL has been undertaken as part of this AIS and the Project Soils Assessment (SLR, 2015), having specific regard to the Upper Hunter SRLUP, SEARs and the recommendations attached to the Conditional Gateway Certificate. BSAL is defined by the Upper Hunter – SRLUP as a category of SAL, containing:

> "*a rare combination of natural resources and is considered highly suitable for agriculture. These lands intrinsically have the best quality landforms, soil and water resources which are naturally capable of sustaining high levels of productivity and require minimal management practices to maintain this high quality. As these lands are rare, the NSW Government is putting mechanisms in place to protect these strategic land assets."* (DP&I, 2012b)

The Upper Hunter SLURP includes verification criteria and published mapping indicating generally where BSAL occurs throughout the region. As part of the Soils Assessment the potential BSAL within the Study Area was verified against the 12 step site verification criteria. **Table 2** provides a summary of the recommendations attached to the Conditional Gateway Certificate and indicates where each has been addressed.

Table 2
Summary of BSAL Gateway Recommendations

Specific issues	Where addressed
With regard to the removal and recreation of verified BSAL soils: 1. Undertake a risk assessment that identifies the hazards and proposes controls with respect to the movement of BSAL soils;	Soils and Land Capability Impact Assessment (SLR 2015)
2. Identify a final location for the verified BSAL soils within the Project Boundary area;	Soils and Land Capability Impact Assessment (SLR 2015) and Section 8.4
3. Detail the methods proposed for the handling, storage and treatment of the verified BSAL soils; and	Soils and Land Capability Impact Assessment (SLR 2015) and Section 8.4.3
4. Propose alternate mitigation measures to be implemented in the event that the methodology selected results in the loss of verified BSAL soils post-implementation.	Soils and Land Capability Impact Assessment (SLR 2015)

2.2.2 Critical Industry Clusters

CICs are concentrations of highly productive industries within a region that are interrelated. CICs are based on an agricultural product that contributes to the identity of that region and provides significant employment opportunities. Under the Upper-Hunter SRLUP CICs are defined as:

- *"there is a concentration of enterprises that provides clear development and marketing advantages and is based on an agricultural product;*
- *the productive industries are interrelated;*
- *it consists of a unique combination of factors such as location, infrastructure, heritage and natural resources;*
- *it is of national and/or international importance;*
- *it is an iconic industry that contributes to the region's identity; and*
- *it is potentially substantially impacted by coal seam gas or mining proposals."*

The latest SRLUP mapping, finalised in January 2014, shows 1,933 ha of potential Equine CIC within the Project Boundary. As part of the AIS an assessment of the Project impacts on Equine CIC has been undertaken, having specific regard to the Upper Hunter SRLUP, SEARs and Conditional Gateway Certificate recommendations. **Table 3** provides a summary of the recommendations attached to the Conditional Gateway Certificate regarding the assessment of CIC issued over the Project and indicates where each has been addressed.

Table 3
Summary of Equine CIC Gateway Recommendations

Specific issues	Where addressed
Mining Petroleum and Gateway Panel	
With regard to the assessment of CIC: Using the Guideline for Gateway Applicants (September 2013) by Department of Planning & Infrastructure, provide a compliant and comprehensive assessment of the Project's potential impacts on the Equine CIC.	Section 8.5

An appropriate methodology for the assessment of potential impacts of the Project on Equine CIC was developed in consultation with NSW Department of Primary Industries (DPI) following the Gateway process. **Table 4** provides a summary of the agreed assessment methodology and indicates where specific aspects have been addressed.

Table 4
Summary of Equine CIC Assessment Methodology

Specific Aspect	Where addressed
Mining Petroleum and Gateway Panel	
With regard to the impacts to CIC: 1. Discuss and outline the history of the land use that has been implemented on the three properties currently mapped as Equine CIC within the Project Boundary;	Section 3.5
2. Explain the possible impacts that may have occurred to the Equine CIC since KEPCO has acquired the Project, including the purchase of two of the three properties mapped as Equine CIC;	Section 3.5
3. Outline KEPCO's plans for land use going forward across all of the Equine CIC land they own; and	Section 8.5 & Section 9.3

Specific Aspect	Where addressed
4. Assess the impacts that the Project will have on these three Equine CIC properties (from the base of land use that is currently implemented) and make a comparison of these impacts in relation to the entire Hunter Valley Equine CIC.	Section 8.5

2.3 Guideline for Agricultural Impact Statements

This assessment has been prepared in accordance with the *Strategic Regional Land Use Policy Guideline for Agricultural Impact Statements* released by (the then) DP&I in October 2012 as a supplementary document to the SRLUP. The *Agricultural Impact Statement Technical Notes - A Companion to the Agricultural Impact Statement Guideline* released by DP&I in April 2013. The technical notes detail the requirements for the assessment of agricultural impacts associated with all State Significant Development applications. These guidelines are provided in **Table 5**.

Table 5
Guidelines for Agricultural Impact Statements Requirements

Guideline Requirement	Report Section Where Addressed
Detailed assessment of the agricultural resources and agricultural production of the project area	Section 4 & Section 0
Identification of the agricultural resources and current enterprises within the surrounding locality of the project area	Section 4
A detailed assessment of the potential impacts of the project on agricultural resources and agricultural enterprises on the site and in the locality, including;	Section 8.1
• Any physical movement of water away from agriculture	Section 8.1 and Section 8.6
• Assessment of socio-economic impacts	Section 8.11
Management measures to avoid, reduce or mitigate impacts on agricultural resources and enterprises, including monitoring programs, trigger response plans and trigger points for cessation or modification of operations	Section 9
Document consultation with adjoining landholders and Government Departments	Section 6

2.4 Water Management Act 2000

The *Water Management Act 2000* (WM Act) establishes licensing regimes for the management of water resources in NSW. The objective of the WM Act is the sustainable and integrated management of the State's water for the benefit of both present and future generations. The WM Act provides clear arrangements for controlling land based activities that affect the quality and quantity of the State's water resources. It provides for four types of approval:

- Water use approval – which authorise the use of water at a specified location for a particular purpose, for up to 10 years;
- Water management work approval;
- Controlled activity approval; and

- Aquifer interference activity approval – which authorises the holder to conduct activities that affect an aquifer such as approval for activities that intersect groundwater, other than water supply bores and may be issued for up to 10 years.

Water use, water management work and controlled activity approvals are not required for a State Significant Development approved under Division 4.1 of the EP&A Act.

The Bylong River, its associated tributaries and alluvial aquifers are regulated by *the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* (WSP). The plan area comprises 39 water sources in the Hunter River catchment.

The WSPs allow for some extraction of water from the river without a Water Access Licence to provide basic landholder rights, which include domestic and stock rights as well as Native Title rights. All water extraction that is not for basic landholder rights must be authorised by a Water Access Licence, which specifies a share component.

Extractions from the Bylong River are subject to Total Daily Extraction Limits which limit the daily extraction volume depending upon the river flow rate. With respect to surface water, the Project has the potential to impact on the Bylong River Water Source under the WM Act, as identified in the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources (2009).

2.5 Aquifer Interference Policy

Aquifer interference activities are defined under the WM Act as activities which involve any of the following:

- "*The penetration of an aquifer;*
- *The interference with water in an aquifer;*
- *The obstruction of the flow of water in an aquifer;*
- *The taking of water from an aquifer in the course of carrying out mining or other activity prescribed by the regulations; and*
- *The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations*" (NOW, 2012).

The Aquifer Interference Policy (AIP) states that "*all water taken by aquifer interference activities, regardless of quality, needs to be accounted for within the extraction limits defined by the water sharing plans. A water licence is required under the WM Act (unless an exemption applies or water is being taken under a basic landholder right) where any act by a person carrying out an aquifer interference activity causes the:*

- *Removal of water from a water source; or*
- *Movement of water from one part of an aquifer to another part of an aquifer; or*
- *Movement of water from one water source to another water source, such as from:*
    - *An aquifer to an adjacent aquifer; or*
    - *An aquifer to a river/lake; or*
    - *A river/lake to an aquifer".*

The Project will comprise open cut and underground mining operations which are classified as aquifer interference activities under the provisions of AIP (NOW, September 2012). Predictions need to be carried out to assess the likely volume of water taken from a water source(s) as a result of an aquifer interference activity. These predictions need to occur prior to granting of Development Consent.

After granting of Development Consent and during operations, these volumes are required to be measured and reported in the Annual Review. The water access licence must hold sufficient share component and water allocation to account for the take of water from the relevant water source at all times.

A numerical groundwater model has been developed as part of the EIS Groundwater Impact Assessment (AGE 2015). The groundwater model has predicted the water takes associated with the Project from the various water sources by year over its life and beyond.

3 Existing Environment

This chapter describes the existing environment of Bylong and the surrounding area relevant to the AIS assessment areas.

3.1 Climate

The climate is dominated by continental influences and is generally described as having hot summers with mild winters. Site-specific climatic data has been recorded at the on-site Automatic Weather Station (Met1) since its installation in July 2011 (PEL, 2015). The Bureau of Meteorology (BoM) has collected longer term climatic information in the vicinity of the Project at the Nullo Mountain AWS (located approximately 20 km south-east of the Project).

Temperatures within the Bylong Region range from an average maximum of 24°C in summer to an average minimum of 2.5°C in the winter months. Meteorological monitoring within the Project Boundary has confirmed that temperature inversions are common during the winter months, generally forming in the late afternoon and reaching maximum resistance at dawn. For the majority of the year, winds predominantly occur from the east-south-east, except during the winter and spring months when winds from the west and north-west prevail.

As part of the Surface Water and Flooding Impact Assessment (WRM, 2015), a detailed review of Bureau of Meteorology (BOM, 2009) monitoring data was undertaken to determine the average annual rainfall over the Bylong River catchment. Daily rainfalls have been recorded at Kerrabee (Murrumbo) (BoM Station No. 062046), approximately 10 km east of the Project Area, since 1951. Rainfall data recorded at this station is representative of rainfall in the vicinity of the Project. Mean annual rainfall is 657 mm with the highest monthly rainfalls occurring in the summer. The highest annual rainfall at this station (1,207.8 mm) was recorded in 1990. These findings are relatively consistent with the Bylong (Heatherbrae) Station which was opened in 1960 and closed in 2008, and the Bylong Automatic Weather Station (Met 1) installed by the KEPCO in 2011 (WRM, 2015).

3.2 Topography

The Bylong Valley is bisected by two broad valleys, which have been mainly cleared for agriculture. These valleys are surrounded by elevated, heavily wooded forests and escarpment-bounded plateaus ranging from 400-600 m above sea level. Some of these narrow plateaus have elevations of up to 700 m at the southern region fringed by the alluvial valleys. Wider tablelands with elevations of up to about 450 m occur to the northwest of the Study Area. The Study Area is characterised by steep sections and rocky escarpments of the Great Dividing Range, which surround the Bylong alluvial valley plains.

3.3 Soils and Land Capability

A Soils Assessment for the Project has been undertaken by SLR (2015). The purpose of the assessment was to:

- Define the soil types present within the Study Area;
- Provide a description of the pre and post-mining land capability and agricultural land suitability within the Study Area;
- Identify the extent and possible impacts to BSAL and Equine CIC with consideration of the SRLUP;

- Determine the topsoil availability, stability and suitability for ongoing disturbance management and post-mining rehabilitation;
- Provide selective topsoil and subsoil management recommendations.

This section describes the soil types identified within the Study Area to provide context of the existing environment. Details on the impacts to soil resources within and adjacent to the Project Boundary, along with the change in land capability and agricultural suitability due to the Project is presented in **Section 8.2**.

3.3.1 Methodology

Soil Survey

A preliminary soil landscape map for the Study Area was developed using aerial photography, topographic maps and previous soil assessments, including the Soil Landscapes Maps of the Singleton 1:250 000 Sheet (Kovac & Lawrie, 1991). The mapping was used to predict the distribution of all soil landscape attributes and guide the field survey.

A risk assessment was undertaken to evaluate the risk of the Project to soil resources (and consequently agricultural activities) and to assign an appropriate soil sampling density (survey scale) to land potentially affected by the Project. The Project activities, related risk rated and applied survey scale is summarised in **Table 6**.

For the majority of the Project activities identified as having a high risk of impacting soil resources, the associated land was subject to a sampling density scale of 1:25,000. For the remaining Project domains identified as having a medium to low risk of impacting soil resources, the associated land was subject to a sampling density scale of 1:50,000 to 1:250,000.

Table 6
Soil Survey Scale

Project Domain		Risk Rating	Survey Scale
No.	**Unit**	**Rating**	
1	Open Cut Mining Areas	A1-A3 – High	1:25,000
2	OEAs	A1-A3 – High	
4	Rail Loop[1]	A3 – High	
6	Water Storage Facilities	A3 – High[2]	
3	Mine Infrastructure Area	A4 – Medium	1:50,000
5	Roads	A4 – Medium	1:50,000
7	Subsidence Study Areas - on non-SRLUP mapped BSAL	B5 – Low	1:100,000
	- on non-alluvial influenced BSAL	C4 - Low[3]	
8	Stockpile Area	C4- Low	
	Nil Disturbance	Nil[4]	1:100,000 – 1:250,000

1. *Project domains will be left in place for future use*
2. *Area of land is small and impact on agricultural industries is minimal; however, as topsoil and subsoil will be significantly disturbed it has been assigned a high rating.*
3. *BSAL on elevated land is not predicted to be impacted by subsidence*
4. *No survey required for BSAL verification. Survey scale nominated to satisfy typical project SEARs*

Extensive fieldwork has been conducted across the Study Area over a one and a half year period, commencing in November 2011 and finishing in April 2013. A total of 657 reference soil profile sites were assessed, comprising 257 detailed profile descriptions, 98 laboratory assessed profiles and 302 mapping observations. Furthermore, numerous field observations were made during the field programs to confirm or adjust previous mapping boundaries. Further details of sampling techniques, relevant guidelines and survey justification are presented in Soils Assessment (SLR, 2015) prepared for the EIS.

Land Capability Assessment

The land capability assessment was conducted in accordance with a new Land and Soil Capability (LSC) assessment scheme that has been developed for NSW: *The land and soil capability assessment scheme: second approximation – A general rural land evaluation system for NSW* (OEH, 2012; hereafter referred to as the LSC Guideline). The LSC Guideline consists of an eight-class system reproduced in **Table 7** and based on two key considerations:

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

Table 7
Land and Soil Capability Class Definitions

LSC Class	General Definition	
Land capable of a wide variety of land uses (cropping, grazing, horticulture forestry, conservation, nature conservation)		
1	*Extremely high capability land* No limitations	No special land management practices required. Land capable of all rural land uses and land management practices.
2	Very high capability land Slight limitations	Limitations 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* Moderate limitations	Is capable of sustaining high-impact land uses, such as cropping with cultivation using more intensive and widely accepted management practices. However careful management of the 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* Moderate to high limitations for high-impact land uses	Limitations 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 specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	*Moderate-low capability land* High limitations for high-impact land uses	Limitations will 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 of a for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)		
6	*Low capability land* Very high limitations for high-impact land uses	Land 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.

LSC Class	General Definition	
Land generally incapable of agricultural land use (selective forestry and nature conservation)		
7	*Very low capability land* Severe limitations that restrict most land uses	Limitations generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations are 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.

3.3.2 Study Area Soil Units

Forty soil units and 14 soil-phases were identified and classified broadly into seven *Australian Soil Classification* (ASC) system orders (Isbell, 1996). **Table 8** provides an overview and a quantitative distribution of each soil type identified within the Study Area and Project Boundary. **Figure 5** provides an illustration of the spatial distribution of each soil type.

Table 8
Soil Unit Distribution Summary

Soil Unit		Study Area		Project Boundary	
		Ha	%	ha	%
Bald Hill Soil Landscape					
BH1	Eutrophic Red Dermosol; deep	729.6	7.1	443.4	6.3
BH1-P1: Shallow Phase	Red Chromosol; shallow	317.1	3.1	191.4	2.8
BH1-P2: Moderate Phase	Eutrophic Red Chromosol; moderate	24.6	0.2	6.4	0.1
BH2	Eutrophic Red Dermosol; deep	211.1	2	211.1	3.1
BH2-P1: Moderate Phase	Red Dermosol; moderate	62.6	0.6	62.5	0.9
BH2-P2: Shallow Phase	Red Chromosol; shallow	436.8	4.2	436.7	6.3
	Total	**1,781.8**	**17.2**	**1,351.5**	**19.5**
Benjang Soil Landscape					
BJ1	Eutrophic Brown Chromosol; deep	354.9	3.4	355.4	5.1
BJ2	Self-mulching Brown Vertosol; shallow	47.1	0.5	47	0.7
BJ3	Subnatric Yellow Sodosol; deep	80.8	0.8	75.3	1.1
BJ3-P1: Shallow Phase	Subnatric Yellow Sodosol; shallow	34.7	0.3	24	0.3
	Total	**517.5**	**5**	**501.7**	**7.2**
Bylong Soil Landscape					
B01	Eutrophic Black Dermosol overlying Stratic Rudosol	341.9	3.3	341.9	4.9
B02	Eutrophic Black Dermosol; deep	54.8	0.5	54.7	0.8
B03	Eutrophic Black Dermosol; deep	149.6	1.5	148.8	2.1
B03-P1: Saline Phase	Eutrophic Black Dermosol; saline	574.4	5.6	31.3	0.5
B04	Black Dermosol; moderate	39.9	0.4	Nil	Nil
B05	Brown-Orthic Tenosol	71	0.7	70.9	0.9
B06	Eutrophic Black Dermosol overlying Stratic Rudosol	228.2	2.2	187.4	2.7

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Soil Unit		Study Area		Project Boundary	
		Ha	%	ha	%
B06-P1: Saline Phase	Eutrophic Black Dermosol overlying Stratic Rudosol; saline	34.7	0.3	32.4	0.5
B07	Chernic-leptic Tenosol	24.8	0.2	Nil	Nil
B08	Eutrophic Grey Dermosol overlying Stratic Rudosol	78.4	0.8	78.3	1.1
B09	Black Dermosol	19.9	0.2	Nil	Nil
B10	Leptic Tenosol	7.9	0.1	Nil	Nil
B11	Eutrophic Brown Kandosol	10	0.1	Nil	Nil
B12	Stratic Rudosol overlying Black Dermosol	28.7	0.3	28.8	0.5
	Total	**1,664.2**	**16.2**	**974.5**	**14**
Growee Soil Landscape					
G01	Eutrophic Red Chromosol; moderate	249.8	2.4	77.1	1.1
G02	Eutrophic Red Chromosol; deep	89.7	0.9	Nil	Nil
G03	Lithic Rudosol	86.9	0.8	39.5	0.5
G04	Mesotrophic Brown Chromosol; moderate	40.2	0.4	40.2	0.6
G04-P1	Mesotrophic Red Chromosol; shallow	368.3	3.6	325.8	4.7
G05	Eutrophic Red Chromosol; moderate	419.3	4.1	208.9	3.1
G05-P1: Shallow Phase	Red Chromosol; shallow	82.8	0.8	Nil	Nil
G06	Eutrophic Red Chromosol; moderate	90.8	0.9	76.8	1.1
G06-P1: Shallow Phase	Red Chromosol; shallow	14.1	0.1	14.1	0.2
G07	Eutrophic Red Chromosol; deep	23.2	0.2	23.2	0.3
G07-P1: Gravelly Phase	Eutrophic Red Chromosol; gravelly	17.1	0.2	17.2	0.3
G08	Eutrophic Red Dermosol; shallow	37.1	0.4	37.1	0.5
G09	Eutrophic Brown Chromosol; moderate	76.5	0.7	76.5	1.1
G10	Eutrophic Black Kandosol	16.9	0.2	10.9	0.1
G11	Stratic Rudosol	80.7	0.8	66.3	1
G12	Black Dermosol; deep	47.8	0.5	47.8	0.6
G13	Black-Orthic Tenosol; light sandy textured	17.8	0.2	17.8	0.2
G14	Eutrophic Brown Chromosol: deep	72.6	0.7	72.4	1.1
G14-P1	Brown Chromosol; shallow	25.9	0.2	25.9	0.4
G15	Subnatric Brown Sodosol	84.2	0.8	84.1	1.1
G16	Stratic Rudosol	9.9	0.1	Nil	Nil
G17	Eutrophic Red Chromosol; deep	117.7	1.1	102.4	1.5
G17-P1: Moderate Phase	Eutrophic Red Chromosol; moderate	171.3	1.7	171.3	2.4
G18	Mesonatric Yellow Sodosol; deep	29.4	0.3	0.4	<0.1
G19	Brown Chromsol*; moderate	28	0.3	Nil	Nil
	Total	**2,298**	**22.4**	**1,535.7**	**21.9**

Soil Unit		Study Area		Project Boundary	
		Ha	%	ha	%
Lees Pinch Soil Landscape					
L1	Clastic Rudosol	577	5.6	578.7	8.4
L1-P1: Shallow Phase	Clastic Rudosol; very shallow	1964.2	19	1,577.50	22.7
	Total	**2,541.2**	**24.6**	**2,156.2**	**31.1**
Ogilvie Soil Landscape					
O1	Mesonatric Brown Sodosol; moderate	159.4	1.5	35.7	0.5
O1-P1: Shallow Phase	Subnatric Brown Sodosol; shallow	950.8	9.2	Nil	Nil
O2	Clastic Rudosol; deep	77	0.7	76.7	1.2
O2-P1: Moderate Phase	Clastic Rudosol; moderate	195	1.9	193.6	2.8
	Total	**1,382.2**	**13.3**	**306**	**4.5**
Sandy Hollow Soil Landscape					
SH1	Subnatric Red Sodosol; deep	132.1	1.3	132.1	1.8
	Total	**132.1**	**1.3**	**132.1**	**1.8**
Total		**10,371.00**	**100**	**6,957.70**	**100**

Bald Hill

The Bald Hill Soil Landscape Unit is associated with low hillocks and basalt or dolerite caps and is present mainly in the northeast of the Study Area. It is occurs on the Tertiary basalt geological unit and the parent rock is olivine basalt and dolerite. Elevations range from 240-1,000 m and slope gradients are between 5-50%.

In the Study Area, the Bald Hill Soil Landscape Unit is a major unit covering a large area of elevated land in the north-east, and smaller pockets of land in the western and southern parts of the Study Area. This soil landscape unit is typically suited to grazing enterprises.

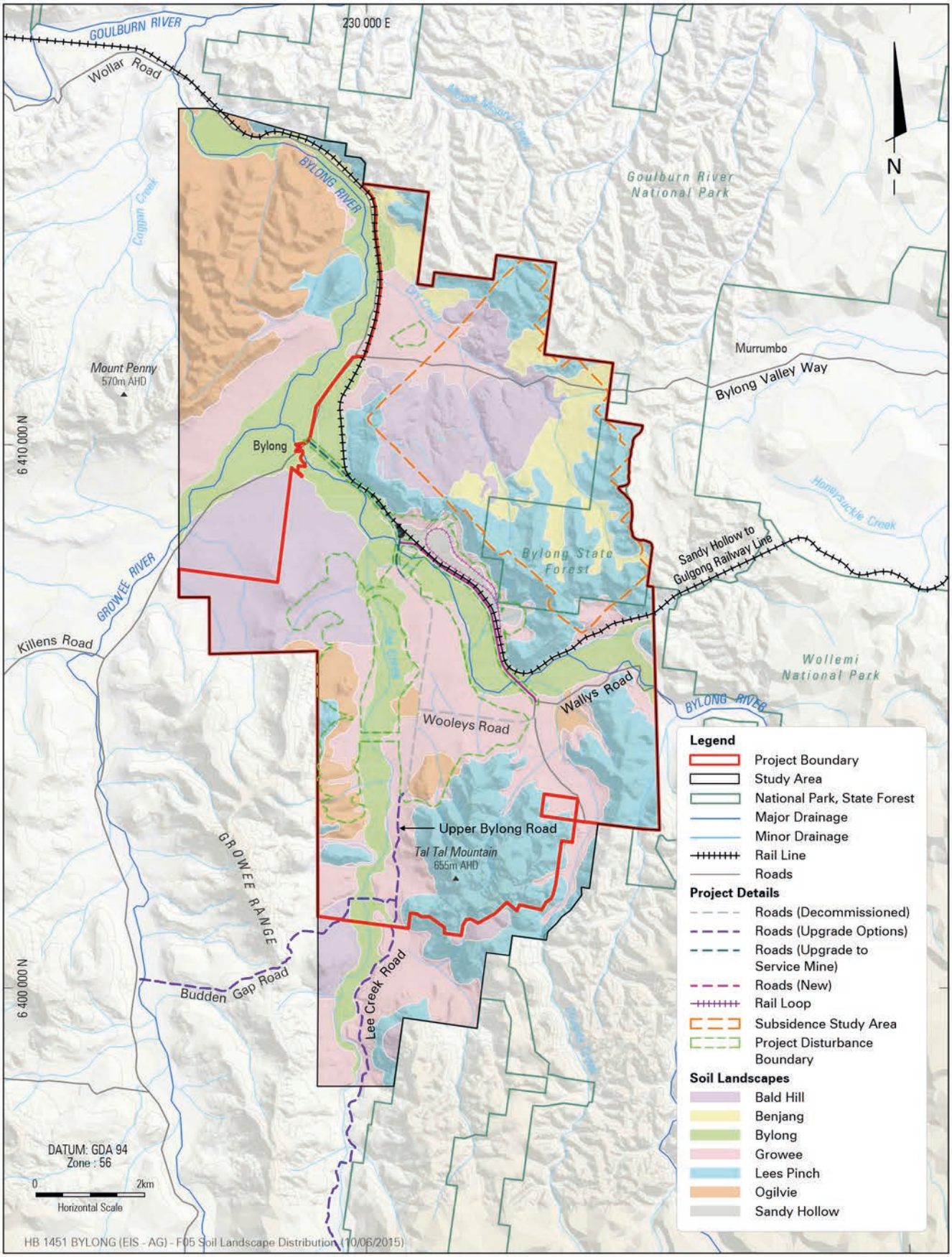
Benjang

The Benjang Soil Landscape Unit is associated with rounded rolling hills with large open valleys and some sandstone cliffs and occurs beside the more rugged Lees Pinch soil landscape in the east of the Study Area. It occurs on the Illawarra Coal Measures geological unit and the parent rock is shale, sandstone, conglomerate, mudstone, coal, tuff and some basalt. The rolling hills range in elevation from 240-440 m and are generally rounded with frequent outcrops of sandstone or conglomerate on the summits. The landform slopes are 10-25%.

The Benjang Soil Landscape Unit is a minor unit covering the lower slopes surrounding the Bald Hill Soil Landscape Unit in the north-eastern part of the Study Area. Soils on the steeper benched country have hard rocks and near horizontal bedding that has resulted in poor soil drainage. This soil landscape unit is typically suited to grazing enterprises.

Bylong

The Bylong Soil Landscape Unit is associated with alluvial flats and low terraces of the Bylong River and the Growee Creek in the vicinity of the Bylong Village. It occurs on the Quaternary alluvium geological unit and the parent material is alluvium. Elevations range from 260-320 m and the landform consists of low (<10 m) alluvial terraces with swampy hollows and abandoned channels. This soil landform provides a stable landscape with little erosion except for stream bank erosion along main drainage channels.



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Soil Landscape Distribution

FIGURE 5

The Bylong Soil Landscape Unit in the Study Area is a major unit covering the alluvial flats around the two main watercourses, which run in a north-south and east-west direction through the centre of the Study Area. This soil landscape unit is typically suited to cropping and grazing enterprises.

Growee

The Growee Soil Landscape Unit is associated with undulating rises and low hills, with broad, widely spaced shallow valleys. The small, closely spaced valleys occur in the areas of undulating low rises. The main valleys often have terraced alluvium near the drainage lines. This unit occurs throughout the Study Area primarily adjacent to the Bylong soil landscape unit. It occurs on the Illawarra Coal Measures geological unit and parent rock is shale, sandstone, conglomerate, coal, tuff and clay.

The Growee Soil Landscape Unit is a major unit within the Study Area covering the low hills and valleys surrounding the alluvial flats and is associated with the Bylong soil landscape unit. The slopes are generally less than 10% throughout the area and this soil landscape unit is typically suited to grazing enterprises.

Lees Pinch

The Lees Pinch Soil Landscape Unit is associated with rolling hills to steep mountains and generally covers the steep sections and rocky escarpments of the Great Dividing Range that surround the Bylong Valley. Summits are rounded or edged by sandstone cliffs, large sandstone outcrops occur on many hills, with occasional small plateaus, and narrow inaccessible valleys and gorges are common. It occurs on the Narrabeen Group geological unit and parent rock is lithic and quartz sandstone, conglomerate, green and red claystone, shale and siltstone. The slopes are up to 90%.

The Lees Pinch Soil Landscape Unit in is the dominant unit in the Study Area covering elevated regions with steeper slopes in the north-west, eastern and southern parts of the Study Area. This soil landscape unit is marginally suited to grazing enterprises or best left protected with green timber.

Ogilvie

The Ogilvie Soil Landscape Unit is associated with steep hills and escarpments with sandstone and conglomerate outcrops forming cliffs. The landscape is also characterised by deep ravines with sandstone rubble and is present as isolated pockets in the Study Area. It occurs on the Narrabeen Group geological unit and parent rock is sandstone, shale and conglomerate. The landform elevation ranges from 180-620 m, with slopes between 15-60%.

The Ogilvie Soil Landscape Unit is a minor unit covering smaller areas of land in the north-west, eastern and southern parts of the Study Area and is usually associated with the Lees Pinch soil landscape unit. This soil landscape unit may be marginally suited to grazing enterprises however is not generally suited to agricultural land use.

Sandy Hollow

The Sandy Hollow Soil Landscape Unit is associated with undulating terrain with smooth and gentle rises. It is associated with the Ogilvie and Lees Pinch soil landscape units as it grades into Lees Pinch on the steep slopes with cliffs and into Ogilvie on and Lees Pinch Soil Landscape Units as it grades into Lees Pinch on the steep slopes with cliffs and into Ogilvie on foot slopes. It is located on Quaternary colluvium derived from the Narrabeen Group and the parent rock is sandstone, shale and conglomerate. Slopes are generally less than 10% with lengths ranging from 100-250 m. There are some outcrops of sandstone and also narrow flat benches on the sandstone with small broken scarps.

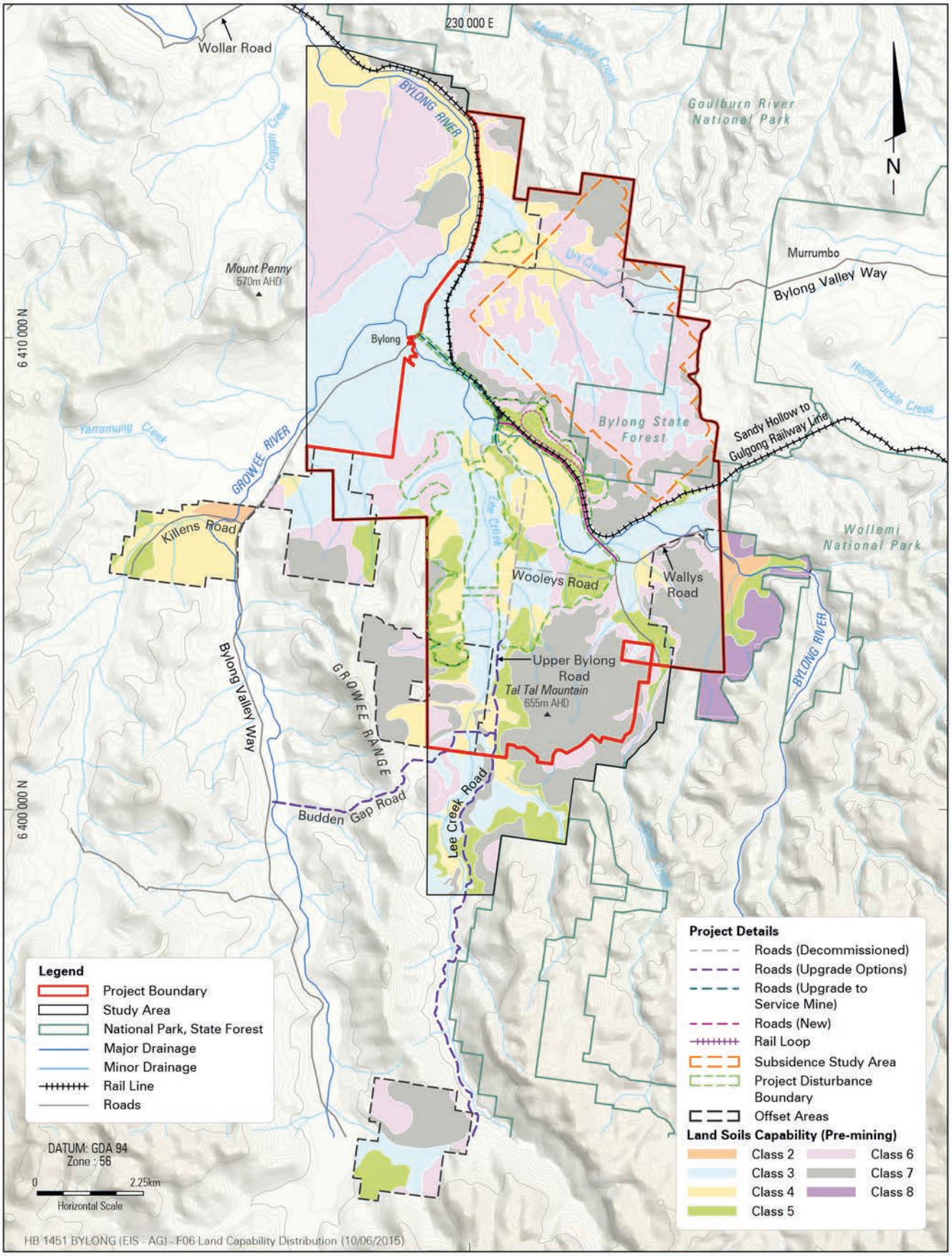
The Sandy Hollow Soil Landscape Unit is a very minor unit covering a small area in the central and eastern part of the Study Area that's grades into the Lees Pinch soil landscape unit. It is typically a slightly saline and sodic soil landscape. This soil landscape unit is typically suited to grazing enterprises.

3.3.3 Land and Soil Capability

Within the Study Area, LSC classes range from 3 to 7 (see **Figure 6**). **Table 9** summarises the LSC classes and their distribution in the Study Area and Project Boundary.

Table 9
Land and Soil Capability Distribution Summary

LSC	Study Area		Project Boundary	
	ha	%	Ha	%
Low to Very Low Capable Land				
Class 7	2,051.80	19.8	1,617.00	23.2
Class 6	2,891.70	28.1	1,680.70	24.3
Subtotal	**4943.5**	**47.9**	**3,297.70**	**47.5**
Moderate to Moderate-Low Capable Land				
Class 5	1,293.80	12.6	884.9	12.8
Class 4	1,273.50	12.3	818.1	11.8
Subtotal	**2,567.30**	**24.9**	**1,703.00**	**24.6**
Highly Capable Land				
Class 3	2,806.20	27.2	1,957.00	27.9
Subtotal	**2,806.20**	**27.2**	**1,957.00**	**27.9**
Total	**10,317.00**	**100**	**6,957.70**	**100**



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Land Capability Distribution

FIGURE 6

The key findings from the LSC assessment include:

- Almost half of the Study Area 4,944 ha (47.9%) and Project Boundary 3,298 ha (47.5%) is suited to low - very low impact agricultural land uses. These areas consist of Class 6 land, which is suitable for a limited set of land uses and is restricted to low-impact land uses such as grazing, forestry and nature conservation and Class 7 land, which is very-low capability land generally incapable of agricultural use;
- Approximately a quarter of the Study Area 2,567 ha (24.9%) and Project Boundary 1,703 ha (24.6%) is suited to moderate to moderate-low impact agricultural uses. This consists of Class 4 land, which is suitable for cropping with restricted cultivation. Strict land management is required for regular high-impact uses such as cropping, high-intensity grazing or horticulture. Class 5 land makes up the remainder and is moderate-low capable land that is largely restricted to grazing, some horticulture and forestry; and
- Just over a quarter of the Study Area 2,806 ha (27.2%) and Project Boundary 1,957 ha (27.9%) is capable of high intensity land uses and is suitable for a range of agricultural uses including high-impact land uses such as cropping with cultivation.

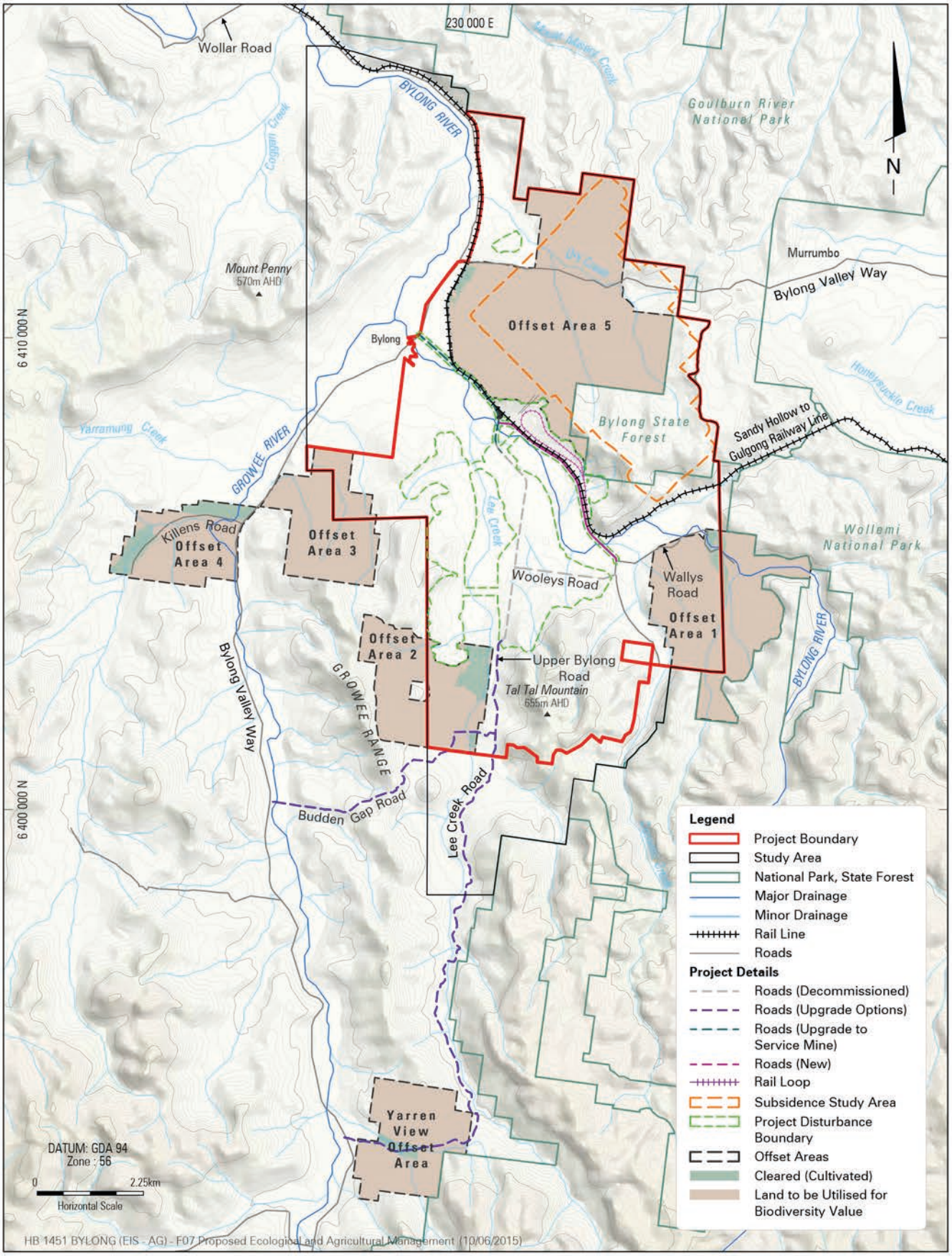
3.3.4 Biodiversity Offset Areas

The *Biodiversity Offsets Report* (Cumberland Ecology, 2015) completed for the Project, broad-scale soils mapping and observations from land managers in the region have indicated that the land and soil capability classes on the Biodiversity Offset Areas are similar to those experienced within the Study Area. As such they are primarily suited to grazing activities, with limited opportunities for cropping and improved pastures.

The areas of Cultivated Lands identified within any of the Biodiversity Offset Areas will remain available for their current and previous agricultural purposes. Therefore 282 ha of regularly cultivated monoculture areas will remain available and dedicated to ongoing agricultural activity within the Biodiversity Offset Areas. These areas are outlined in **Table 10** and illustrated on **Figure 7**.

Table 10
Cultivated Lands within Biodiversity Offset Areas

Offset Property	Total Offset Areas(ha)		Cultivated Land to Continue to be Managed for Agricultural Activities		Remainder of Offset Area to be managed for Biodiversity Value	
	ha	%	ha	%	ha	%
Offset Area 1 (ha)	762	19	73	26	689	18
Offset Area 2 (ha)	526	13	105	37	421	11
Offset Area 3 (ha)	458	11	0	0	458	12
Offset Area 4 (ha)	380	9	69	24	311	8
Offset Area 5 (ha)	1,513	37	13	5	1,500	39
Yarran View Offset Area (ha)	443	11	22	8	421	11
Total	**4,082**	**100**	**282**	**100**	**3,800**	**100**



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Proposed Ecological and Agricultural Management of Biodiversity Areas

FIGURE 7

LSC classes have been developed for the sections of the Biodiversity Offset Areas located outside the Study Area. **Table 11** and **Figure 6** illustrate the total area of each LSC class across the land occupied by the Biodiversity Offset Areas.

Table 11
Estimated Land and Soil Capability Distribution Summary on Biodiversity Offset Areas

LSC Class	Offset Area	
	ha	%
Class 2	104	3
Class 3	750	18
Class 4	587	14
Class 5	320	8
Class 6	997	24
Class 7	1,091	27
Class 8	232	6
Total	**4,082**	**100**

3.4 Biophysical Strategic Agricultural Land

The Upper Hunter SRLUP published regional mapping of potential BSAL areas. This regional scale mapping was used to provide an indication of areas within the Study Area that potentially have strategically significant agricultural value and to guide the in-field verification assessment of these resources. **Figure 8** illustrates the areas of BSAL mapped as potentially occurring within the Study Area. As part of the Soils Assessment the regional mapping was verified against the BSAL criteria (SLR, 2015). This methodology uses a two-phase verification assessment:

- Phase 1 – Confirm access to reliable water supply; and
- Phase 2 – 12 step site verification criteria.

As the Upper Hunter SRLUP states that reliable water supply has been verified for the Study Area and surrounding locality only the 12 step site verification was undertaken.

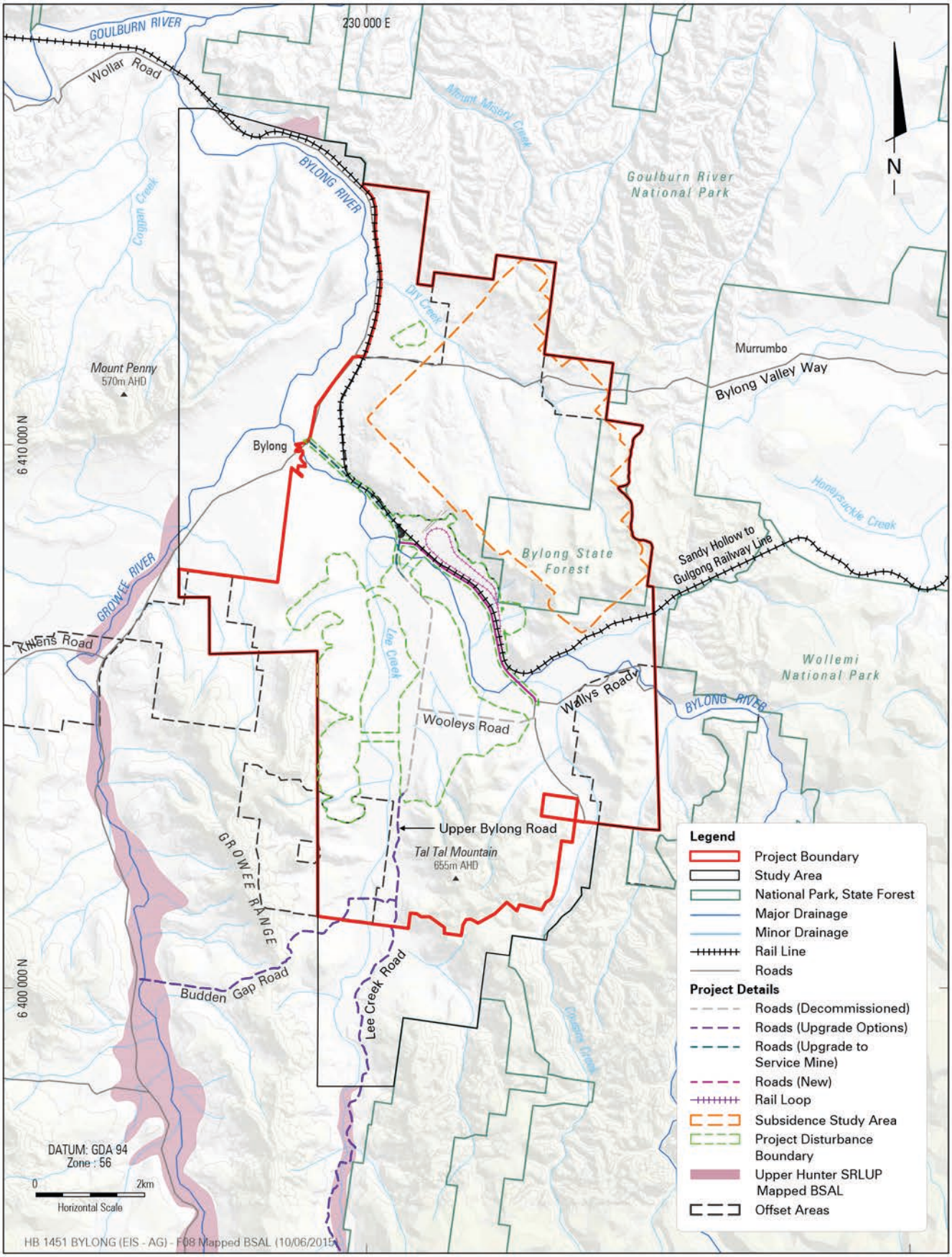
3.4.1 Study Area Verified Biophysical Strategic Agricultural Land

The Soils Assessment confirmed 2,366 ha of land within the Study Area and 1,675.9 ha of land within the Project Boundary to be verified BSAL (SLR, 2015). The key findings from this assessment are:

- Approximately one quarter of the Study Area 2,366 ha (23.0%) and Project Boundary 1,676 ha (24.1%) was determined to be BSAL in that it meets all the relevant site verification criteria;
- Generally BSAL in the Study Area is associated with the alluvial influenced deep non-saline Black Dermosol soil units on very gently inclined land. Surprisingly some basaltic influenced Red Dermosols on elevated gently inclined land were also assessed as BSAL, as well as some deep Red Chromosols on the sedimentary derived Growee Soil Landscape Unit;
- The remainder of the Study Area has been assessed as non-BSAL. This included moderately to steeply inclined land, poorly developed or shallow soils, low fertility soils and soils with subsoil constraints such as sodicity and salinity; and

- Of the area identified as non-BSAL, approximately half of the Study Area and Project Boundary had unfavorable slope inclines; one-tenth contained unfavorable chemical limitations; and fertility and physical limitations largely composed the bulk of the remaining limitations.

Table 12 summarises the main criteria limitations (for discounting land as BSAL) and verified BSAL distribution across the Study Area. **Figure 9** illustrates the site verified distribution of BSAL across the Study Area and Project Boundary.



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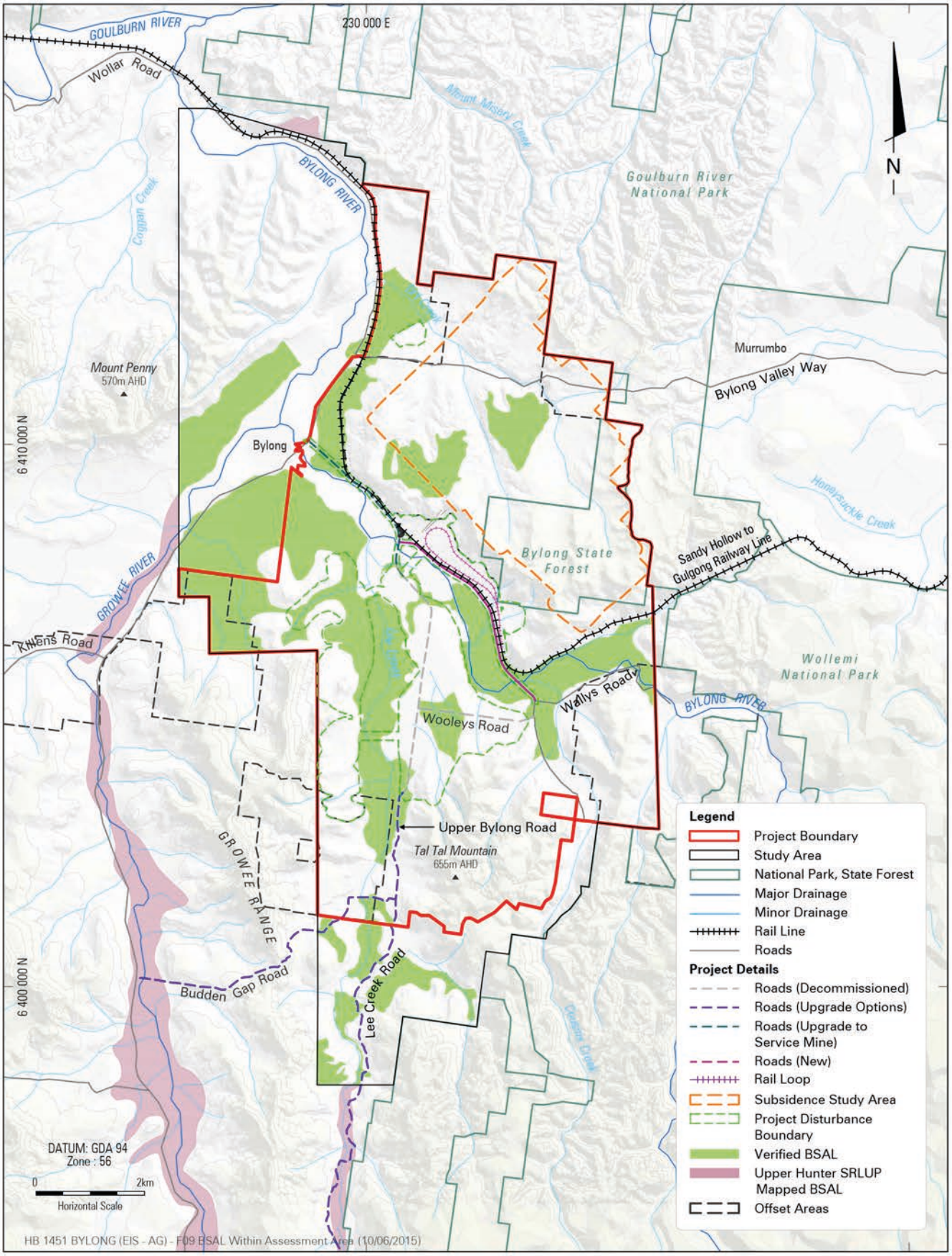
Upper Hunter - Mapped SRLUP BSAL

FIGURE 8



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BSAL Within Assessment Area

FIGURE 9

Table 12
BSAL Distribution and Verification Assessment Summary

BSAL by limitation	Study Area		Project Boundary	
	ha	%	ha	%
Areas failing to meet BSAL verification criteria				
Land Area (<20 ha)	16.9	0.2	10.9	0.1
Chemical	1,255.0	12.0	691.2	10.0
Fertility	813.6	8.0	588.1	8.3
Physical	684.2	6.7	547.3	7.9
Slope (> 10%)	5,181.3	50.1	3,444.3	49.6
Subtotal	**7,951.0**	**77.0**	**5,281.8**	**75.9**
Area of verified BSAL				
No limitations	2,366.0	23.0	1,675.9	24.1
Subtotal	**2,366.0**	**23.0**	**1,675.9**	**24.1**
Total	**10,317.0**	**100.0**	**6,957.7**	**100.0**

The Upper Hunter SRLUP BSAL mapped in the Study Area is 1,610 ha. The property scale field verification assessment has shown that there is a larger amount of BSAL present, with over 2,366 ha conforming to the BSAL criteria within the Study Area. The verified BSAL does not completely mirror the Upper Hunter SRLUP BSAL mapping as this was regional mapping largely covering the Bylong Soil Landscape Unit at a publication scale of 1:250,000.

The local field verification assessments found that some soil units associated with the Bylong Soil Landscape Unit contained physical or chemical limitations, which preclude them from being verified BSAL. However, the site inspection identified further land beyond the soil associated with the Bylong Soil Landscape Unit that is good quality agricultural land associated with igneous parent material. This land occurs in the east and in the west of the Study Area, therefore increasing the overall quantity of BSAL in the Study Area.

3.4.2 Biodiversity Offset Areas Potential BSAL

As part of the Project, a significant amount of land within the Bylong River catchment will be managed primarily for biodiversity conservation outcomes, which will provide material flow on improvements to water quality outcomes within the catchment. The Biodiversity Offset Areas comprise six parcels of land totalling 4,082 ha. Of this 2,226 ha falls within the Study Area. The BSAL within the Study Area has been verified as part of the Soils Assessment. For the remaining land within the Biodiversity Offset Areas and outside of the Study Area, the Upper Hunter SRLUP mapping has been relied upon to identify BSAL.

The area of BSAL within the Biodiversity Offset Areas is quantified in **Table 13** and illustrated on **Figure 9**.

Table 13
Potential BSAL Biodiversity Offsets Distribution Summary

Area	Mapped BSAL Outside the Study Area		Verified BSAL within the Study Area		Total BSAL	
	ha	%	ha	%	ha	%
Offset Area 1	-	-	16.69	4.11	16.69	3.43
Offset Area 2	-	-	55.12	13.57	55.12	11.34
Offset Area 3	-	-	94.07	23.16	94.07	19.35
Offset Area 4	28.81	36	0	0.00	28.81	5.92
Offset Area 5	-	-	240.32	59.16	240.32	49.42
Yarran View	51.24	64	0	0.00	51.24	10.54
Total	**80.05**	**100**	**406.2**	**100.00**	**486.25**	**100.00**

Of the total 486.25 ha of mapped and verified BSAL within the Biodiversity Offset Areas, 109.44 ha of BSAL within Offset falls within the cultivated lands described in **Table 10** and **Section 3.3.4**. These areas will continue to be managed as agricultural activity.

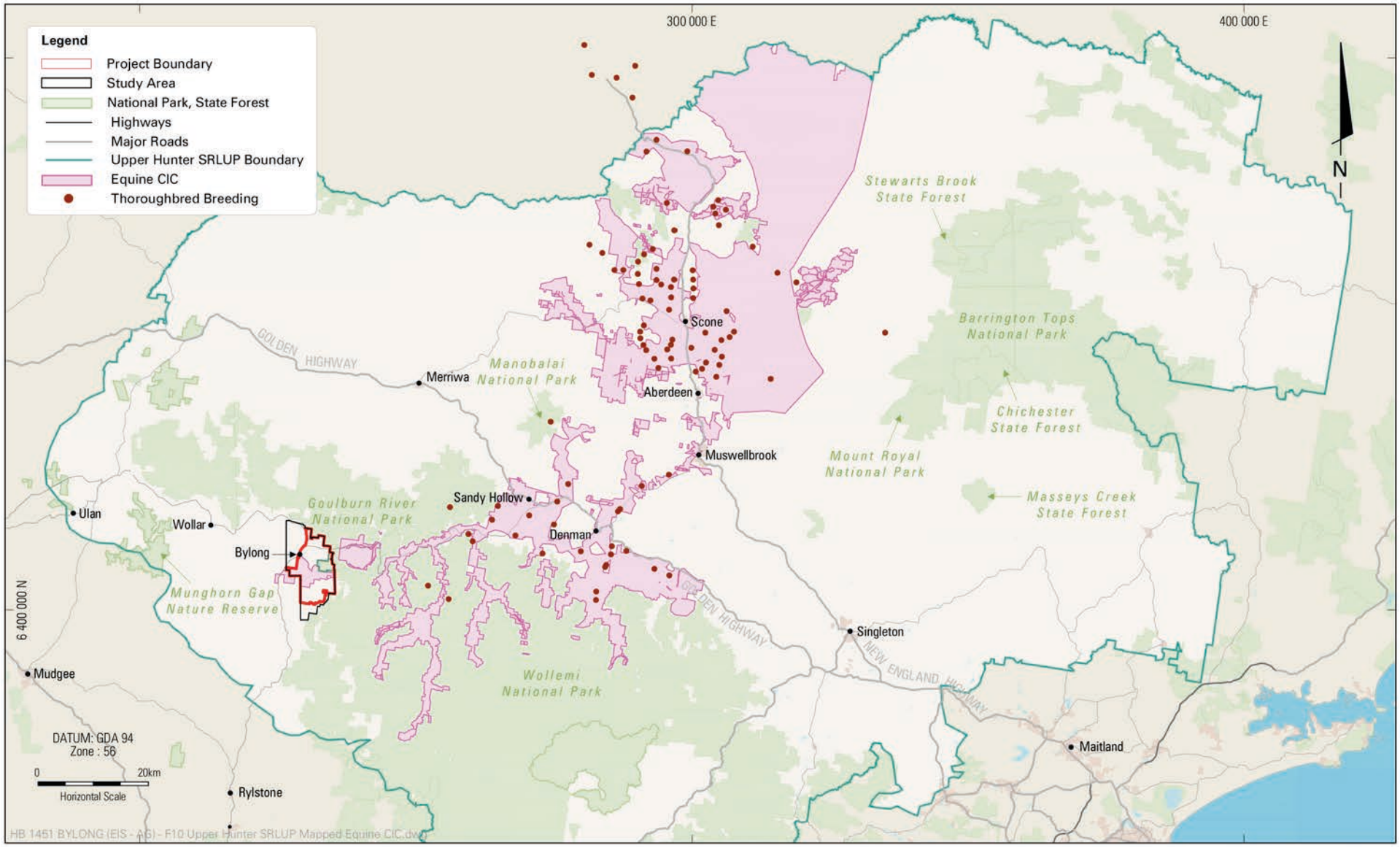
The remaining 376.81 ha of mapped and verified BSAL within the Biodiversity Offset Areas which contains suitable biodiversity attributes, will be managed in order to facilitate the gradual migration away from agricultural uses to biodiversity conservation so as to enhance its biodiversity values into the medium to long term. In particular one of the Biodiversity Offset Areas has been identified by OEH in its letter dated 5 September 2014 as potentially being acceptable for inclusion in the NSW National Park Estate.

3.5 Equine Critical Industry Cluster

The Upper Hunter SRLUP identifies areas of Viticulture and Equine CICs across the Upper Hunter region and the Bylong–Wollar–Ulan corridor (total area of 2.41 million ha) (see **Figure 10**). The January 2014 dated Finalised Upper Hunter SRLUP CIC mapping indicates there is a total of 254,900 ha of Equine CIC, of which 2,400 ha is located within the Agricultural Assessment Areas (see **Figure 11**). The total area of Equine CIC within the Agricultural Assessment Areas accounts for 0.94 % of the total Equine CIC mapped within the Upper Hunter SRLUP region.

Of this approximately 2,400 ha of Equine CIC land located within the Agricultural Assessment Areas, 1,933 ha is located within the Study Area. There is a total of 584 ha located within the Biodiversity Offset Areas, 117 ha of which lies within the Study Area. The Study Area accounts for 0.75 % and the Biodiversity Offset Areas accounts for 0.23 % of the total land mapped as Equine CIC within the Upper Hunter SRLUP region.

The area of Equine CIC mapped as occurring within the Bylong Valley is located on the south-western extremity of the mapped Equine CIC. The Upper Hunter SRLUP identifies that the relevant thoroughbred horse breeding industry is focused around Scone, which is now one of the major horse breeding areas in the world with over 70 studs in this specific concentrated area. In 2009-2010 the Scone area accounted for 80 to 90% of the total value of stud horses exported by Australia. The SRLUP states the following:



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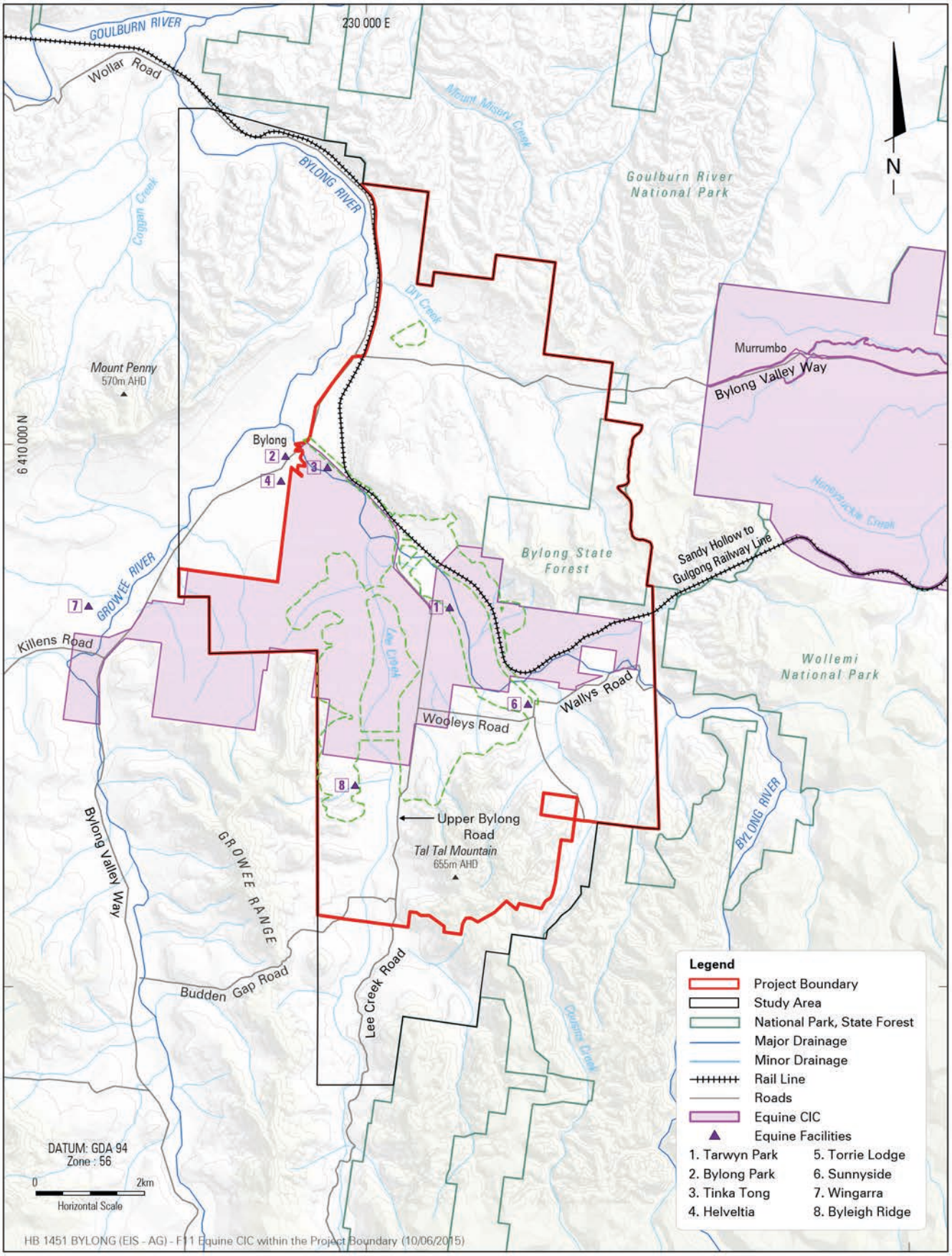
Upper Hunter - SRLUP Mapped Equine CIC

FIGURE 10



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Equine CIC within the Project Boundary

FIGURE 11

> '*The horse breeding cluster includes a highly integrated concentration of horse breeding facilities and related infrastructure covering thoroughbred and stock horse breeding centres and numerous other equine developments and support services, such as a specialised veterinary centres*' (Upper Hunter SRLUP, 2012)

The mapped Equine CIC located in the Bylong Valley is an isolated pocket located at the absolute extremity of the mapped Equine CIC, approximately 1½ hours' drive from the equine centre of Scone. **Figure 10** illustrates the isolated location of the mapped Equine CIC within the Study Area in relation to the key equine region at Scone. In addition the figure illustrates the relevant thoroughbred horse breeding studs and key industry enterprises located a substantial distance from the Bylong Valley corridor.

3.5.1 Study Area

There are facilities within the Study Area, which have been historically used by sectors of the equine industry. Properties currently mapped as Equine CIC include:

- Tarwyn Park (Owned by KEPCO);
- Tinka Tong (In private ownership at the time this report was prepared);
- Individual properties which are part of the Walling's aggregation (Owned by KEPCO) including:
    - A portion of Torrie Lodge (located outside the Project Boundary and within the Biodiversity Offsets);
    - A small portion of Harley Hill;
    - Sunnyside (located both within the Project Boundary and outside);
    - Almerta;
    - Homeleigh; and
- Wingarra (In private ownership at the time this report was prepared).

The portion of Torrie Lodge mapped as Equine CIC is located outside the Study Area. However this area is located within part of Biodiversity Offset Area 4. Sunnyside is located within and adjacent to the Study Area. A portion of Sunnyside is located outside the Study Area and will make up part of Biodiversity Offset Area 2. The location of mapped Equine CIC within the Study area and Biodiversity Offset areas is illustrated on **Figure 11**Murrumbo (in private ownership at the time this report was prepared), which is also mapped as Equine CIC, is located within an approximate 2 km radius of the Study Area. This property will largely be screened by the steep topography and rocky escarpments associated with the Great Dividing Range, which surround the Project. As the property is also approximately 4 km from the Project Disturbance Boundary it will not be impacted by the Project and has not been considered further in this assessment.

As part of this AIS, an assessment has been undertaken on each of the identified properties to determine the relevant land use history, recent land use practices and any specialist infrastructure relevant to the equine activities.

This assessment included:

- Desktop analysis of equine related agricultural activities within the Assessment Areas and surrounding locality;
- A site visit to Bylong in September 2013 to assist in reviewing current equine industry practices and infrastructure within the Study Area and surrounding locality;
- Individual land manager interviews to confirm current equine enterprises located within the area in question;
- Discussions with Australian Stock Horse Association (ASHA) and a detailed review of their website;
- Interviews with MWRC staff and a detailed review of their website
- Interviews with NSW DPI staff including District Livestock Officer (Beef Cattle) and immediate past District Agronomist;
- Desktop analysis of the value of agricultural production from Bylong, and enterprises in the locality; and
- Desktop assessment of the value of agricultural production associated with the Assessment Areas.

Tarwyn Park

Tarwyn Park is located within the central eastern portion of the Study Area. Historically the property was the first to implement and demonstrate the land management concept of Natural Sequence Farming.

Historically Tarwyn Park was set up as a horse stud, spelling and training facility in the 1930s. The property became famous from 1927 to 1939 as the home of the renowned thoroughbred horse, Heroic, who won 21 races and was a leading Australian sire to the Melbourne Cup winner Hall Mark (1933). Horse breeding was continued on the property after it was sold in 1975 with the new owners bringing with them a number of horses from South Australia, including Rain Lover, who won the Melbourne Cup in 1968 and 1969. Rain lover remained at Tarwyn Park as a breeding Stallion until his death when he was buried on the property. Tarwyn Park Farm Complex is well-known for its association with thoroughbred horses of exceptional quality, including a number of Melbourne Cup winners (AECOM, 2015)

The remaining equine related infrastructure includes:

- A stable complex comprising 14 stable and associated facilities;
- A stable complex of 16 stables in fair to poor condition;
- Covered round yard; and
- Steel and post and railing fencing which provides a disused 2000m training track.

In approximately 2005, equine related activities including the horse stud, ceased operation at Tarwyn Park. Current land use within the Tarwyn Park property is cattle breeding and grazing supplemented by fodder cropping.

Tinka Tong

Tinka Tong is located within the Study Area directly adjacent to the Bylong township. This property is utilised as an Australian Stock Horse stud run in conjunction with a beef cattle enterprise. Observations from public roads indicate that Tinka Tong has limited but adequate horse infrastructure for a small scale horse enterprise.

Australian Stock Horse Association records showed that as of 28 October 2013 Tinka Tong Stud had 13 horses registered with the Australian Stock Horse Association (ASHA). It is noted that there is potential that the ASHA register may not be completely up to date and therefore may include animals which have died or have been sold.

Walling's Aggregation

The entire Walling's aggregation comprises nine smaller previous independent holdings that have been acquired and aggregated over the past 40 years by a prominent beef cattle grazier. As previously outlined, of the aggregation only a portion of Torrie Lodge, a small portion of Harley Hill, Sunnyside, Almerta and Homeleigh are mapped as Equine CIC.

These properties have a number of equine related infrastructure areas related to previous land use and owners including:

- Helvitta complex - Machinery shed/stable complex comprising eight stables and associated facilities;
- Torrie Lodge -Stable complex and part covered day yards, and
- Sunnyside - Stable complex comprising 12 stables and associated facilities.

The current land use of the Walling's Aggregation is beef cattle, fodder cropping and conservation (Lucerne, and oats) and opportune winter cereal cropping. The broader landholding making up the Walling's aggregation is not used for horse breeding, horse husbandry, horse sales or forage sales directly to registered horse breeders.

3.5.2 Surrounding Locality

The in-depth desktop assessment, including searches of various business directories and discussions with the NSW DPI staff revealed there are no significant equine related facilities recorded within the Bylong Valley. According to current business and landuse records there are no:

- Horse breakers;
- Horse trainers;
- Farriers; or
- Equine veterinarians.

Interrogation of the MWRC LGA website and discussion with Council officers on 19 March 2015 show that within the Bylong Valley there have been no equine related developments approved from September 2013 to present nor are there any equine related developments awaiting determination.

Under the proposed land management practices within the Biodiversity Offsets Areas, Equine CIC infrastructure and heavily cultivated areas containing exotic pastures will remain available for their current and previous agricultural purposes.

It is only the areas of ecologically valuable native vegetation that will have intensive agricultural activities such as equine production excluded from them.

3.6 Hunter Unregulated and Alluvial Water Source

The Project Boundary is located within the catchment of the Bylong River, a tributary of the Goulburn River, which in turn is a tributary of the Hunter River. The Bylong River drains generally northwards, from the south-east, through the Project Boundary. A number of tributaries feed into the Bylong River throughout the Project Area, including:

- Wattle Creek;
- Cousins Creek;
- Lee Creek;
- Growee River;
- Dry Creek; and
- Coggan Creek (WRM, 2015).

A number of bores are present within the zone of drawdown predicted by the model around the mining area. However the majority of these bores are located on land owned by KEPCO. No licenced bores are predicted to be impacted on land not owned by the proponent. However, there are a number of unregistered bores that lie within the zone of depressurisation.

The WSP report card for the Bylong River water source indicates the area has a total groundwater entitlement of 5,843 ML/year (100% used for irrigation purposes). There are 23 groundwater licences in the area for agricultural purposes which are primarily extracted from the Quaternary alluvium. An in-field bore census survey undertaken as part of the Groundwater Impact Assessment identified 84 sites comprising:

- Nine bores;
- Two government monitoring bores;
- 69 wells; and
- Four sites unable to be identified.

The extensive pumping required from the borefield during the early stages of the Project depressurizes the alluvium and results in an increase in flow from the Permian to the alluvium aquifer to a peak of -71 ML/year during Project Year 3. As open cut mining operations progress, the Permian is depressurised around the open cut mining areas, reducing this effect and leading to a reduction in flow from the Permian to the alluvial aquifer. The annual total water take from the alluvial groundwater systems due to mining, averages 153 ML/year (peak of 295 ML/year) with a total of 3,829 ML at the end of mining in Year 25(AGE, 2015).

KEPCO has secured 2,535 units of water allocation from the Bylong Water Source under the Hunter Unregulated and Alluvial WSP. Water will be utilised from the alluvial water sources, which is comprised of interception of water due to mining and pumping from the proposed borefield. The proponent holds sufficient entitlements to account for its water use even if the available water determination (AWD) reduces to less than 80% (AGE, 2015).

3.7 Agricultural History

William Lawson and James Blackman were the first Europeans to explore the Bylong district setting out from Bathurst in 1822 heading out along the Goulburn River. For much of its early history, land within the Bylong Valley was occupied by a handful of pioneering families with the two most significant being the Lee and Tindale families.

Historical land settlement throughout Bylong's early settlement was dominated by pastoral activities. Initially sheep were grazed throughout the area; however, it was soon recognised for its potential for cattle and thoroughbred horses (Barrie 1967). Further, the Bylong Valley was also well known for its production of crops such as Lucerne, Rye Prairie and English grasses.

In 1918, Herbert Thompson, part of the Thompson horse breeding family from Widden, purchased part of John Lee's old estate in Bylong. He called this property Tarwyn Park, which became famous in the period between 1927 and 1939 as the home of the famous thoroughbred racehorse "Heroic". The Thompson family also purchased Wingarra and Torrie Lodge in the 1920s, followed by Bylong Station and later Sunnyside, considerably increasing their stud holdings in Bylong. The Thompson studs produced a large number of thoroughbreds from their properties in Bylong and Widden. Herbert Thompson became one of Australia's greatest horse breeders and was a founding member of the Sydney Turf Club. After his death in 1955, the Thompsons reduced their thoroughbred breeding activities across the Bylong stud properties.

Land use in the Bylong Valley has remained unchanged from the 1830s and still retains its pastoral and grazing focus. Aside from a commercial cheese factory in the early twentieth century and the various general stores, commercial developments in Bylong have been limited.

3.8 Bylong State Forest

The Bylong State Forest is located to the central eastern side of the Project Boundary which also links to the more extensive Goulburn River National Park (north-east of the Project Boundary) and the Wollemi National Park (east of the Project Boundary). Bylong State Forest includes 652 ha of hardwood forests.

The forestry land within Bylong State Forest would historically have been used for timber harvesting. Despite this, the Bylong State Forest is predominately comprised of native vegetation and still retains significant values for native flora and fauna. The residual areas of land comprise largely intact forest and woodland. Much of this land has remained intact due to the inaccessibility resulting from steep terrain.

4 Existing Agricultural Enterprises and Resources

This chapter identifies and describes the existing agricultural resources and enterprises within the Assessment Areas. These agricultural resources and enterprises are shown on **Figure 12**.

4.1 Agricultural Enterprises

The information presented in this section is based on individual land manager interviews completed 10 and 11 June 2014 for agricultural enterprises and represents what is current agricultural practice on the land in question. It is noted that the existing land management practices do not always align fully with the land capability or agricultural suitability of the individual sections of the properties in question. In particular the utilisation of the Study Area by the equine industry has diminished substantially over the past several decades with a trend towards beef cattle production and fodder production. The agricultural value of the enterprises identified are discussed in more detail in **Section 0** of this report.

4.1.1 Surrounding Locality

In general, agricultural activities in the surrounding locality include:

- Beef Cattle grazing;
- Fodder Cropping
- Improved Pastures
- Irrigated cropping; and
- Equine activities (Australian Stock Horse and pleasure and performance horses).

Further afield in the general MWRC LGA wine grape production, sheep enterprises and horse breeding and husbandry is also carried out.

4.1.2 Study Area

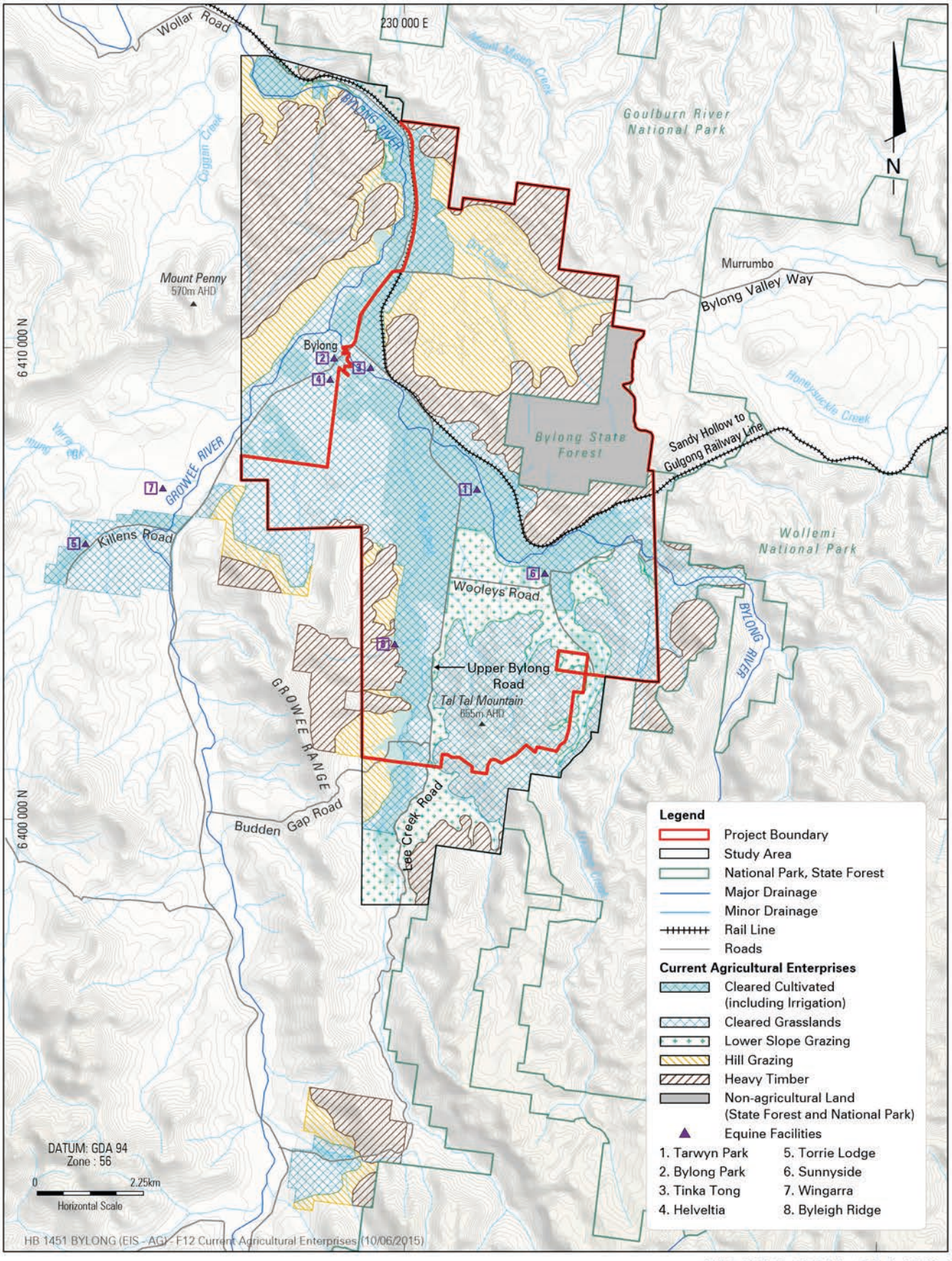
The current enterprises operating within the Study Area and the carrying capacity of each have been sourced by KEPCO from applicable land-holders as commercial-in-confidence documents. As such not all information has been disclosed in the AIS. Agricultural enterprises within the Study Area reflect the general agricultural land use of the regional locality.

The predominant enterprise within the Study Area is beef cattle grazing supported by fodder cropping (oats, lucerne, millet and forage sorghum) and improved pastures on the better quality land and larger holdings. This typically reflects the enterprises found in the northern end of the Bylong Valley (where the Project is located), which is generally representative of cattle breeding with a lesser emphasis on lucerne hay production and fodder cropping.

There are no thoroughbred breeding enterprises currently within the Study Area or within a 2km radius. There is a number of small equine horse breeding and husbandry enterprises (including an Australian Stock Horse stud) situated within the study area most of which also run beef cattle. These enterprises and their associated properties are discussed further in the context of the Equine CIC in **Section 3.5**.

Further examination of the agricultural productivity (quantum and value) generated by current agricultural enterprises within the Project is detailed in **Section 4.4**.

The spatial distribution of agricultural enterprises is shown in **Table 14** and **Figure 12**.



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Current Agricultural Enterprises

FIGURE 12

Table 14
Current Agricultural Enterprises within the Study Area

Enterprise	Study Area (ha)	Area (%)
Arable including irrigation areas	3,331	32.3
Lower slope grazing only	1,007	9.8
Hill grazing	1,763	17.1
Heavily timbered	3,691	38.1
Non-agricultural use	525	5.1
Total	**10,317**	**100.0**

4.1.3 Biodiversity Offset Areas

Agricultural enterprises within the Biodiversity Offset Areas are of a similar nature to those within the Study area as all offsets are located within a 10 km radius of the Project Disturbance Boundary. Further examination of the agricultural productivity (quantum and value) generated by current agricultural enterprises within the Biodiversity Offset Areas is detailed in **Section 4.4**.

The spatial distribution of agricultural enterprises across all of Biodiversity Offset Areas is shown in **Table 15** and **Figure 12**. As 2,226 ha of the Biodiversity Offset Areas are located within the Study Area, these portions have also been addressed as part of **Section 4.1.2**.

Table 15
Current Agricultural Enterprises within the Biodiversity Offset Areas

Enterprise	Total Area within Offsets (ha)	Area (%)
Arable including irrigation areas	1,108	27.14
Lower slope grazing only	40	0.98
Hill grazing	1,275	31.23
Heavily timbered	1,659	40.64
Non-agricultural use	0	0.00
Total	**4,082**	**100.00**

4.2 Supporting Infrastructure and Services

Agricultural enterprises in the locality are supported by a range of general and specialist services and infrastructure. Agricultural input suppliers that service Bylong Valley are located in the surrounding towns of Mudgee (95 km from Bylong), Rylstone (52 km) and Denman (71 km) by road in the Hunter Valley.

Agricultural industries in the locality rely on a range of services provided in the Central West and Upper Hunter LGAs. These include input supplies (fertilizer, seed, chemicals, animal health and agricultural hardware), agricultural equipment suppliers, irrigation suppliers and technicians, heavy and light engineering works, veterinary practices, grain marketers, and professional services (accountancy, financial, legal and agricultural consultancy). Mudgee is the closest large regional centre and serves as an agricultural service centre to the locality.

It was estimated by the DPI that 50% of the cattle produced in Bylong Valley are sold out of paddock direct to abattoirs or feedlots. The major abattoirs are located at Scone (121 km), Singleton (140 km) and Tamworth (250 km). The remaining 50% are sold through local sale yards, being Mudgee, Scone and Singleton.

The regional and local road network is used to transport all agricultural inputs and outputs from the Bylong valley and forms a vital connection to the agricultural network at Mudgee, Rylstone and the Upper Hunter (**Figure 2** and **Figure 3**).

The Bylong Valley Way forms the main regional roadway and runs north south through the Bylong valley. Within the Project Boundary, there are a number of smaller rural local roads that provides access to the various properties. These include:

- Upper Bylong Road;
- Lee Creek Road;
- Wooleys Road;
- Wallys Road; and
- Wollar Road.

The Sandy Hollow to Gulgong Railway Line runs through the northern section of the Study Area and is proposed to be used for the transport of coal from the Project to the Port of Newcastle (**Figure 1**). This rail line is not used for the transport of agricultural products or inputs. However, this line joins the Great Northern Railway Line at Muswellbrook, which is used for the bulk and containerised commodity transport (mainly cereal grains) from the north-west region to the Port of Newcastle. Australian Rail Track Corporation (ARTC) is responsible for the management of rail movements on the Great Northern Railway Line with demands from various rail users.

4.3 Agricultural Resources

The significant agricultural resources in the locality of Bylong include:

- BSAL;
- Equine CIC;
- The Bylong River alluvium and its highly productive groundwater resources;
- Alluvial influenced deep non-saline Black Dermosol soil units on very gently inclined land; and
- Deep Red Chromosls on the sedimentary derived Growee soil landscape.

4.4 Agricultural Value

The Project is situated within the MWRC LGA and just to the west of the Muswellbrook LGA and Upper Hunter LGA which are part of the hunter region. Agriculture, viticulture, mining and tourism are important driving industries in the MWRC LGA that together with Mudgee's expanding retail, service and commercial sectors, provides a growing employment base for a diverse economy. The value of agricultural output and contribution of each agricultural enterprise in the MWRC LGA is outlined in **Table 16**.

Table 16
Value of Agricultural Production

Resource	MWRC LGA (per annum)	NSW (per annum)	Australia (per annum)
Total agricultural production	$64.70 M	$12,128.2 M	$ 48,048.00 M

Source: ABS, 2008; ABS 2011, ABS 2014

Therefore the Gross annual value of Agriculture in the MWRC LGA is $65 Million per annum, NSW is $12,128 Million per annum and Australia $48,048 Million per annum.

4.5 Employment

As part of the EIS a Social Impact Assessment (SIA) has been undertaken by Hansen Bailey which documents the socio-economic impacts associated with the Project. As part of the SIA, a detailed assessment of the labour market dynamics has assessed the existing industry employment statistics relevant to the Project. Employment statistics within the mining sector in the MWRC LGA is outlined in **Table 17**. The key findings of the labour market dynamics assessment indicate:

- Mining was the top employing industry in the MWRC LGA in 2011 (13.8%) compared to 1.6% in NSW;
- Within the MWRC LGA, the proportion of people employed in the mining industry sector was significantly higher in Rylstone (17%), Kandos (15.3%) and Mudgee (14.9%);
- In the MWRC LGA, retail trade was the second largest industry of employment at 12.9% (NSW=8.3%), followed by agriculture, forestry and fishing at 9.5% (NSW = 2.9%);
- The Breakfast Creek State Suburb (Breakfast Creek) is the smallest ABS geographical area which includes the Bylong Valley. In Breakfast Creek the agriculture industry sector accounted for 42.3% of employment; and
- Mudgee showed a diverse spread of industries, commensurate with the profile of a regional service town.

Table 17
Employment in Mining, MWRC LGA, 2006 and 2011

Mining Type	No of people employed	
	2006	2011
Coal Mining	458	1,119
Mining (no further detail)	14	48
Oil and Gas Extraction	0	0
Metal Ore Mining	18	33
Non-Metallic Mineral Mining and Quarrying	9	41
Exploration and Other Mining Support Services	105	48
Total	**604**	**1,289**

As shown in **Table 18**, in the MWRC LGA, the highest proportion of employment associated with agriculture lies with the beef, sheep and viticulture sectors (ABS, 2006).

Table 18
MWRC LGA Agricultural Industry Employment

Employment Sector	Number	Percentage
Agriculture	26	2.4
Nursery and Floriculture Production	4	0.4
Nursery Production (Outdoors)	4	0.4
Vegetable Growing (Outdoors)	3	0.3
Grape Growing	131	12.3
Stone Fruit Growing	3	0.3
Olive Growing	10	0.9
Sheep, Beef Cattle and Grain Farming	4	0.4
Sheep Farming (Specialised)	250	23.4
Beef Cattle Farming (Specialised)	220	20.6
Sheep-Beef Cattle Farming	219	20.5
Grain-Sheep or Grain-Beef Cattle Farming	47	4.4
Other Grain Growing	8	0.7
Other Crop Growing	20	1.9
Deer Farming	3	0.3
Horse Farming	35	3.3
Pig Farming	3	0.3
Beekeeping	10	0.9
Other Livestock Farming	7	0.7
Fishing, Hunting and Trapping	3	0.3
Agriculture, Forestry and Fishing Support Services	3	0.3
Shearing Services	21	2.0
Other Agriculture and Fishing Support Services	25	2.3
Agriculture, Forestry and Fishing	10	0.9
Total Agricultural Employment	**1,069**	**100.0**

Source: ABS, 2006

5 Agricultural Assessment

This chapter discusses the agricultural assessment of the land that will be occupied by the Project. It also provides alternative land uses for Bylong and the suitability of those enterprises.

5.1 Methodology

The assessment methodology comprised:

- A review of the Soils Assessment prepared by SLR Consulting Australia (SLR, 2015);
- A review of the Groundwater Impact Assessment prepared by Australasian Groundwater and Environmental Consultants (AGE, 2015);
- A site visit to Bylong to assist in reviewing the soil and land capability impact assessment and to inspect the current agricultural production at Bylong and surrounding locality;
- Interviews with DPI staff to confirm current agricultural enterprises on the project area and in the locality;
- Interviews with MWRC staff to confirm current agricultural enterprises on the project area and in the locality;
- Desktop analysis of the value of agricultural production from Bylong, and enterprises in the locality;
- Desktop assessment of the value of agricultural production associated with the Study Area biodiversity offset areas and enterprises in surrounding locality;
- Desktop analysis of the agricultural production's contribution to the local, regional, State and national agricultural output; and
- Consideration of the potential impacts of the Project on verified BSAL and Equine CIC as defined by the SRLUP.

5.2 Agricultural Domains

The Study Area, Project Boundary, Disturbance Boundary and Biodiversity Offset Areas (see **Section 1.4**) have been dissected into agricultural domains based on the Soils Assessment (SLR 2015) and Scott Barnett & Associates' own observations. The following information is presented for each of the Assessment Areas (the Study Area, Project Area, and Biodiversity Offset Areas):

- A physical description of the agricultural domains;
- The area of each domain (in hectares and as a percentage);
- The relevant soil type;
- The relevant Land Capability class;
- The relevant agricultural suitability;
- The quantum of agricultural production currently derived from each agricultural domain; and
- The value of agricultural production currently derived from each agricultural domain.

Agricultural domains were used to reflect the current land practices as they align to the various land classification systems within the limitations of individual land manager's management style and choices and the variance between individual land managers.

The agricultural domains (and therefore the agricultural enterprises) mapped for the Agricultural Assessment Areas are shown in **Figure 13**.

5.2.1 Study Area and Project Disturbance Boundary

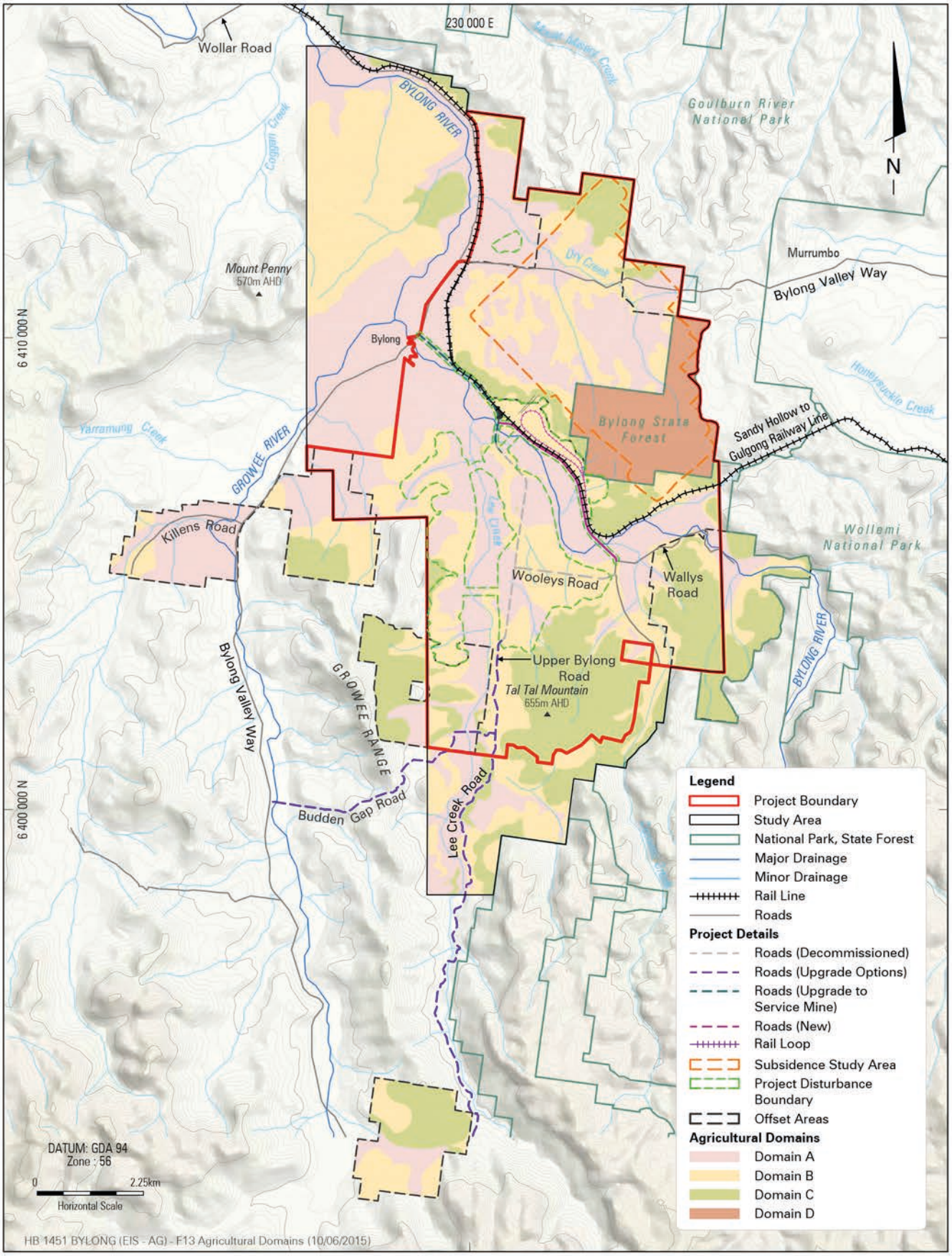
The agricultural domains within the Study Area are shown in **Figure 13**. **Table 19** provides an overview of each of the agricultural domains and their quantitative distribution within Study Area and Project Disturbance Boundary.

Table 19
Agricultural Domain Distribution within the Study Area and Project Disturbance Boundary

Agricultural Domains	Description	Study Area		Project Disturbance Boundary	
		Area (ha)	Area (%)	Area (ha)	Area (%)
A	Arable land- Land suitable for high impact land uses such as cropping including; irrigated cropping; fodder cropping; and improved pastures for grazing. Careful management of limitations is still required for intensive cropping and grazing to avoid environmental degradation.	3,975	39	451	39
B	Extensive Grazing Land –lower slopes and hill grazing, suitable for grazing activities. Some occasional cultivation for fodder and improved pasture establishment may be undertaken on the lower slopes. Not suitable for high intensity agricultural activities such as regular cropping. Specialised management practices required to prevent long-term degradation.	3,805	37	694	60
C	Heavily Timbered - Low carrying capacity, dense vegetation, steep slope and stoniness limit agricultural activities. Domain has limited agricultural value and is generally suited to nature conservation.	1,919	19	15	1
D	Non-agricultural use	618	6	0	0
Total		**10,317**	**100.0**	**1,160**	**100**

Table 19 shows that the majority of the Study Area is composed of land classified as Agricultural Domains A and B. Agricultural Domain A is the most abundant (3,975 ha or 39%) and is the highest quality agricultural land within the Study Area. This land is suited to fodder cropping and/or cultivation to establish improved pasture. It is not suited to continuous (annual) cultivation due to the underlying soil type. This land primarily coincides with the LSC Class 3 and 4.

Agricultural Domain B covers an area of 3,805 ha (or 37%) and is suitable for grazing by beef cows for weaner production. Some areas are also suited to occasional cultivation for fodder cropping and pasture establishment. This land is capable of supporting reasonable levels of pasture production and such can be used for beef cattle grazing for raising vealers. This land primarily coincides with the LSC Class 5 and 6.



BYLONG COAL PROJECT

Agricultural Domains

FIGURE 13

Domain C covers an area of 1,919 ha (or 19%) and is the lowest quality agricultural land within the Study Area. The land is suited to limited grazing by beef breeders to produce weaner cattle (unfinished). The agricultural value of this land is limited by its slope, which restricts the level of pasture improvement and requires careful management to avoid over grazing. This land primarily coincides with the LSC Class 7.

Agricultural Domain D covers an area of 518 ha (or 6 %) and is considered as non-agricultural land. This domain includes areas of State Forest and National Park land.

5.2.2 Biodiversity Offset Areas

The Project Biodiversity Offsets Strategy (Cumberland Ecology, 2015), broad-scale soils mapping, broad-scale land capability mapping and observations from land managers in the region have been used to delineate the Agricultural Domain distribution where it falls outside the Study Area. The agricultural domains within the Biodiversity Offset Areas are summarised in **Table 20**. **Figure 13** provides an overview of each of the agricultural domains and their quantitative distribution. Of the Biodiversity Offset Areas, 2,226 ha are located within the Study Area and are also included in **Table 19**. The Biodiversity Offset Areas include an additional 1,856 ha located outside the Study Area.

It is noted that all areas within the Biodiversity Offset properties that are currently cultivated will remain available for agricultural production. **Table 20** shows that a substantial portion of the land associated with the Biodiversity Offset Areas to be removed from agriculture and managed for Biodiversity Value (1,324 ha or 35%) is composed of land classed as Agricultural Domain C and therefore has limited agricultural value.

Table 20
Agricultural Domain Distribution within the Biodiversity Offset Areas

Agricultural Domains	Description	Biodiversity Offset Areas		Total Offset Area to be managed for Biodiversity Value	
		(ha)	(%)	(ha)	(%)
A	Arable land- Land suitable for high impact land uses such as cropping including; irrigated cropping; fodder cropping; and improved pastures for grazing. Careful management of limitations is still required for intensive cropping and grazing to avoid environmental degradation.	1,440	35	1,158	30
B	Extensive Grazing Land –lower slopes and hill grazing, suitable for grazing activities. Some occasional cultivation for fodder and improved pasture establishment may be undertaken on the lower slopes. Not suitable for high intensity agricultural activities such as regular cropping. Specialised management practices required to prevent long-term degradation	1,318	32	1,318	35

C	Heavily Timbered - Low carrying capacity, dense vegetation, steep slope and stoniness limit agricultural activities. Domain has limited agricultural value and is generally suited to nature conservation.	1,324	32	1,324	35
Total		**4,082**	**100**	**3,800**	**100**

** Denotes areas of land to be managed for biodiversity value i.e. does not include the areas that are currently cultivated exotic monoculture.*

5.3 Agricultural Production and Value

To examine the quantum and value of the agricultural production within the Study Area and surrounding locality, information as to the current agricultural practices and the number of livestock licensees are allowed to carry under their licenses was obtained from KEPCO. It is noted that the current operators' Licenses to Occupy include land outside the Study Area.

Licensee stocking limits have been determined by expert agricultural advisors to ensure the long term sustainability of each agricultural enterprise.

This information was used in association with the NSW Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) (Primary Industries) (2011) gross margin budgets to calculate the quantum and value of agricultural production from the Bylong Valley on an annual basis.

5.3.1 Surrounding Locality

Staff from the NSW DPI (former District Agronomist and District Livestock Office (Beef Cattle)) identified the main agricultural activity in the Bylong Valley as cattle breeding. DPI estimated that there are 6,000 breeding cows within the extended Bylong Valley area turning off an approximate 4,800 progeny per annum, mainly for the European market (550 kilogram (kg) live weight). In addition to the cattle breeding enterprises it is estimated 2,000 head of trading stock are grown out from 240 kg live weight to be turned off at 460 kg live weight per annum depending on seasonal and market conditions.

Hill grazing country, which is used for cattle breeding, has a carrying capacity of 3 to 4 Dry Sheep Equivalent (DSE)/ ha. The lower slope grazing country has a carrying capacity of 6 to 7 DSE/ha based on a mix of native, naturalised and improved pasture species. The arable irrigated pasture is capable of carrying 25 DSE/ha under intense management systems, but a more representative average is 10 DSE/ha. Heavily timbered country which is mainly for shelter grazing has a carrying capacity of 0.3 DSE/ha.

Of the stock turned off from Bylong Valley, 50% are sold via paddock sales, mainly to abattoirs at Tamworth, Scone and Singleton or direct to feedlots, with the remaining 50% sold through sale yards at Scone or Mudgee.

Of lesser importance is limited lucerne hay production for the stock feed market or Sydney horse market. Most lucerne is used on farm for grazing or supplementary feeding of livestock. Oaten hay production is also carried out. Forage millets for hay and sorghum forages are grown under irrigation in summer. Lucerne hay yields are typically 12-15 tonnes (t)/ha with the more proficient hay growers achieving 17-20 t/ha based on average irrigation water usage of 6 ML/ha and up to 8 ML/ha four years in five. Oaten hay yields of 8t/ha are expected with wheat grain crops yielding 3t/ha average, peaking at 5t/ha.

Opportune wheat and oat grain crops are also grown but mainly in the south-eastern end of the Bylong Valley. Cropping country is restricted to the alluvial flats of the Bylong and Upper Bylong Valley and associated creek flats with the irrigation areas being limited to the alluvial aquifer below and adjacent the Bylong River and its associated feed water courses.

There are no thoroughbred breeding enterprises currently within the locality; however, there are a number of small equine enterprises (primarily associated with stock horse breeding and husbandry) many of which also run beef cattle.

5.3.2 Study Area

The enterprises operating within the Study Area and the carrying capacity of each have been sourced by KEPCO from applicable land-holders as commercial-in-confidence documents. As such not all information has been disclosed in the AIS. This information was used in association with the NSW DPI gross margin budgets to calculate the quantum and value of agricultural production within the Study Area. These assumptions are summarised in **Appendix 1**.

The predominant enterprise within the Study Area is beef cattle grazing supported by fodder cropping (oats, lucerne, millet and forage sorghum) and improved pastures on the better quality land and larger holdings. As provided in **Section 5.3.1**, this reflects the enterprises in the northern end of the Bylong Valley (where the Project is located), which is generally representative of cattle breeding with a lesser emphasis on lucerne hay production and fodder cropping. Existing agricultural enterprises within Study Area are outlined in **Section** 4 and illustrated on **Figure 12**.

The relative production of each Agricultural Enterprise is outlined in **Table 21.**

Table 21
Current Enterprises per Agricultural Domain within the Study Area

Enterprise	Average Stocking Rate (ha/Head)	Average Carrying Capacity/Yield*	Agricultural Domain
Livestock			
Young Cattle (15-20 Months)	5.54	6.63 DSE/ha	A, B and C
Custom Young Cattle (15-20 Months)	5.18	6.19 DSE/ha	A, B and C
Steers (240-460kg)	2.29	7.13 DSE/ha	A, B and C
Steers (in 240 kg out 420kg)	2.94	4.62 DSE/ha	A, B and C
In 200-350kg out 680kg (Jap OX Market)	2.36	5.59 DSE/ha	A and B
Breeders (Inland weaners)	3.23	7.29 DSE/ha	A, B and C
EU Custom Steers (240-460kg)	1.23	15.45 DSE/ha	A and B
Bulls	12.3	10.25 DSE/ha	A and B
Semen and Embryos	Semen and embryos imported from overseas and sold. Approximately 200 Straws of semen and 41embryos annually.		
Cropping			
Lucerne Dry Land	0.25	4.00 t/ha	A
Lucerne Irrigated	0.08	12.86 t/ha	A
Oaten/Cereal Hay	0.25	4.00 t/ha	A
Equine			
Stockhorse Stud	1.6	15.52 DSE/ha	A

** DSE – Dry Sheep Equivalent. The equivalent daily energy requirement of a 50 kg wether not losing or gaining weight.*

The value of the agricultural production from enterprises within the Study Area is summarised in **Table 22**. Details are provided in **Appendix 1**.

Table 22 shows that the existing gross value of agriculture production within the Study Area, based on the current land use, is $5,281,063 per annum and a net value of agriculture production of $2,457,497.

The three closest regional sale yards with weekly prime sales are at Mudgee, Scone and Singleton. Both sale yards also hold monthly store cattle sales. The National Livestock Reporting Service NSW Cattle Saleyard Survey for the financial year ended 30 June 2014 (MLA, 2014) shows that the Scone, Mudgee and Singleton sale yards had a throughput of 60,693, 31,746 and 45,258 head, respectively. During this period, the Scone sale yard was ranked 9th and the Singleton sale yard was ranked 14th and the Mudgee sale yard was ranked 16th in NSW for cattle sold by auction through the sale yard system. The National Livestock Reporting Service NSW Cattle Saleyard Survey (MLA, 2011) reports a total of 1,946,033 cattle sold through NSW sale yards in 2014.

Table 22
Quantum and Value of Agricultural Production from within the Study Area

Domain	Crop Production (Tonnes)	Animals Sold (Head)*	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	4,755.37	2,726	$4,251,681.41	$1,961,737.19
Domain B	0	1,074	$901,597.05	$440,674.04
Domain C	0	180	$127,785.46	$55,086.37
Domain D	0	0	$0.00	$0.00
Total	**4,755.37**	**3,981**	**$5,281,063.93**	**$2,457,497.59**

**Note this includes horses from the stockhorse stud*

There is a small sale yard at Denman, which holds monthly store sales. MLA did not report the number of cattle sold through the Denman sale yard in 2014 nor was it ranked amongst NSW sale yards. The 2010 NSW Cattle Saleyard Survey did report Denman sale yards, which was ranked 53rd out of 54 yards listed.

If it is assumed that all cattle from the Study Area (4,201 head) are sold through the Scone, Mudgee and Singleton sale yards, the expected number to be turned off represents approximately 7% of Scone's throughput, 13% of Mudgee's throughput or 9% of Singleton's throughput.

Based on the Upper Hunter Shire Council's yard charges of $8.18 per head (financial year 2011/12), the 4,201 head of cattle sold from the Study Area would contribute $34,364.18 of income to the Scone sale yards (if all were sold through Scone). Yard charges for Singleton and Mudgee are not available; however, a similar figure to Scone would be expected.

It should be noted that cattle do not necessarily have to be sold through these sale yards but could be sold direct to slaughter works (prime stock) or "*out of the paddock*" to be grown out and/or fattened by other producers. These options are also popular management choices.

5.3.3 Biodiversity Offset Areas

As outlined in **Section 3.3.4** and **Table 10**, the agricultural production and value of Biodiversity Offset Areas has been calculated for the 3,800 ha that will ultimately be removed from agricultural production to increase the value of native biodiversity in the region. The areas currently cultivated comprising exotic monoculture has not been included, as they will remain available for agricultural production (see **Figure 7**). The enterprises operated within the agricultural domains of the Biodiversity Offset Areas are shown in **Table 23**.

The value of the agricultural production from enterprises within the Biodiversity Offset Areas is summarised in **Table 24**. Details are provided in **Appendix 2**.

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Table 23

Current Enterprises per Agricultural Domain within the Biodiversity Offset Areas*

Enterprise	Stocking Rate (ha/Head)	Average Carrying Capacity/Yield**	Agricultural Domain
Livestock			
Young Cattle (15-20 Months)	5.54	6.63 DSE/ha	A, B and C
Custom Young Cattle (15-20 Months)	5.18	6.19 DSE/ha	A, B and C
Steers (240-460kg)	2.29	7.13 DSE/ha	A, B and C
Steers (in 240 kg out 420kg)	2.94	4.62 DSE/ha	A, B and C
In 200-350kg out 680kg (Jap OX Market)	2.36	5.59 DSE/ha	A and B
Breeders (Inland weaners)	3.23	7.29 DSE/ha	A, B and C
EU Custom Steers (240-460kg)	1.23	15.45 DSE/ha	A and B
Bulls	12.3	10.25 DSE/ha	A and B
Semen and Embryos	Semen and embryos imported from overseas and sold. Approximately 200 Straws of semen and 41embryos annually.		

** Denotes areas of land to be managed for biodiversity value i.e. does not include the areas that are currently cultivated exotic monoculture.*

*** DSE – Dry Sheep Equivalent. The equivalent daily energy requirement of a 50 kg wether not losing or gaining weight.*

Table 24

Quantum and Value of Agricultural Production from within the Biodiversity Offset Areas*

Domain	Animals Sold (Head)**	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	988	$1,032,846.79	$566,531.14
Domain B	372	$312,300.86	$152,643.45
Domain C	124	$88,164.64	$38,006.44
Domain D	0	$0.00	$0.00
Total	**1484**	**$1,433,312.30**	**$757,181.03**

** Denotes areas of land to be managed for biodiversity value i.e. does not include the areas that are currently cultivated exotic monoculture.*

***Note: The total head does not include 200 straws semen and 41embryos which are included in the Gross and Net Production*

5.3.4 Equine CIC within Agricultural Assessment Area

A representative land-use scenario for land mapped as Equine CIC was developed to determine its potential value to the Hunter Equine Industry. It has been assumed that the two best practice equine land-uses for the region would include:

- Lucerne production to be sold to the industry; and
- Broodmare farming.

The Agricultural Domain mapping, interviews with relevant landowners and knowledge of the existing agricultural enterprises was used to develop the optimum equine land use scenario.

The potential value of lucerne production has been developed based on existing cropping enterprises undertaken within the Study Area. Using the Equine CIC land use scenario it has been determined that a broodmare farm, incorporating both broodmares owned, and dry and wet mare agistment during thoroughbred breeding season as demand dictates, would be a suitable alternative to a beef grazing operation. This enterprise would potentially agist mares following a 'walk on walk off' service at thoroughbred breeding studs from within the Upper Hunter or Scone region.

The potential value of each Agricultural Domain for the Equine CIC land use scenario has been assessed assuming the average DSE rating for a thoroughbred horse is approximately 14 DSE. However unlike cattle who generally graze evenly across an area, horses are naturally wasteful grazers due to their selective grazing. Therefore in similar broodmare operations cattle are utilised to ensure even grazing and help manage feed wastage and ground cover. Therefore the average carrying capacity per hectare for horses is approximately double their feed requirements.

It is unlikely any land mapped as Agricultural Domain C would be utilised for either Equine enterprise (cropping or broodmare operations) due to the steep slopes, dense vegetation and low DSE. However these areas would likely be utilised as part of the cattle grazing management program. As the cattle grazing management program, including areas of Domain C, will not directly increase the potential quantum value to the Equine Industry they have not been assessed further as part of the potential Equine CIC scenario.

The average operational income and variable costs obtained from a survey of brood mare farms (Scott Barnett & Associates, 2011, Unpublished data) are listed in **Table 25.**

Table 25
Average Operation Costs of Brood Mare Farms

Activity	Value/Unit
Income	
Daily agistment dry mare	$24.00/day
Daily agistment wet mare	$26.00/day
Variable Costs	
Under full hand feeding (pellets)	4 kg/day @ $0.70 per kg ($700/tonne)
Under full hand feeding (hay)	4 kg/day supplemented from Lucerne cropping enterprise
Labour	$6.67/day (20 minutes per mare per day @ $20.00/hr)

Source: Scott Barnett & Associates, 2011 (Unpublished Data)

Other costs such as animal health and veterinary services, farrier services, service fees and transport to and from the stud farm for the mare to be serviced are charged direct to or on charged to the mare owner (see **Table 26**). The cost of the service fee varies greatly depending on stallion and inducements available to the mare owner.

Table 26
Additional Operation Costs of Brood Mare Farms

Activity	Cost/Unit	Frequency
Drenching	$30.00/per mare	6 weeks
Farrier	$45.00/per mare	6 weeks
Veterinary service contract	$1,200.00/per mare	Each season
Transport to stud farm and return	$150.00/per mare	As required

Source: Scott Barnett & Associates, 2011 (Unpublished Data)

The nature of dry mare agistment would suggest that the demand for the service would be driven more by factors related to the buoyancy of the thoroughbred breeding industry (demand for mares to be put to stallions standing at local studs) than by agricultural or seasonal conditions.

The value of the potential equine land use scenario is summarised in **Table 27**. Details are provided in **Appendix 3**.

Table 27
Maximum Quantum and Value of Equine CIC Land Use Scenario

Domain	Crop Production (Tonnes)	Number Horses (Head)	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	2,040	680	$6,500,820.00	$3,184,666.12
Domain B	0	158	$1,359,800.00	$698,331.72
Domain C	0	0	$0	$0
Total	**2,040**	**837**	**$7,860,620.00**	**$3,882,997.84**

5.3.5 Quantum and Value of Agricultural Water

As noted in **Section 3.6**, KEPCO has secured 2,535 units of water allocation for the Bylong Water Source under the Hunter Unregulated and Alluvial WSP. This water allocation entitles extraction of up to 2,535 ML of water in periods where the Available Water Determination (AWD) remains at 100%. The Project's water demands from the Bylong River Water Source is discussed in the Surface Water and Flooding Impact Assessment for the Project (WRM, 2015).

To conservatively quantify the potential agricultural production (quantum and value) of the water it is assumed that the water would be used for cash crops, namely lucerne hay. A 100% water allocation was assumed, that is 2,535 ML used per year over the 443 ha of suitable land.

DTIRIS (2011) farm budgets for summer irrigated crops and dryland crops for the Northern NSW irrigation region have been utilised to determine agricultural water values for the Project. **Table 28** summarises the gross value (per ML) of irrigation water for lucerne grown in the locality assuming all 443 ha of suitable land within KEPCO ownership was being utilised.

Table 28
Potential Production from KEPCO Water Allocation

Crop Grown	Lucerne	Maize	Total	Value/ML
Years Grown	5	2	7	
ML/ha	8.0	7.2	-	
Weight average ML/ha	5.7	2.1	-	
Ha grown	231.2	94.6	326.2	
Yield (t)	4,194	932	-	
Gross Value	**$1,145,419**	**$249,772**	**$1,395,191**	**$550**
Net Value	**$265,168**	**$104,695**	**$369,863**	**$146**

The potential 2,535 ML of water available under KEPCO's water allocation has the potential to produces a gross value production of $1,395,191 and a net value of $369,863 from the production of 4,194 tonnes of Lucerne hay and 932 tonnes of Maize grain. The potential gross value of production per ML of water is $550 and the net value is $146.

Whilst there is potential for the above area and water quantities to be irrigated on KEPCO land, at the time of purchase of the land it has been estimated that approximately 750 ML per annum was utilised for irrigation purposes. **Table 29** summarises the potential gross value (per ML) of irrigation water for lucerne and sorghum grown in the locality under the existing land use scenario.

Table 29
Potential Production from KEPCO Water Allocation under Existing Land Use Scenario

Crop Grown	Lucerne	Maize	Total	Value/ML
Years Grown	5	2	7	
ML/ha	8.0	7.2	-	
Weight average	5.7	2.1	-	
Ha grown	68.5	28	96.5	
Yield (t)	1,241	276	-	
Gross Value	**$338,881**	**$73,897**	**$412,778**	**$550**
Net Value	**$78,452**	**$30,975**	**$109,427**	**$146**

The 750 ML of water currently utilised under KEPCO's water allocation has the potential to produces a gross value production of $412,778 and a net value of $109,472 from the production of 1,241 tonnes of lucerne hay and 276 tonnes of Maize grain.

Table 30 summarises the potential gross value of a comparative dryland cropping land use scenario for lucerne and sorghum. **Table 30** also summarises the potential value per ML of water removed from agriculture.

Table 30
Potential Production from Dryland Cropping
and Value of Water Removed from Agriculture

Crop Grown	Lucerne	Sorghum	Total	Value/ML Removed
Years Grown	5	2		
Ha grown	231.2	94.6	-	-
Yield (t)	932	419	-	-
Gross Value	**$268,412**	**$75,491**	**$343,903**	**$415**
Net Value	**$86,553**	**$27,361**	**$113,915**	**$101**

Potential production from the alternative dryland cropping scenario estimated a gross value production of $343,903 and a net value of $113,915 from the production of 932 tonnes of lucerne hay and 419 tonnes of sorghum. The potential gross value of agricultural water per ML removed is $415 and the net value is $101.

Assumptions used for calculations of the value of irrigation water are presented in **Appendix 4**.

Quantification of the loss to agricultural water is provided in **Section 8.1.4**.

5.4 Potential Agricultural Production

The potential agricultural production of the Study Area was examined assuming changes to management to represent superior management and or capital investment. The changes identified were pasture improvement and paddock subdivision to allow for more intense grazing management.

The following assumptions were made:

- Domain A: $350 per hectare invested in pasture improvement and repeated every seven years; one off $125 per hectare for paddock subdivision and stock water reticulation; additional annual pasture maintenance cost of $50 per hectare per annum; carrying capacity improves from 16.11 DSE/hectare to 20 DSE/hectare;
- Domain B: $250 per hectare invested in pasture improvement and repeated every seven years; one off $125 per hectare for paddock subdivision and stock water reticulation; additional annual pasture maintenance cost of $50 per hectare; carrying capacity improves from 6.08 DSE/hectare to 10 DSE per hectare;
- Domain C: $150 per hectare invested in pasture improvement and repeated every seven years; one off $75 per hectare for paddock subdivision and stock water reticulation; additional annual pasture maintenance cost of $30 per hectare per annum; carrying capacity improves from2.11 DSE/hectare to 5 DSE per hectare.

No allowance has been made for increased risk of seasonal climatic variations and greater sensitivity to timeliness of management decisions and actions. Under the above scenarios the management systems would be operating further along the marginal risk reward portion of the production curve.

Table 31 shows that the gross value of agricultural production could potentially be increased to $7,606,075 per annum and the net value to $2,833,811 per annum.

Table 31
Maximum Potential of Agricultural Production within Study Area

Domain	Crop Production (Tonnes)	Animals Sold (Head)*	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	4,755	3,981	$5,462,563.26	$2,071,449.72
Domain B	0	2,108	$1,749,890.36	$638,724.87
Domain C	0	548	$393,621.28	$123,636.88
Total	**4,755**	**6,717**	**7,606,075**	**2,833,811**

**Cattle would need to be withheld from grazing for first 12 months of pasture improvement.*

5.5 Alternate Agricultural Land Use Suitability

The land within the Study Area and portions of the Biodiversity Offset Areas are well suited for cattle grazing with some carefully managed cropping and improved pastures depending on slope and soil type.

Alternative agricultural land uses would aim to value add to the crop and forage production from the locality. These would include beef feedlots and freestall dairying. These activities are not inherently dependant on the production capability of the land which they occupy but proximity to surrounding reliable feed supplies and ability to handle and utilise appropriately manure accumulated at the site.

6 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. Full details of the stakeholder engagement program for the Project are discussed in the main volume of the EIS. A summary of the regulators and neighbouring landowners and industries consulted with regard to Project and its potential impacts on agriculture are provided below:

Regulators

- DP&E;
- DTIRIS (Primary Industries);
- Hunter Central Rivers – Catchment Management Authority / Hunter Local Land Services; and
- Mid-Western Regional Council.

Neighbouring Landowners and Industries

- Wallings;
- Wright;
- Andrews;
- Desreaux;
- Kelleher;
- Grieve; and
- Mead.

Various consultation methods were adopted to identify stakeholder issues, including Project briefings, Community Newsletters, presentations, and open days.

In addition to the above regulators and neighbouring landholders, ongoing consultation was carried out with the KEPCO Farm Manager to validate the data and methodologies utilised in this assessment.

Table 32 outlines the regulatory stakeholder issues specific to this AIS and the section of the report which corresponds to each issue.

Table 32
Regulatory Stakeholder Issues

Ref.	Issue Raised	Section
1	Assess air quality impacts (including cumulative impacts)	**Section 8.7**
2	Assess noise impacts (including cumulative impacts)	**Section 8.8**
3	Assess impacts on local watercourses, including Bylong River and its tributaries	**Section 8.6.1**
4	Assess groundwater impacts, including potential for contamination and draw down on the Bylong alluvial groundwater aquifers	**Section 8.6.2**
5	Identify and assess impacts on existing groundwater users	**Section 8.6.2**
6	Assess impacts on BSAL	**Section 8.4**

Ref.	Issue Raised	Section
7	Assess impacts on Equine CIC	**Section 8.5**
8	Identify and assess potential agricultural land use conflicts	**Section 8.1**
9	Assess impacts on agricultural resources and enterprises and proposed avoidance or mitigation strategies	**Section 8.1 and Section 9.3**
10	Describe post-mining land uses	**Section 8.3**
11	Assess traffic impacts (including cumulative impacts) on the local road network	**Section 8.10**
12	Assess impacts on the local skills base	**Section 8.11**

Table 33 outlines the community stakeholder issues specific to this AIS and the section of the report which corresponds to each issue. Issues are not listed in any specific order of significance.

Table 33
Community Stakeholder Issues

Ref.	Issue Raised	Section
1	Air quality impacts (including cumulative impacts) on residences and livestock	**Section 8.7**
2	Noise impacts (including cumulative impacts) on residences and livestock	**Section 8.8**
3	Impacts on surface water quality	**Section 8.6.1**
4	Extraction of water from the Bylong River	**Section 8.6.1**
5	Discharges into the Bylong River	**Section 8.6.1**
6	Impacts on groundwater aquifers, including draw down and contamination	**Section 8.6.2**
7	Impacts to the visual amenity of the surrounding landscape and sensitive receptors	**Section 8.9**
8	Onsite screening to conceal construction and operation activities	**Section 8.9**
9	Increases in traffic volumes	**Section 8.10**
10	Impact on travel time associated with Bylong Way realignment	**Section 8.10**
11	Access during the construction phase of the Upper Bylong Road realignment	**Section 8.10**
12	Impacts of subsidence on agricultural land use	**Section 8.1.3**
13	Loss of agricultural land	**Section 8.1**
14	Reduced availability of water for agricultural purposes	**Section 8.1.4**

7 Risk Assessment

To assist in identifying the key environmental impacts to agricultural resources and enterprises within the locality of the Project, a risk assessment was completed utilising the KEPCO Risk Assessment Tools. This risk assessment is presented in **Appendix 5**. Each of the potential environmental issues was ranked in accordance with the KEPCO Risk Matrix as either being of low, moderate, high or extreme risk (see **Table 34**). The risk assessment presents the relevant risk category prior to the application of mitigation and management measures.

Table 34
Risk Assessment

Category	Issues
Extreme	None
High	• Availability and productivity of agricultural land • Availability of water for agricultural production • Surface water and groundwater • Traffic and transport
Moderate	• Subsidence • Noise • Air quality • Soils and Land Capability • Impacts on BSAL • Rehabilitation and Final Land Use and Closure • Labour • Weed Management • Bushfire
Low	• Visual and lighting • Business and Infrastructure • Impacts on CIC • Geochemistry

Following the assessment of potential impacts issues ranked as high, medium and low have been assessed in further detail as part of the EIS and this AIS. The risks will be reduced, where reasonable and feasible, or controlled through the implementation of appropriate mitigation and management measures.

8 Impact Assessment

This chapter assesses the potential impacts on agricultural land within the Assessment Area. As part of the AIS, Gillespie Economics were engaged to undertake an economic review of the potential agricultural impacts of the Project. A summary of the findings of the Gillespie Economics review are presented throughout this section.

8.1 Availability and Productivity of Agricultural Land

8.1.1 Project Disturbance Boundary

Any agricultural land that is situated within the Project Disturbance Boundary will be removed from production for up to five years following completion of rehabilitation. Land disturbed for the purposes of open cut infrastructure will be progressively rehabilitated and may take up to five years following the completion of open cut mining before it can be returned to agricultural production. Land disturbed for the purposes of infrastructure to support underground mining will be progressively rehabilitated and returned to agricultural production as soon as is practicable following the completion of underground mining. A portion of land above the underground mining area will form part of the Biodiversity Offset Strategy with any existing cultivated areas remaining available for that purpose.

Sustainable farming practices will continue during the life of the Project in available areas outside the disturbance footprint on land owned by KEPCO.

The Project disturbance footprint was defined by the Soils Assessment to be land associated with the construction and operation of infrastructure and mining activities proposed for the Project. Three categories have been identified for the Project's impact on agricultural resources after consideration of the Project's rehabilitation strategy. The distribution of the three impact categories across the Project Disturbance Footprint are summarised in **Table 35** and include the following:

- Indirect and temporary impacts include impacts that do not directly disturb the lands surface and are temporary;
- Direct and temporary impacts include those which disturb the land's surface, however are short term by nature and will be rehabilitated to pre-mining status; and
- Direct and long-term impacts will experience a long-term change in soil and landscape characteristics as a result of the complete removal of the soil profile and underlying rock strata during coal extraction activities and the emplacement of overburden material. Impacts for the Open Cut Mining Areas and OEAs will be mitigated and offset through reinstatement of an equivalent amount of impacted LSC Class 3 and 4 lands within the Project Boundary. The Internal Roads and Rail Loop will not be decommissioned and will be retained for future use at closure (SLR, 2015).

Table 35
Project Disturbance Footprint Impacts

Impact Category by Project Domain	Area (ha)
Indirect and Temporary Impacts	
Subsidence Study Area	1,714.3
Sub-Total	**1,714.3**
Direct and Temporary Impacts	
Haul Roads	118.3
Mine Infrastructure Area	85.0
Stockpile Area	11.1
Water Storage Facilities	26.5
Sub-Total	**240.9**
Direct and Long-term	
Internal Roads	73.5
Open Cut Mining Area	532.7
OEAs	225.0
Rail Loop	88.3
Sub-Total	**919.5**
Total	**2,874.7**

Indirect and temporary impacts cover 1,714.3 ha and comprise 59.6% of the Project disturbance footprint. Following coal extraction and progression of the longwall panels the overlying landform will subside. The Soils Assessment has confirmed that land indirectly and temporarily impacted by the Subsidence Study Area will experience localised short-term changes in soil and landscape characteristics by means of minor surface cracking and localised topographical depressions. Minor cracks may facilitate erosion and localised depressions may result in ponding which can affect chemical soil characteristics and physical characteristics (SLR, 2015). However given the nature of underground mining it is unlikely these impacts would be to an extent that the land and associated agricultural productivity is significantly impacted and cannot proceed without remediation.

Surface remediation will be investigated to ensure soil and landscape characteristics are not significantly impacted from its pre-mining condition. Upon progressive settlement of each subsided longwall panel, it is expected that the land will be able to retain its pre-mining land capability characteristics and, where available, continue current agricultural production (SLR, 2015b).

Only the direct impacts (temporary or long-term) have the potential to impact the agricultural productivity of the land within the Study Area. The Project Disturbance Boundary covers an area of 1,160ha (illustrated on **Figure 3**) and has been defined to include the direct impacts (temporary and long-term).

It is estimated that the following areas of the identified agricultural domains will be affected:

- Domain A 451 ha;
- Domain B 694 ha; and
- Domain C 15 ha.

An additional 33 ha outside of the Project Disturbance Boundary and within Domain A will cease to be irrigated due to the removal of the irrigation infrastructure as a result of its proximity to the Project Disturbance Boundary.

Table 36 shows the quantum of agricultural production impacted by the Project within the Project Disturbance Boundary. This is based on the information provided for each agricultural domain in **Section 5**.

Table 36
Quantum and Value of Agricultural Production within Project Disturbance Boundary

Domain	Crop Production (Tonnes)	Animals Sold (Head)	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	540	315	$654,422.25	$271,121.90
Domain B	0	196	$164,443.70	$80,375.23
Domain C	0	2	$998.84	$430.59
Total	**540**	**513**	**$819,864.80**	**$351,927.71**

If it were to be assumed that agricultural production from the entire Project Disturbance Boundary ceases at the commencement of the Project for perpetuity, the present value of the gross value of production foregone is $10.8 M (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $4.6 M (using a 7% discount rate) (Gillespie Economics, 2015). These values are developed as a conservative worst-case scenario as the mitigation measures and proposed rehabilitation strategy ensures the present value of agricultural production will be forgone for as little time as practicable.

This loss will be mitigated by the Project's long-term rehabilitation objective to provide a stable rehabilitated landform with either a self-sustaining vegetation cover or of adequate stability conducive to agricultural activities. Specific landscape objectives seek to return the rehabilitated land to its pre-mining land use or similar, where practical, and to enhance biodiversity values where possible. As described in **Section 9.3.2**, the Project's Farm Management Plan will ensure the best agricultural use of adjacent non-mine lands to maximise this integration and to provide opportunities for private farmers to use these through long-term leases.

8.1.2 Biodiversity Offset Areas

Pending further land management arrangements upon development and approval of the Biodiversity Offset Management Plan, the properties selected as Biodiversity Offset Areas for the Project will be managed for agricultural purposes, in conjunction with the conservation of ecological values in perpetuity.

As described in **Section 5.3.3** Biodiversity Offset Areas includes land that is currently cultivated comprising exotic monoculture, will remain available for agricultural production. As such the below areas and values exclude the areas proposed to be maintained for agricultural production as identified on **Figure 7**.

The area of each Agricultural Domain which will be removed from agricultural production for the purposes of biodiversity value within the Biodiversity Offset areas are:

- Domain A 1,158 ha;
- Domain B 1,318 ha; and
- Domain C 1,324 ha.

Table 37 shows the total quantum of production impacted by the Project on agricultural land within the Biodiversity Offset Areas should that land become unavailable for agricultural purposes. This is based on the information provided for each agricultural domain in **Section 0**.

Table 37

Quantum and Value of Agricultural Production within Biodiversity Offset Areas*

Domain	Animals Sold (Head)**	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	988	$1,032,846.79	$566,531.14
Domain B	372	$312,300.86	$152,643.45
Domain C	124	$88,164.64	$38,006.44
Total	**1484**	**$1,433,312.30**	**$757,181.03**

** Denotes areas of land to be managed for biodiversity value i.e. does not include the areas that are currently cultivated exotic monoculture.*

***Note: The total head does not include 200 straws semen and 41embryos which are included in the Gross and Net Production*

Conservatively assuming that agricultural production from the onsite Biodiversity Offset Areas ceases at the commencement of the Project for perpetuity, the present value of the gross value of production foregone is $18.9 M (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $10.0 M (using a 7% discount rate) (Gillespie Economics, 2015).

8.1.3 Underground Extraction Area

Subsidence impacts have been predicted and mapped as occurring within an area defined as the Subsidence Study Area, which is 1,714 ha in size (see **Table 35**). Subsidence movements include the vertical and horizontal displacement of ground, which may change the slope of the ground surface or cause fracturing and deformations in the bedrock or overlying strata. Within the Study Area, subsidence movements as a result of longwall mining have been predicted by MSEC (2015).

The maximum predicted vertical displacement as a result of longwall mining within the Study Area is 3,300 mm. MSEC (2015) has made an estimate of potential surface cracking over the Subsidence Study Area that may develop in tensile zones around the ends and sides of longwalls using a cut off for the development of tensile cracks of 0.5mm/m predicted tensile strain and an allowance for surface cracks that may develop across the panel as the transient tensile/compressive zone travels along the length of the longwall. The estimated area of cracking was calculated as less than 1 % of the total subsidence area for the proposed longwalls. It is predicted that surface cracking in the flatter areas above the proposed longwalls will typically be between 25 mm and 50 mm, with some isolated cracking around 100 mm or more.

On the steeper slopes, towards Bylong State Forest, surface cracks may be in the order of 50 mm to 100 mm, with isolated cracking of 200 mm or greater.

Although subsidence impacts can vary in terms of surface expression, typical subsidence effects can include surface cracking, rock fall and alterations to hydrological regimes. Tree fall or failure as a direct result of subsidence movements would be localised and is unlikely to significantly impact upon agricultural land quality within the Study Area. Rock falls from cliff lines have the potential to be more significant, but it is not predicted that these will occur as a result of the longwall mining within this Project.

Cracking can result in increased erosion, or the removal of surface-water by the diversion of water below ground. There is some potential for these impacts to occur as a result of the longwall mining within this Project. Changes in the ground slope may also cause alterations in the alignments of drainage lines, ponding and increased flooding.

Monitoring of subsidence related surface impacts will be undertaken during and following the extraction of each longwall panel to identify impacts which require remediation. It is unlikely that subsidence would result in changes to surface micro relief or significantly alter the chemical or physical composition of the soil profile to the extent that the land and associated agricultural productivity is significantly impacted and cannot proceed without remediation.

Remediation techniques will include infilling of surface cracks with soil or other suitable materials, or by locally re-grading and compacting the surface. In some cases, erosion protection measures may be needed, such as the regrading and planting of vegetation in order to stabilise the slopes created within subsided areas.

Upon progressive settlement of each subsided longwall panel, it is expected that the land will be able to retain its pre-mining land capability characteristics and, where applicable, continue current agricultural production. A detailed Subsidence Impact Assessment has been prepared for the Project (MSEC, 2015).

8.1.4 Water Diverted from Agriculture

As stated in **Section 0**, KEPCO has secured 2,535 units of water allocation for the Bylong Water Source under the Hunter Unregulated and Alluvial WSP. This water allocation entitles extraction of up to 2,535 ML of water in periods where the AWD remains at 100%. Water from the Bylong River alluvial will be utilised for the Project, which is comprised of interception of water due to mining and extraction of water from the proposed borefield. The proponent holds sufficient entitlements to account for its Project related water use even if the available water determination (AWD) reduces to less than 80% (AGE, 2015).

KEPCO will utilise its water allocation entitlements responsibly across both its agricultural pursuits and to supplement the ongoing operational water demands for the Project. Utilising these entitlements will assist in ensuring the Project does not adversely impact adjacent private landholders water supplies.

The EIS Groundwater Impact Assessment (AGE, 2015) and the EIS Surface Water Impact Assessment (WRM, 2015) prepared for the Project have identified the impact of the Project on groundwater and surface water. These are summarised in **Section 8.6.2** and **Section 8.6.1** of this report respectively.

It is predicted that pumping will be required from a borefield constructed within the alluvium throughout the life of the Project in order to supplement water supplies within the water management system for the continued operation of the CHPP. The annual total water take from the alluvial groundwater systems due to mining, averages 153 ML/year (peak of 295 ML/year) with a total of 3,829 ML over the life of the Project (AGE, 2015).

Predicted average water usage requirements for the mining operations are presented in **Table 38**. Throughout the Project, where this water is not used for mining related activities it will be available for use in agricultural activities on KEPCO owned land. The surface water and groundwater impact assessments have confirmed that the Project will be operated so as to not adversely impact upon any neighbouring private groundwater bores.

Table 38
Quantum and Value of Water Potentially lost from Agriculture

Project Year	Borefield Water Requirements (ML/annum)*	Water Available for Agriculture (ML/annum)*	Gross Value of Water Lost from Agriculture per annum	Net Value of Water Lost from Agriculture per annum
PY 3 – 6 (open cut only operations)	990	1,605	$410,562	$99,956
PY 11 – 25 (underground only operations)	0	2,065	$0	$0
PY 7 – 10 (combined mining operations)	500	1,815	**$207,355**	**$50,483**

** Based on the median borefield water demand plus predicted average alluvial groundwater seepage*

As presented in **Section 0**, the potential gross value of agricultural water per ML removed is $415 and the net value is $101. The maximum gross value lost from agriculture due to Project water requirements is $410,562 per annum and the maximum net value lost is $99,956 per annum during open cut operations (Project Years 3-6). During underground only operations there is predicted to be no loss of water from agriculture.

If it were to be assumed that the predicted maximum loss of water from agriculture under median conditions due to Project water requirements is removed for perpetuity, the present value of the gross value of production foregone is $5.4 M (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $1.3 (using a 7% discount rate) (Gillespie Economics, 2015).

Table 38 presents a worst case value from loss of agricultural water when compared to the utilisation of the entire KEPCO held water allocation. In reality the loss is far less as the actual quantity of water utilised for agriculture is approximately 30% of that available under KEPCO held water allocations. The predicted quantum of water which will remain available for agricultural land use between Project Years 3 and 6 remains greater than the currently utilised 750 M under average conditions.

Assumptions used for calculations of the value of water removed from agriculture are presented in **Appendix 4**.

8.1.5 Total Combined Agricultural Production

Table 39 presents a comparison of annual value of agricultural production affected by the Project to the annual value of agricultural production within MWRC LGA, NSW and Australia. As shown in **Table 39** the combined gross value of production from the agricultural land and water impacted by the Project is $2.66 M per annum. This represents 4.12% of the total agricultural production of the MWRC LGA, 0.02% of NSW and 0.005% of Australia's agricultural production.

Table 39
Comparison of Annual Value of Agricultural Production

Resource	Project Impact (per annum)	MWRC LGA (per annum)	NSW (per annum)	Australia (per annum)
Land	$ 2,253,176*			
Water	$ 410,5620			
Total agricultural production	$ 2,663,738	$64.70 M	$12,128.2 M	$ 48,048.00 M

Source: ABS, 2008; ABS 2011, ABS 2014
** Project Impact to land includes both the Project Disturbance Boundary and the Biodiversity Offset Areas*

In total, foregone gross value and net value of agricultural production from land and water resources required for the Project is estimated at a present value of $35.1 M and $15.9 M, respectively (using a 7% discount rate).

As the overall agricultural contribution of the land within Project Disturbance Boundary and the Biodiversity Offset Areas is small when compared to the total agricultural production on a regional, state and national scale, the reduced availability and productivity of this land will have a minimal impact to the industry.

8.1.6 Surrounding Locality

The Project and associated Biodiversity Offset Areas will not have a significant impact on agricultural enterprises in the surrounding locality. There will be no effect on the productivity of existing agricultural land outside the Agricultural Assessment Areas within the immediate locality, including land utilised by equine enterprises.

8.1.7 Regional Impacts of Agriculture Forgone as a Result of the Project

The regional impacts of the level of annual agricultural production foregone as a result of the Project were estimated from the sectors in the Upper Hunter regional input-output table by Gillespie Economics (2015).

Table 40 compares the annual regional production and economic impacts associated with the Project with the level of annual agricultural production that would be foregone as a result of the Project.

Table 40
Annual Regional Production and Economic Impacts

Aspect	Agriculture[1]	Project
Production Type	Beef and cropping	Coal
Direct Output Value ($M)	$3	$469
Direct Value Added ($M)	$1	$305
Direct Income ($M)	$0	$41
Direct Employment (no.)	16	290
Direct and Indirect Output Value ($M)	$4	$624
Direct and Indirect Value Added ($M)	$2	$378
Direct and Indirect Income ($M)	$1	$72
Direct and Indirect Employment (no.)	23	$830

[1]This the agricultural land and water that would be impacted in perpetuity by the Project

The direct annual output of the Project is estimated at $469M per annum. In contrast, the direct annual output of future use of agricultural land and water that would be utilised by the Project is estimated at $3M per annum.

Gillespie Economics (2015) also undertook a benefit cost analysis which included an estimation of the present value of production costs and benefits of the Project over a 25 year period. The present value of net production benefits of the Project to Australia are estimated at $596 (7% discount rate) with this estimate already including foregone agricultural production as an economic cost. In contrast, the present value of future use of agricultural lands that would be utilised by the Project is estimated at $15.9 M (7% discount rate).

8.2 Soils and Land Capability

Section 3.3 of this assessment outlines the soil survey methodology, confirmed soil types and Land and Soil Capability classes identified within the Study Area. This section outlines the potential impacts to soil resources and land capability within the Study Area as a result of the Project.

8.2.1 Soil Type

The soil landscape verification and distribution across the Study Area is described in **Section 3.3.** This section outlines the potential impacts to soil resources and land capability. Within the Project Disturbance Boundary and Overburden Emplacement Area (Project disturbance footprint) there are six soil type ASC orders summarised in **Table 41**.

Table 41
Soil Types within the Project Disturbance Footprint

ASC Order	Area (ha)	Percentage (%)
Chromosols		
Brown Chromosols	572.2	20.0
Red Chromosols	748.9	26.1
Subtotal	**1,321.1**	**46.1**

ASC Order	Area (ha)	Percentage (%)
Dermosols		
Black Dermosol	20.6	0.8
Black Dermosol overlying Rudosol	33.3	1.1
Grey Dermosol overlying Rudosol	4.8	0.2
Red Dermosol	369.1	12.8
Subtotal	**427.8**	**14.9**
Rudosols		
Clastic Rudosol	851.0	29.5
Lithic Rudosol	2.0	0.1
Stratic Rudosol overlying Dermosol	7.2	0.2
Subtotal	**860.2**	**29.8**
Sodosols		
Brown Sodosol	74.3	2.5
Red Sodosol	121.2	4.2
Subtotal	**195.5**	**6.7**
Tenosols		
Black-Orthic Tenosol	0.9	<0.1
Brown-Orthic Tenosol	26.4	1.0
Subtotal	**27.3**	**1.0**
Vertosols		
Brown Vertosol	42.8	1.5
Subtotal	**42.8**	**1.5**
Total	**2,874.7**	**100.0**

8.2.2 Land and Soil Capability Classes

Impacts to the land as a result of the Project will remain within the Disturbance Boundary. Areas outside this are expected to maintain its existing pre-mining class. Following the completion of mining, LSC classes within the Project Boundary will include the following key changes:

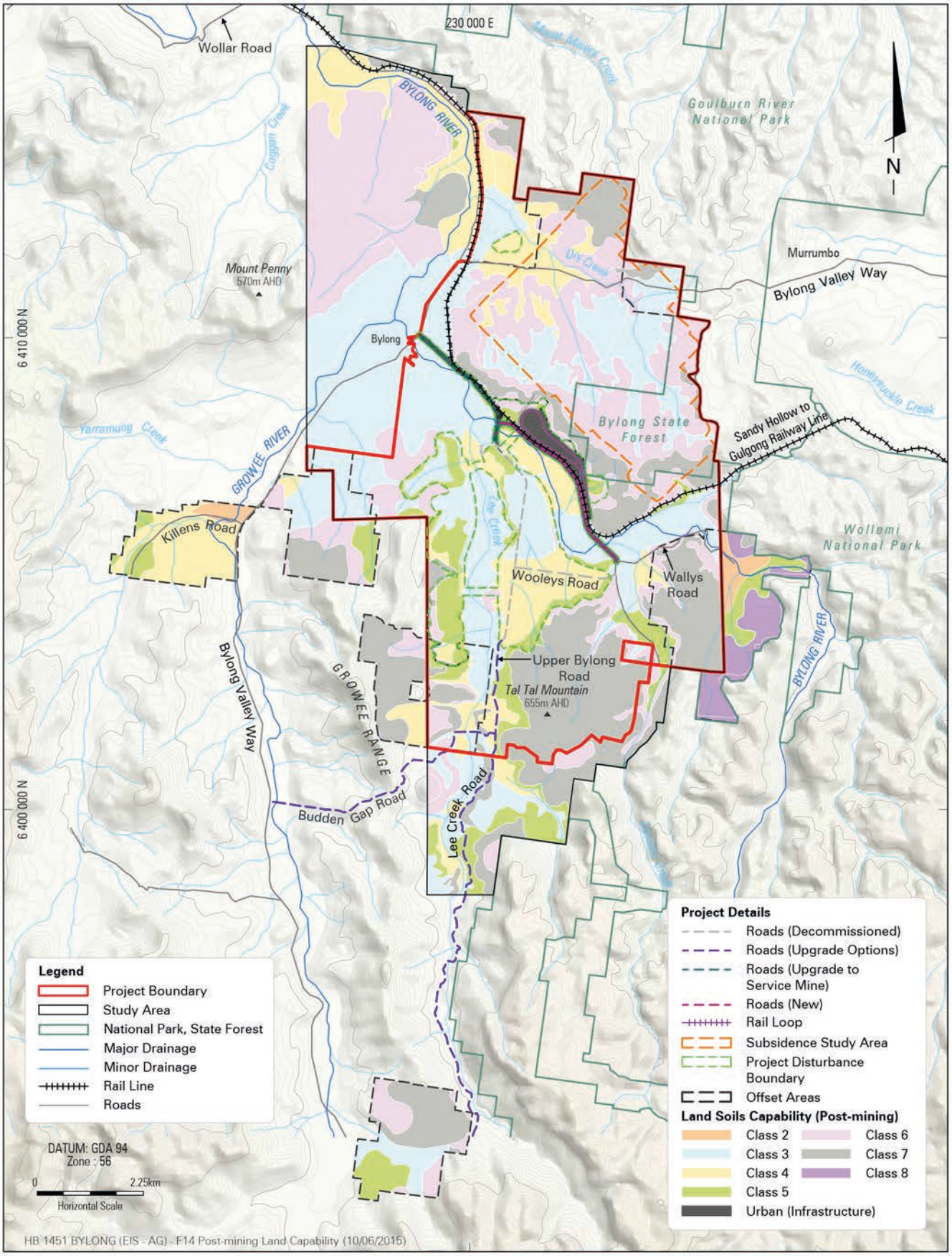
- Overall, the spatial distribution of LSC classes will change; however, the quality of LSC will improve overall due to the increase in LSC Class 3 and 4 lands;
- A predicted permanent reduction in LSC Class 5 and Class 6 lands. This will be offset by the reinstatement of a greater area of land LSC Class 3 and 4;
- An increase in the area of LSC Class 7; and
- A total of 161.8 ha (2.3%) of infrastructure including Internal Roads and the Rail Loop will remain post-mining and therefore is not designated a LSC Class.

The changes in LSC class within the Project Boundary, pre and post-mining are summarised in **Table 42** and illustrated on **Figure 14**.

Table 42
Pre- and Post-mining LSC Class

LSC Class	Pre-mining		Post-mining		Difference	
	ha	%	Ha	%	ha	%
3	1,957.0	27.9	2,042.1	29.3	85.1	1.4
4	818.1	11.8	888.2	12.9	70.1	1.1
5	884.9	12.8	676.2	9.5	-208.7	-3.3
6	1,680.7	24.3	1,564	22.6	-116.7	-1.7
7	1,617.0	23.2	1,625.4	23.4	8.4	0.2
Non-Rehabilitated Infrastructure						
Urban	Nil	Nil	161.8	2.3	161.8	2.3
Total	**6,957.7**	**100.0**	**6,957.7**	**100.0**	**-**	**-**

Source: SLR, 2015



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Post-mining Land Capability

FIGURE 14

8.3 Rehabilitation and Post-Mining Land-use

Within the Project Disturbance Footprint all land within areas to be temporarily disturbed (i.e. excluding internal roads and rail loop), whether indirectly or directly, will be returned to their pre-mining land capability.

Direct and long-term disturbance is proposed within areas that will experience a long-term change in soil and landscape characteristics. Any internal roads and the rail infrastructure will not be returned to a pre-mining land use and will remain for continued use. For the remaining 757.7 ha of land, cropping will be established on LSC Class 3, grazing on LSC Classes 4 and 5 and woodland on the remaining LSC Class 6 and 7 due to their association with moderately steep to steep land. The proposed post-mining land-use associated with the direct and long-term impacts from the Project are summarised in **Table 43** and illustrated on **Figure 15**.

Table 43
Post-mining Land-use for Direct and Long Term Disturbance Areas

Land Use	Associated LSC Class	Post-mining	
		ha	%
Rehabilitated Land			
Cropping	Class 3	227.0	24.8
Grazing	Class 4 and 5	497.1	54.0
Woodland	Class 6 and 7	33.6	3.6
Non-Rehabilitated Infrastructure			
Urban	N/A	161.8	17.6
Total		**919.5**	**100.0**

Additionally, it is proposed to establish a small trial area within the Class 4 and 5 rehabilitated lands to investigate the benefits of Natural Sequence Farming (or Soil Hydrology Management) that has been pioneered in the locality. This trial will be conducted in conjunction with local farming experience and expertise and may involve other organisations such as the Tom Farrell Institute centred at the University of Newcastle and the Outcomes Australia Soils for Life Program.

A key outcome of the rehabilitation of the open cut mining areas is to ensure that no voids are retained within the final landform. This results in the final landform becoming a source of water to the surrounding environment as opposed to taking water from the catchment in perpetuity.

8.4 Biophysical Strategic Agricultural Land

As noted in **Section 2.2** this AIS must address the gateway criteria for BSAL as outlined in the Upper Hunter SRLUP. As part of the Soils Assessment the extent of BSAL within the Study Area was verified against the relevant criteria. The Project disturbance footprint includes the Project Disturbance Boundary and Underground Extraction Area as illustrated in **Figure 3**.

8.4.1 Impact on BSAL within Project Disturbance Footprint

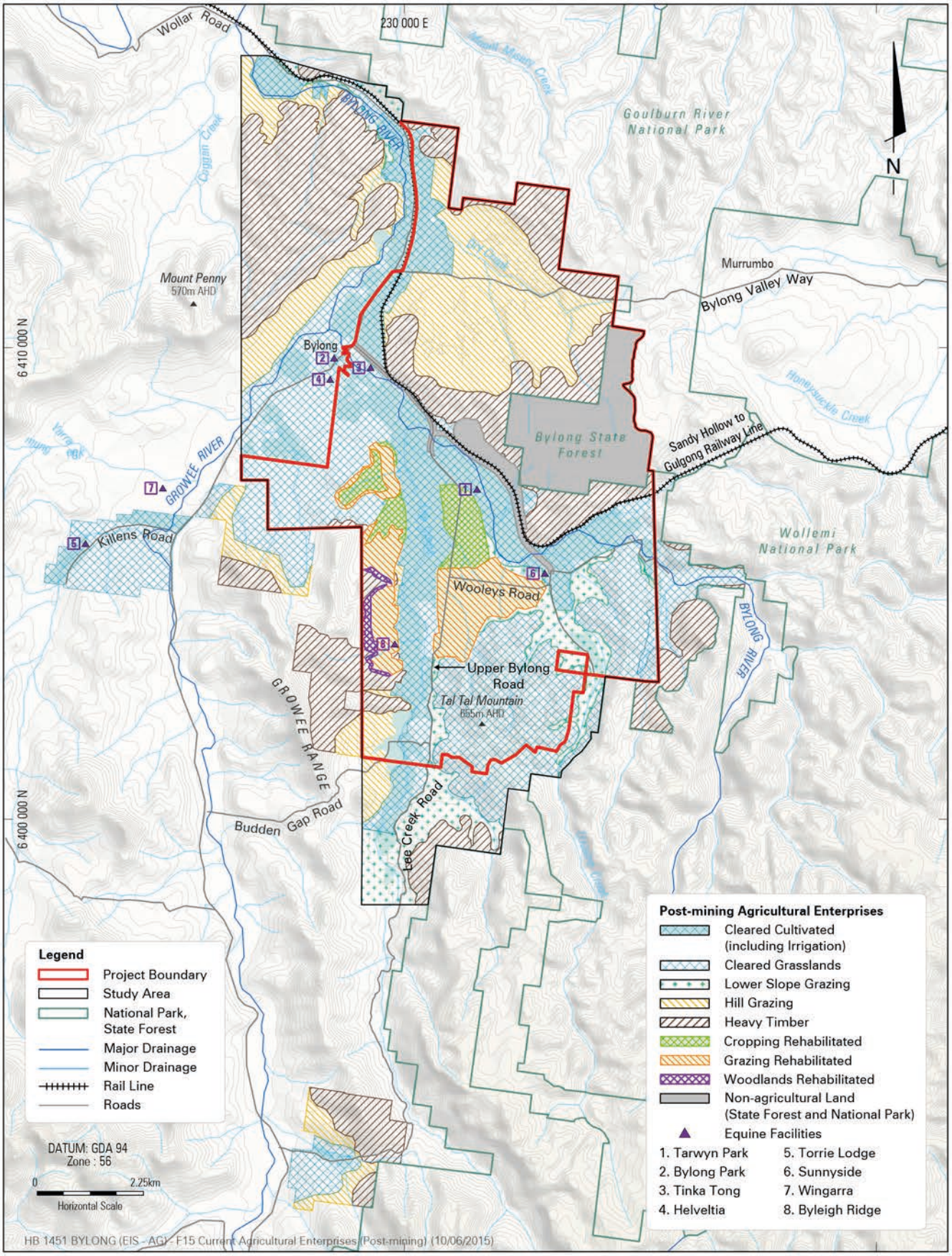
There is a total of 440.8 ha of verified BSAL within the Project disturbance footprint (**Figure 9**). This represents 26.3% of the total verified BSAL within the Project Boundary (1,675.9 ha). The Project has been designed to avoid BSAL where possible. Of the potential 2,874.7 ha of land to be impacted by the Project, approximately 15.4% (440.8 ha) is located on land verified as BSAL (**Table 44**).

Table 44
Total BSAL within Project Disturbance Footprint

Classification	Area (ha)	Percentage (%)
Not BSAL	2,433.9	84.6
Verified BSAL	440.8	15.4
Total	**2,874.7**	**100.0**

The key impacts to BSAL within the Project disturbance footprint include:

- 39.0% (171.8 ha) of the verified BSAL within the Project disturbance footprint will be indirectly and temporarily impacted by the Subsidence Study Area;
- 14.2% (62.7 ha) of the verified BSAL within the Project disturbance footprint will be directly; however, temporarily impacted by the development of Haul Roads, Mine Infrastructure, Stockpile Area and Water Storage Facilities;
- 46.8% (206.3 ha) of the verified BSAL within the Project disturbance footprint will experience direct and long-term impacts from the proposed Internal Roads, Rail Loop, Open Cut Mining Areas and OEAs; and
- There are no impacts on verified BSAL resulting from the Rail Loop.



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Current Agricultural Enterprises (Post-mining)

FIGURE 15

8.4.2 Post Mining BSAL Re-instatement

In order to minimise the impacts to BSAL, KEPCO has committed to avoiding (where practicable) and minimising the impacts on BSAL. KEPCO's objective is to return all lands disturbed by the Project back to at least or better than the original land formation. The quantity of BSAL that experience direct and long-term impacts is proposed to be re-instated to mitigate Project impacts. There will be no reduction in the quantity of BSAL, however, as per the LSC classes, the spatial distribution of BSAL will differ from the pre-mining landscape. Additionally, KEPCO will aim to reinstate 10% greater area of BSAL than is predicted to be disturbed as a conservative and practical objective for rehabilitation.

BSAL will be reinstated on land which also meets LSC Class 3 criteria with slopes preferably less than 3%, but may be reinstated on land up to 10% slope. Where practical, reinstated BSAL will be located adjacent to, or nearby existing and undisturbed BSAL. **Figure 16** shows the proposed spatial distribution of areas where the reinstatement BSAL is proposed. Further details regarding the rehabilitation of this land and compensatory measures are provided in Project's Rehabilitation and Decommissioning Strategy (SLR, 2015b).

8.4.3 Handling, Storage and Treatment of the Verified BSAL Soils

The Soils Assessment (SLR, 2015) outlines the soils proposed to be assessed for stripping and salvage, their suitability for re-use in rehabilitation and the limitations of each soil unit. The quantity of soil that can be salvaged from the disturbance footprint for re-use in rehabilitation works as a primary or secondary media is based on the recommended soil stripping depths per soil unit horizon and the area of land that will be disturbed.

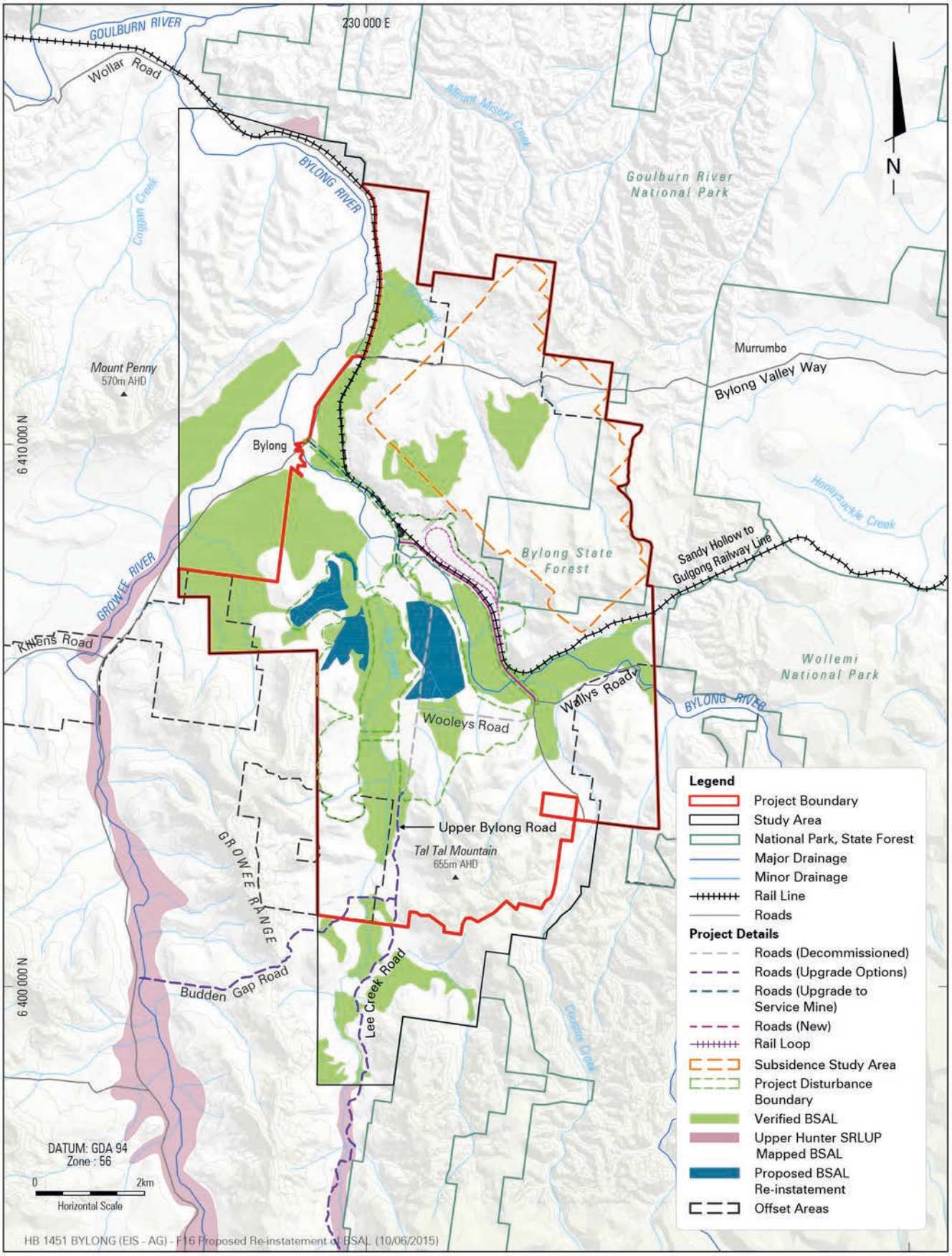
The estimated total volume of soil available from areas to be disturbed is approximately 7.42 million cubic metres (MCM). The total volume of primary media capable for BSAL reinstatement is 0.96 MCM. The soil volume available calculated from land to be directly disturbed in the long-term compared to directly and temporary disturbed land is shown in **Table 45**.

Table 45
Soil Volume Availability

Soil Suitability	Disturbance Impact		Total
	Direct and Long-term	Direct and Temporary	
Primary LSC Class 3 / BSAL	0.61	0.35	0.96
Primary LSC Class 4 and 5	0.80	0.23	1.03
Primary LSC Class 6 and 7	0.24	0.01	0.25
Secondary LSC Class 3 and 4*	2.98	1.09	4.07
Secondary LSC Class 5, 6 and 7	0.88	0.23	1.11
Total MCM	**5.51**	**1.91**	**7.42**

** Including Secondary soils that require amelioration*

It has been recommended that prior to the commencement of construction a detailed Topsoil Management Plan be developed which provides strategies on how to minimise topsoil losses during stripping to ensure that topsoil resources are preserved.



BYLONG COAL PROJECT

Proposed Re-instatement of Biophysical Strategic Agricultural Land

FIGURE 16

8.4.4 Biodiversity Offset Areas

As noted in **Section 5.3.3,** the Upper Hunter SRLUP Mapping 2014 indicates that 486 ha of BSAL is likely to occur within the biodiversity offset areas (**Figure 8**).

The Project Biodiversity Offset Strategy (Cumberland Ecology, 2015b) has proposed that agricultural activities will continue in areas, which have previously been used for cultivation. Therefore 109.44 ha of BSAL which currently lie within areas of cultivated land will continue to be utilised for agricultural purposes. A further 245 ha of BSAL lies within areas of C/EEC. The Project is proposing to utilise these areas for ecological conservation purposes by excluding agricultural activities. Actively regenerating and preserving the areas relevant to native woodland and grassland is considered a priority land-use for preservation of native biodiversity in the region. The proposed management of the Biodiversity Offset Areas is illustrated on **Figure 7**.

As such, the Biodiversity Offset Areas will experience some changes in land use as a result of the Project; however the inherent agricultural productivity of the land will not be reduced. No land within the Biodiversity Offset Areas will be subject to direct or permanent disturbance nor will there be any impacts to soil fertility, rooting depth, soil profile materials, soil thickness, surface microrelief and/or soil salinity. Therefore, the Project will not significantly reduce the agricultural productivity of potential BSAL within the Biodiversity Offset Areas, but rather modify the land use in the areas of native vegetation.

Section 5.3.3, conservatively assumes that agricultural production from the Biodiversity Offset Areas ceases in the native vegetation areas at the commencement of the Project for perpetuity, the present value of the gross value of production foregone is $21.7 (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $11.5M (using a 7% discount rate) (Gillespie Economics, 2015).

8.5 Equine Critical Industry Cluster

As noted in **Section 3.5**, there are 1,933 ha of mapped Equine CIC within the Study Area. However, it is noted that there are no thoroughbred breeding activities currently occurring within 10 km of the Project Boundary. A total of 699.90 ha of Equine CIC is located within the Project Disturbance Boundary (29 % of the total mapped Equine CIC within the Study Area) and will be directly disturbed as a consequence of the Project. There is an additional 584 ha of mapped Equine CIC within the Biodiversity Offset Areas, 69 ha of which falls within areas of cultivated land and as such will remain for agricultural activities such as equine husbandry.

The area of Equine CIC mapped as occurring within the Bylong Valley is located on the south-western most extremity of the mapped Equine CIC in the Upper Hunter region. The Upper Hunter SRLUP identifies that the relevant equine industry is focused in the Upper Hunter Valley surrounding the township of Scone. **Figure 10** illustrates the isolated location of the mapped Equine CIC within the Study Area in relation to the key equine breeding facilities and related infrastructure surrounding Scone as identified within the Upper Hunter SRLUP.

The impacts in relation to the entire Upper Hunter Equine CIC have been identified as minimal. This is due to the location of the mapped Equine CIC as an isolated pocket located at the absolute extremity of the mapped Equine CIC, approximately 1½ hours drive from the equine centre of Scone.

The maximum potential value of the mapped Equine CIC land within the Project Disturbance Boundary and Biodiversity Offset Areas, should the land be utilised for a purpose which contributes to the equine industry has been estimated below.

8.5.1 Project Disturbance Boundary

Total direct disturbance of 699.90 ha of mapped Equine CIC is predicted as a result of the Project. This constitutes a total of 0.27% of the total mapped Equine CIC in the Upper Hunter.

In accordance with the Rehabilitation and Decommissioning Strategy (SLR, 2015b) developed for the Project, this area of land will be returned to agricultural land use as soon as practical after achieving relevant rehabilitation goals.

Table 46 shows the total quantum value of potential production in areas of mapped Equine CIC within the Project Disturbance Boundary. This value has been developed to determine a potential worst case loss to the equine industry from the land should it be utilised for the best practice equine land use scenario.

Table 46
Quantum and Value of Potential Equine CIC within the Project Disturbance Boundary

Domain	Crop Production (Tonnes)	Number Horses (Head)	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	635	211	$2,023,062.77	$991,071.81
Domain B	0	51	$436,979.88	$224,413.09
Domain C	0	0	$0.00	$0.00
Total	**635**	**262**	**$2,460,042.66**	**$1,215,484.90**

Table 46 demonstrates that under the best practice equine land use scenario described above and in **Appendix 6**, the annual Net Value of Production potentially lost as a result of the direct Disturbance within areas of mapped Equine CIC is $1,215,484.90.

Should, as an absolute worst case, the mapped Equine CIC within the Project Disturbance Boundary be lost for perpetuity, the present value of the gross value of production foregone is $32.4 M (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $16.0 M (using a 7% discount rate) (Gillespie Economics, 2015).

It should be noted that the land within the Project Disturbance Boundary will be returned to agricultural land use as soon as practical after achieving relevant rehabilitation goals, and will not be lost in perpetuity.

8.5.2 Biodiversity Offset Areas

There is 584 ha of Equine CIC mapped within the Biodiversity Offset Areas. Of this, 69 ha falls within areas of cultivated land and as such will remain for agricultural activities such as equine husbandry. Of the remaining 515 ha of mapped Equine CIC, 100 ha is classed as Agricultural Domain C and is therefore considered inappropriate for equine activities. Therefore it has been assumed that 415 ha of mapped Equine CIC will be removed from agricultural production for the purposes of biodiversity value.

The management of the adjacent native vegetation areas adjacent to these farm lands will enhance the farmlands both by improving the aesthetics and providing shelter belts for valuable livestock.

Table 47 shows the total quantum value of potential production in areas of mapped Equine CIC within the Biodiversity Offset Areas. This value has been developed to determine the worst case loss to the equine industry from the land should it be utilised for the best practice equine land use scenario.

Table 47
Quantum and Value of Equine CIC Land Use Scenario within the Biodiversity Offset Areas

Domain	Number Horses (Head)	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	165	$1,422,912.23	$729,741.82
Domain B	32	$272,731.49	$140,062.54
Domain C	0	$0	$0
Total	**197**	**$1,695,643.72**	**$869,804.36**

Table 47demonstrates that under the best practice equine land use scenario described above and in **Appendix 3**, the annual Net Value of Production potentially lost as a result of the Biodiversity Offsets Areas within areas of mapped Equine CIC is $869,804.

Should the mapped Equine CIC within the Biodiversity Offsets Area be lost for perpetuity, the present value of the gross value of production foregone is $22.4 (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $11.5 M (using a 7% discount rate) (Gillespie Economics, 2015).

8.6 Water

A significant proportion of mine site water requirements will be sourced from water collected on the site, including rainfall runoff and groundwater inflows to the open cut pits and underground mining areas which will be stored for reuse within the Mine Water Management System. In addition to this, a borefield will be constructed within the alluvium to supplement water supplies required for the processing of coal within the CHPP.

The results of the water balance modelling show that the existing water licence allocations held by KEPCO of 2,535 units (currently equivalent to 2,535 ML/year) will meet all site demands for all years of operation, even in the driest climatic sequence experienced over the past 112 years. This is partially due to groundwater inflows supplementing the surface water captured on site.

As all off-site water supplies for the Project will be obtained from licensed sources, there will be no adverse impact on other licensed users who will still have access to their entitlement (subject to climatic conditions and the operation of the water supply scheme).

8.6.1 Surface water

The Surface Water and Flooding Impact Assessment for the Project was undertaken by WRM (2015). The Project Boundary is located within the catchment of the Bylong River, a tributary of the Goulburn River, which in turn is a tributary of the Hunter River.

The drainage network in the area of interest is shown in (**Figure 3**). The Bylong River drains generally northwards, from the south-east, through the Project Boundary.

Other named ephemeral rivers and creeks within the Study Area include:

- Wattle Creek;
- Cousins Creek;
- Lee Creek;
- Growee River;
- Dry Creek; and
- Coggan Creek.

The primary areas of disturbance for the Project are in the Dry Creek catchment, where underground mining will occur, and along reaches of the Lee Creek and the Bylong River where mine infrastructure and open cut mining areas are located. The remaining tributaries are not affected by the Project.

The headwaters of the Bylong River catchment are typically steep and well vegetated and include areas of State Forest, such as the Nullo Mountain State Forest. In the lower portions of the catchment, extensive vegetation clearing has occurred for agricultural use, particularly in alluvial areas adjacent to the river channel.

The drainage network within the Project Boundary varies from the steep headwater gullies to wide, flat, alluvial floodplains. The lower reaches of Lee Creek consist of a wide, flat floodplain, with a small, poorly defined low-flow channel. Extensive clearing of the floodplain has been undertaken as part of farming activities, with complete removal of riparian vegetation along substantial reaches. Significant bank erosion is evident in the mid-reaches of Lee Creek.

Surface water monitoring has been undertaken at nine sites since early 2011. Sampling has been undertaken generally on a monthly basis, subject to climate conditions, for salinity, pH, temperature, Dissolved Oxygen, turbidity, alkalinity as well as a number of metals and organic compounds. The monitoring has shown that the Bylong River is slightly alkaline, with electrical conductivity (salinity) ranging from fresh to brackish, with the fresher water within the upper reaches. Similarly, Lee Creek and Dry Creek are slightly alkaline with generally fresh water.

Streamflow monitoring data for the Bylong River is available at the Bylong No.2 Stream Gauge (Station No. 210062) for the period between November 1969 and April 1979. This stream gauge is located within the Project Boundary, approximately 8.5 km upstream of the confluence of the Bylong River with Goulburn River and has a catchment area of approximately 660 km^2. This data shows that the Bylong River contained some flow for 98% of the time based on the available data.

The potential surface water impacts that have been identified as part of the EIS Surface Water and Flooding Impact Assessment (WRM, 2015) include:

- Potential for increased turbidity and sedimentation resulting in impacts to water quality downstream;
- Potential for additional demands on existing water sources;
- Changes to the catchment areas, with consequent impacts on catchment yields and drainage downstream of the site;
- Potential impacts to other licensed users of surface water sources;

- Any requirement for discharge of surplus water, with potential consequent impacts on downstream water quality and quantities; and
- Post-mining surface water impacts on catchment yields, water quality and quantity.

The design of the mine plan has been formulated to reduce the subsidence effects and the associated impacts on the identified sensitive surface features by restricting underground mining to areas outside the valley floors, creek and river systems. Further, the orientation of the longwall panel layout reduces the effects of subsidence on sensitive surface features (for example cliff lines and alluvial land).

8.6.2 Groundwater

The Preliminary Groundwater Impact Assessment included within the Gateway Certificate Application submitted in January 2014 was based on a "*simple modelling platform*" and utilised baseline information available as required by the NSW Government's Guideline for Gateway Applicants.

Since this time, an extensive amount of work has been completed by the Project team to address the detailed recommendations received during the Gateway Certificate Process from:

- Independent Expert Scientific Committee (IESC);
- NSW Office of Water (NOW); and
- Mining and Petroleum Gateway Panel (Gateway Panel).

This ongoing work has resulted in the development of a comprehensive groundwater model for the region to conservatively quantify the impacts of the Bylong Coal Project's operations on water resources.

A Groundwater Impact Assessment has been undertaken for the Project EIS by AGE (2015). As stated previously in **Section 3.6**, one of the significant agricultural resources of the local area is irrigation water from the Bylong River Alluvial groundwater.

Hydrological investigations and extensive groundwater and surface water monitoring within the Study Area have occurred since December 2011. The monitoring program was developed in consultation with NSW Office of Water (NOW) to obtain a detailed understanding of the hydrogeological environment to simulate possible groundwater impacts due to the Project. The monitoring bore network now comprises:

- 35 bores screened with alluvium;
- 10 bores screened with within the weathered zone;
- One bore screened with within basalt;
- Three bores screened with within sandstone strata; and
- 13 bores screened with within the Ulan and Coggan coal seams.

In addition to the monitoring bores there are 13 Vibrating Wire Piezometers , 10 of which have automatic data loggers.

The fieldwork that has been completed to date has indicated that the alluvium in the valley floors is predominately permeable sand and gravel that provide a source of water for the majority of registered groundwater bores in the region. Hydraulic testing suggests that the permeability of the alluvium is high.

The groundwater regime at Bylong has been identified to consist of the following aquifer systems:

- Alluvial aquifer associated with the Bylong River, Lee Creek and Growee River systems.
- Weathered Permian formation aquifer which ranges across the Project Boundary from 5 m to 30 m in thickness. This zone of weathering has the potential to act as a conduit for groundwater depressurisation, a consequence of the increased permeability of the weathered rock matrix;
- There are several coal seams overlying the target Coggan and Ulan coal seams, which could potentially contain water in the lower reaches further to the north-east. Hydraulic testing indicates that the permeability of the coal seams can be high with a median hydraulic conductivity of 0.05 m/day; and
- There are 23 groundwater licences present within the Study Area, which are primarily extracted from the Quaternary Alluvium and used for agricultural purposes.
- Potential groundwater impacts identified include:
- Acceleration of groundwater drawdown effects, changes to groundwater flow directions and changes to groundwater quality;
- Potential for further depressurisation of aquifer systems in the area through the mine void and underground dewatering;
- Increased groundwater seepage in the underground mine workings;
- Impacts of subsidence on the alluvial groundwater systems;
- Acceleration of loss of groundwater yield at existing bore locations; and
- Long term changes (post mine closure) to groundwater levels, groundwater quality and flow direction.

The modelling undertaken within the EIS Groundwater Impact Assessment provides a highly conservative approach in relation to quantifying the Project's impacts on water resources and includes various sensitivity scenarios to address potential worst-case events.

8.7 Dust

The Air Quality and Greenhouse Gas Impact Assessment has been undertaken for the Project EIS by Pacific Environment Limited (2015). The existing air quality within and surrounding the Project Boundary is consistent with a typical rural environment dominated with grazing land. Currently contributors to the local air quality include vehicles (including agricultural plant, traffic on Bylong Valley Way and rail traffic on the Sandy Hollow-Gulgong Railway Line), agricultural activities and quarry emissions.

Baseline air quality has been monitored since August 2011 in accordance with the relevant NSW Environmental Protection Agency (EPA) approved method.

Wind patterns are aligned along the north-west to south-east axis across all seasons which are representative of the topography of the region.

Potential air quality (dust and NOx), spontaneous combustion and greenhouse gas impacts as a result of the Project include:

- Dust generation from land disturbance (vegetation clearing and topsoil stripping);
- Dust generation from mining activities (blasting, loading and movement of haul trucks, overburden emplacement, in pit activities, coal processing and transportation);
- Emissions from ventilation equipment;
- Short-term dust impacts associated with construction activities; and
- Emissions of odorous gases from spontaneous combustion and ventilation shafts.

The modelling results show that no private sensitive receptor is predicted to experience ground level concentrations of PM_{10}, $PM_{2.5}$, TSP and dust deposition above the relevant assessment criteria. Only KEPCO owned receptors are predicted to experience concentrations of dust above the acquisition criteria. The assessment of maximum NO_2 emissions from blasting activities in PY 5 (considered to be the 'worst-case' year) predicted that no receivers would experience NO_2 concentrations above the 1-hour impact assessment criterion of 246 $\mu g/m^3$.

Therefore impacts of dust on agricultural resources and enterprises in the locality are assessed as minimal as the Project will meet legislative criteria governed for air quality. The implementation of real time monitoring systems within the vicinity of the Project will also ensure that dust emission targets are not exceeded. This will be accompanied by the establishment of progressive rehabilitation as each mining area advances, thereby, minimising the extent of dust emissions.

The EIS Air Quality and Greenhouse Gas Impact Assessment addresses the extent of dust emissions in further detail (see PEL (2015)).

8.8 Noise

The Project is located within the Bylong Valley which is a rural area primarily used for agricultural purposes. Industrial noise from the Bylong Quarry which operates in the north-east of the Bylong Valley can occasionally be heard. The Sandy Hollow to Gulgong Railway Line runs through the northern part of the Project Boundary, which is primarily used to carry freight trains from the mines further west to the Port of Newcastle. The Bylong Valley Way and Upper Bylong Road are considered important travel routes within NSW, however neither route is a significant goods transportation route and as such truck movements along the roads are not a significant contributor to noise and vibration levels.

The EIS Noise and Blasting Impact Assessment concluded that with the adopted noise mitigation measures, 12 receivers were predicted to be residually affected greater than the relevant assessment criteria (PEL, 2015). Three receivers are predicted to be significantly impacted (receivers 60, 63 and 69), six moderately impacted (receivers 58, 65A, 68, 141, 151 and 158) and impacts were negligible at three (receivers 56, 57A and 57C) (see EIS Main Volume for ownership information)

In accordance with the requirements of the Voluntary Land Acquisition and Mitigation Policy (DP&E, 2014), the moderately impacted receivers will be subject to voluntary at-property mitigation rights . Significantly impacted receivers will be subject to voluntary at-property mitigation or acquisition rights.

Receiver 69 (Tinka Tong) is predicted to be significantly impacted and is subject to voluntary at-property mitigation or acquisition rights. The Tinka Tong property is mapped as Equine CIC and further described in **Section 3.5.1**.

A campaign of seasonal noise monitoring is currently being undertaken. Five periods of noise monitoring occurred from autumn 2012 to autumn 2013 in five locations within the Project Boundary. The EIS Noise and Blasting Impact Assessment (PEL, 2015b) addresses the extent of noise impacts in further detail.

Given the measures in place to control noise, privately owned agricultural resources and enterprises are not anticipated to be impacted by the Project from this aspect.

8.9 Visual

The EIS Visual Impact Assessment has been undertaken by JVP Visual Planning & Design (2015). The purpose of the assessment was to define the character of the surrounding landscape, assess the visual impacts of the Project and recommend measures to mitigate and manage these impacts.

The existing visual environment of the locality is consistent with that of a rural area. The topography of the Project Boundary includes flat, alluvial floodplains along the Bylong River, surrounded by steep topography and rocky escarpments associated with the Great Dividing Range. Land within the Project Boundary contains cleared grazing areas whilst also including parcels of native vegetation.

Potential visual impacts of the Project include development of Open Cut Mining Areas, OEAs and construction and operation of the mining related infrastructure (including lighting impacts). The OEAs and open cut mining areas have been designed to minimise visual impacts. Materials and colour schemes utilised during the construction of the infrastructure will be designed as to best replicate natural features to lessen the visual impact.

The development and operation of the Project will have minimal visual and landscape impacts outside of the immediate local setting of Lees Creek and the Upper Bylong Valley. The location of the proposed open cut mining areas is isolated from the more sensitive view locations, including Bylong Valley Way and surrounding residences, due to topography and to some extent vegetation screening. In addition the life of the Open Cut operations and proposed progressive rehabilitation ensure the visual exposure times of high visual effect is comparatively very limited (2-5 years) when compared to typical Open Cut mining operations.

There may be some potentially high visual impacts on the Bylong Valley Way associated with the initial construction of the WAF. Roadside and facility landscape treatments will provide screening in 1-2 years for the life of the facility. The recommended rehabilitation strategy, proposed final landform, revegetation strategy and other visual mitigation strategies will ensure that a landscape of high visual diversity is retained in the long term.

The establishment of the Biodiversity Offset Strategy will further mitigate visual impacts over the longer term as stock is gradually removed from the native vegetated areas of each property so that native shrub and tree cover increases.

8.10 Traffic and Support Infrastructure and Services

The EIS Traffic and Transport Impact Assessment has been undertaken by Parsons Brinckerhoff (2015).

The Bylong Valley is primarily accessed via the Bylong Valley Way, which runs generally through the centre of the Study Area. The Bylong Valley Way connects to the Golden Highway to the north and the Castlereagh Highway to the south. The Traffic Impact Assessment found that the Project will have a minimal impact on the surrounding road network in terms of road traffic.

The local road network will continue to operate within substantial spare capacity available in the network and at more than reasonable levels of service throughout the life of the Project. Only small impacts to the operation of the Wollar Road / Ulan-Wollar Road and Wollar Road / Ulan Road intersections are anticipated during peak Project traffic periods (Parsons Brinckerhoff, 2015).

The Project proposes to upgrade existing roads and intersections and build new roads and intersections as required. Road upgrades include the widening of Upper Bylong Road between Bylong Valley Way and the open cut MIA, the realignment of Upper Bylong Road to the east, a new access road from Upper Bylong Road to the underground MIA and the improvements to the existing driveway access from Bylong Valley Way to the proposed Workers Accommodation Facility (WAF) (Parsons Brinckerhoff, 2015).

The closure of Upper Bylong Road south of the Project Disturbance Boundary will impact residents to the south. Alternative routes will include Lee Creek Road or Budden Gap Road. The closure of Upper Bylong Road will increase travel times for residents to the south of the Project by up to 30 minutes, if they utilised Lee Creek Road to access Bylong Valley Way (and Bylong Village) in its current state.

In the event that upgrades of either Lee Creek Road or Budden Gap Road is determined to be not reasonable and feasible then KEPCO will consult with the landowners most impacted by the closure of the southern reaches of Upper Bylong Road in regard to compensation for the loss of access from the northern part of the Upper Bylong Road. The preferred option will be selected as part of the detailed engineering design phase and in close consultation with the MWRC and the local landholders within this area. In the event that upgrading one of these roads is the selected outcome, then it is anticipated to be completed under a separate approval by MWRC and at the cost of KEPCO.

The assessment of the potential implications of the Project on the capacity of the rail network has determined that impacts on the rail network are minor with ample spare capacity provided on the Sandy Hollow to Gulgong Railway line. The Projects rail loop has also been designed not to impact or interfere with train movements on the main line (Sandy Hollow to Gulgong Railway line). Accordingly, minimal impacts are anticipated to the capacity of the Sandy Hollow to Gulgong Railway Line (Parsons Brinckerhoff, 2015).

8.11 Labour Supply

KEPCO proposes the construction and operation of a combined open cut and underground mine in the Bylong Valley. The Project will have a peak workforce of 800 full time employees during Construction, 450 full time employees during dual operations (when open cut and underground mining occur simultaneously) and 275 full time employees during the underground only operation. The Project will, further strengthen the local economy and create significant revenue at Local, State and Federal levels.

The Project will have positive impacts on the local and regional economy through capital costs of the Project, contractor and employee salaries, associated local spending and contributions to community enhancement programs.

KEPCO will continue consultation with the local community and MWRC to develop an employment strategy which will aim to employ locally in preference to seeking employees external to the MWRC LGA, where practical.

The SIA includes a wide range of mitigation strategies which have been developed to address the social impacts of the Project. KEPCO is currently in negotiations with the MWRC LGA in relation to the preparation of a Voluntary Planning Agreement (VPA) for the Project. The VPA is the primary mechanism for managing socio-economic impacts associated with the Project and enhancing positive benefits and opportunities. As part of the VPA KEPCO in conjunction with MWRC aims to develop a Community Investment Fund which will be designed to provide funding for strategic infrastructure projects and community initiatives that aim to deliver measurable improvements in selected priority focus areas which will include skill development and training for young people to mitigate impacts to the labour market.

The EIS Social Impact Assessment (Hansen Bailey, 2015) describes the Project's impact on the broader community in further detail.

9 Mitigation and Management Measures

This section describes the alternatives, which were considered during the design of the Project to minimise impacts to agricultural resources. This section also outlines the recommended mitigation, monitoring and management measures to be implemented during the Project to minimise impacts to agricultural resources.

9.1 Project Design Review

The development of the Project included the consideration and refinement of a number of mine plans and operational alternatives. A key focus of these Project design refinements was to minimise impacts to agricultural resources. EIS Mine Plan Justification Report (Mine Advice, 2015) provides a summary of the work that was undertaken in order to arrive at the proposed Project design. The Project design review has included the consideration of numerous mine plans, operational methods and infrastructure designs and alternatives.

The primary objective of the Project design review was to develop an economically viable mine plan that considered the principles of Ecologically Sustainable Development (ESD), minimised potential environmental and social impacts whilst maximising coal recovery. The various alternatives have also been considered and modified where possible in light of the changing stakeholder's expectations as experienced by other recent Projects within the NSW planning approvals regime.

The mine plan as proposed has been designed so as to reduce impacts to agricultural resources. In particular the design considerations have focussed on avoiding areas of verified BSAL as far as practicable. Relocating the proposed Project Disturbance Boundary would sterilise further coal resources (additional to the coal already sterilised within the Project mine plan) and would result in the Project being unviable from an operational and economic perspective. Additionally, KEPCO's appointed Farm Manager will continue to manage the agricultural land surrounding the mining activities within KEPCO ownership throughout the life of the mine.

The initial development of the Mine Infrastructure, open cut mining areas and OEAs have been designed to ensure they are located outside of the floodplain and alluvial areas, with minimal impacts on BSAL while ensuring maximum coal resource recovery. The North-Western OEA has been designed to disturb as little verified BSAL as practicable (92.5 ha of verified BSAL) within the Project Boundary. This BSAL is mostly beyond the alluvial soils (with only 1 ha within) associated with Lee Creek which was previously understood to be the only BSAL within the Project Boundary. Rehabilitation of the OEAs will ensure the final landform remains in keeping with the surrounding topography.

The Underground Extraction Area has been constrained to minimise impacts to sensitive surface features and the alluvial groundwater. The area contains 186 ha of BSAL, 152 ha of which is located within the Subsidence Study Area. Appropriate management measures will be implemented at the time of subsidence effects to ensure that the limited impacts predicted to this BSAL will not result in a loss of agricultural production capability of this land.

The Project as proposed presents the only viable option for the construction and operation of a coal mine within the authorisation. Mining the coal resource within A286 and A342 utilising underground mining methods only is not economically viable and also presents further environmental constraints in relation to the disposal of fine and coarse reject materials.

Further reducing the areas of open cut mining or readjusting the OEAs to avoid areas of verified BSAL would result in the Project being economically unviable, whilst also potentially resulting in other environmental impacts. The location of Project infrastructure also provides the most appropriate layout in terms of minimising environmental impacts, whilst also avoiding areas of BSAL.

9.2 Environmental Management System

KEPCO will develop and implement an Environmental Management System (EMS) for the Project, consistent with the principles of AS/NZS ISO 14001:2004. The EMS will be a key tool in assisting to reduce any impacts to agricultural resources. The EMS will comprise a number of Environmental Management Plans, an Environmental Monitoring Program (EMP), associated operating procedures and standards, and requirements to report on the Project's performance.

The EMS will be subject to regular reviews and audits, recording of incidents and non-conformances and the maintenance of a Corrective Action Register. All Management Plans will also have measurable Key Performance Indicators. All of these tools will assist in regular feedback and improvement of the EMS, which in turn assesses its effectiveness.

9.2.1 Monitoring and Measurement

KEPCO operates an EMP for the purposes of obtaining relevant background monitoring data. The environmental monitoring network currently comprises of:

- One meteorological monitoring stations;
- Six air quality monitoring stations;
    - Five dust deposition gauges; and
    - One Tapered Element Oscillating Microbalance (TEOM) (including provisions for Particulate matter less than 10 μm (PM_{10}) and Particulate matter less than 2.5 μm ($PM_{2.5}$);
- Nine surface water monitoring locations and three automated loggers; and
- Groundwater monitoring including 84 monitoring locations (with 107 observation points) located within the alluvium (37), shallow hardrock (17) and deep hardrock aquifers (23) and vibrating wire piezometers into various strata depths (total of seven).

The existing EMP is described further in the Main Volume of the EIS. Further refinement of monitoring programs and management plans will be undertaken prior to construction of the Project. A key component of the management plans will be the development of trigger levels and Trigger Response Action Plans, in consultation with stakeholders. The environmental monitoring program and data collected as listed in **Table 48** will form the basis in this regard.

An Annual Review will be prepared for the Project. This document will summarise Project activities and performance in the areas of health, safety, environment and community and will be made available to the public.

Further, all management plans and monitoring data will be made publicly available on the Bylong Coal Project website.

Table 48
Proposed Monitoring Programs and Management Plans

Parameter Monitored	Management Plan	Parameters monitored	Approximate Frequency

Rehabilitation / Biodiversity Offset	Rehabilitation Strategy
	Biodiversity Management Plan
	Biodiversity Offset Management Plan
	Farm Management Plan
		• Pasture Monitoring:
		  ○ Ground cover (%);
		  ○ Frequency of all plant species present (%);
		  ○ Presence of weeds;
		  ○ Estimated pasture yield (kg/ha);
		  ○ Visual assessment of general health.
		• Soil Monitoring
		• Photo Monitoring
		• Weed monitoring
		• Geotechnical stability
		• Surface and groundwater monitoring
			• Six Monthly

Surface Water	Water Management Plan	• Downstream and upstream surface water quality • Sediment dam water quality • Surface water flows	• Monthly
Groundwater	Water Management Plan	• Seepage/leachate • Groundwater levels • Water quality	• Monthly • Monthly • Quarterly
Air Quality	Air Quality Management Plan	• Predictive meteorological forecasting • PM10 and PM2.5 Monitoring (including real time monitoring) • Dust Deposition • Total Suspended Particulate (TSP) • Regional Monitoring (control site)	• Daily • Daily • Monthly • Monthly • Monthly
Blasting	Blast Management Plan	• Filming • Air blast overpressure (dB[Linear peak]); and • Peak particle velocity (mm/s).	• Daily
Noise	Noise Management Plan	• Predictive meteorological forecasting • Real – time noise monitoring for day to day planning • Supplementary attended monitoring	• Daily • Daily • Quarterly
Meteorological Conditions	Air Quality Management Plan	• Rainfall • Temperature @ 2m • Temperature @ 10m • Wind Speed @ 10 m • Wind Direction @ 10 m • Sigma Theta • Solar Radiation	• Daily
Traffic	Construction Environmental Management Plan	• Traffic volume surveys • Amount of coal transported from site • Date and time of each train movement	• Annual • Daily • Daily
Waste	Waste Management Plan	• Quantities of waste • Waste streams	• Six Monthly

9.3 Proposed Agricultural Management Measures

This section describes the recommended management measures and monitoring plan proposed to be implemented for the Project to minimise potential agricultural impacts. The plan should include trigger points and plans for predicted and unforseen impacts of the Project. It should also include appropriate operational responses and remedial action, including the basis for each trigger response.

9.3.1 Minimisation of Disturbance to Agricultural Lands

The area of agricultural land disturbed by the Project at any one time should be minimised so that agricultural uses can continue where practicable. Detailed mine planning should minimise land disturbance in advance of operations and include provisions for progressive rehabilitation. This will assist in reducing impacts to agricultural lands. Once areas are rehabilitated they should be returned to agriculture or set aside for biodiversity purposes.

9.3.2 Continued Management of Existing Agricultural Lands

KEPCO has appointed a Farm Manager to ensure available agricultural land will continue to be used for Agricultural enterprises where practicable. The Farm Manager will also assist to develop and implement the Farm Management Plan for all KEPCO owned land not required for mining purposes. This will ensure the continued productivity of agricultural land not directly impacted by the Project.

The Farm Management Plan will include provisions for grazing and cropping management, erosion and sediment controls and weed and pest controls. This should be communicated and enforced over all land holdings to ensure the ongoing agricultural productivity of agricultural land within the Assessment Area.

The Biodiversity Offset Plan has proposed that a portion of land will be retained for agricultural use in each of the Biodiversity Offset Areas (see **Figure 7**). These areas will be defined within the Biodiversity Management Plan and managed as part of the Farm Management Plan. Sustainable farming practices should be implemented that are consistent with the best management practices for the appropriate Land Capability and Agricultural Suitability Class.

Sustainable farming practices, including reduced till farming and rotational grazing techniques should be implemented in available areas outside of the Project Disturbance Boundary. Farm managers will be required to commit to the implementation of sustainable practices while managing the land to its full potential.

9.3.3 Rehabilitation Strategy and Re-establishment of Agricultural Land

A Rehabilitation Strategy has been developed by KEPCO in consideration of the long and short-term rehabilitation objectives for the Project. Development of the Project will disturb land which is termed the Project Disturbance Boundary. This land is associated with the construction and operation of infrastructure facilities and mining activities proposed for the Project. Each Project activity has a construction and operational disturbance footprint with some parts of the disturbance footprint being progressively rehabilitated immediately after construction and the remainder being rehabilitated following operational use.

The Project's rehabilitation strategy seeks to minimise risks to agricultural resources and minimise long-term impacts. The Project disturbance footprint, impacted by key Project activities in each impact category and preliminary rehabilitation goals are provided in the EIS Rehabilitation and Decommissioning Strategy (SLR, 2015b).

One of the post-mining goals for the Project is to limit impacts on BSAL and minimise the total quantity of BSAL foregone within the Project Boundary. KEPCO's objective is to return all rehabilitated lands disturbed back to at least or better than original land formation. To achieve these objectives the following has been implemented:

- Hydrological alluvial influenced BSAL have been avoided as part of the Project design, as far as practical without causing harm to other environmental aspects;
- KEPCO has committed to the salvage and treatment of suitable soil resources for re-use at closure for land directly and temporarily impacted by mining related activities; and
- BSAL impacted upon by direct and long-term activities will be reinstated on less capable land.

Additionally, it is proposed to establish a small trial area within the Class 4 and 5 rehabilitated lands to investigate the benefits of Natural Sequence Farming (or Soil Hydrology Management) that has been pioneered in the locality. This trial will be conducted in conjunction with local farming experience and expertise and may involve other organisations such as the Tom Farrell Institute centred at the University of Newcastle and the Outcomes Australia Soils for Life Program.

Given the predicted nature of underground mining, it is unlikely that subsidence would result in changes to surface microrelief (MSEC, 2015) or significantly alter the chemical or physical composition of the soil profile to the extent that the land and, where applicable, associated agricultural productivity is significantly impacted and cannot proceed without remediation.

Upon progressive settlement of each subsided long wall panel, it is expected that the land will be able to retain its pre-mining land capability characteristics and, will be utilised as part of Offset Area 5 for the improvement of ecological values.

9.4 Water Management System

The Surface Water Impact Assessment (WRM, 2015) and the Groundwater Impact Assessment (AGE, 2015) prepared for the Project EIS include a detailed explanation and justification of the proposed mitigation and management measures.

KEPCO will utilise its water allocation entitlements responsibly across both its agricultural pursuits and to supplement the ongoing operational water demands for the Project. Utilising these entitlements will assist in ensuring the Project does not adversely impact adjacent private landholders water supplies.

No loss to the currently utilised agricultural water available under KEPCO water allocation entitlements is predicted as a result of mining activities, therefore facilitating effective ongoing agricultural land use management.

The site Water Management Plan will detail reporting and action procedures to monitor compliance with objectives and a process for implementing corrective actions if required.

9.5 Dust and Noise

The impacts of dust and noise on agricultural resources and enterprises in the locality have been assessed as minimal. To ensure that dust and noise targets are not exceeded, real time monitoring systems within the vicinity of the Project will be implemented. Should real time monitoring detect any potential for exceedances appropriate corrective actions will be implemented to avoid impacts where possible. This may include relocating equipment and or scaling back operations in certain areas during unfavourable weather conditions.

9.6 Visual

Numerous mitigation measures have been incorporated into the design and operating plans for the Project that will reduce the visual effect and mitigate the visual impact of the Project on sensitive viewing locations. These include:

- Mine planning and design to ensure that the open cut mining areas are designed to minimise the extent and number of a final void(s) only providing sufficient capacity for the storage of coal processing waste for the ongoing underground long-wall mining operations. The conceptual final landform has also been designed to blend in with the neighbouring topography, as far as practical;
- Progressive rehabilitation of OEAs and disturbed areas. KEPCO plans to minimise the time that disturbed areas are removed from agricultural production by progressively rehabilitating disturbed areas as soon as practical; and
- Development of the Biodiversity Offset Strategy and tree screens, to be planted prior to the construction phase to allow for substantial growth and to maximise survival rates.

The mitigation measures listed above will reduce the visual effect of project components by reducing visibility for sensitive receivers and reducing the level of contrast with the surroundings.

KEPCO will also conduct ongoing consultation with stakeholders surrounding the site throughout the life of the Project. Should any issues arise in relation to visual impacts on surrounding sensitive viewing locations these will be addressed through consultation with the relevant parties.

At completion of mining operations, the Project will be fully rehabilitated and decommissioned. The final rehabilitation and decommissioning of the site will involve further revegetation of disturbed areas on the mine site with woodland communities.

9.7 Weed and Pest Management

The presence of weeds, in particularly noxious species, and feral animals in the landscape has the potential to significantly impact on agricultural productivity. Weed and pest management will be a critical component of continued agricultural production within KEPCO owned land and form part of the Farm Management Plan. Weeds and pests will be managed through a series of controls, including herbicide application, biological controls, manual weeding and baiting. Regular inspections will be undertaken to identify potential weed and pest infestations. Control programs will be implemented according to industry best management practice for the weed or pest species of concern and in consultation with the relevant regulatory bodies. A monitoring and reporting system will be an integral part of this program.

10 Conclusion

The mine plan design in conjunction with land management and monitoring measures (as proposed) will ensure the impact of the Project on agriculture, including SAL, is avoided or minimised to the extent practicable.

The current gross value of agricultural production from land within the Study Area is estimated to be $5,281,063 per annum and the net value of agriculture production is estimated to be $2,457,497.

An area of approximately 1,160 hectares will be lost from agricultural production for varying periods of time as a result of the Project, which includes 440 hectares of land verified as Biophysical Strategic Agricultural Land. As a worst case scenario assuming all land within the Project Disturbance Boundary is unavailable for agricultural production at the same time, the gross value of lost agricultural production is predicted to be $0.8 Million per annum.

An area of approximately 3,800 hectares will be lost from agricultural production for as a result of the Project's Biodiversity Offsets Strategy, which includes 486.25 ha of land verified as Biophysical Strategic Agricultural Land, of which 109.44 ha falls within the cultivated lands and will continue to be managed for agricultural production. As a worst case scenario assuming all land within the 3,800 hectares of Biodiversity Offset Area is unavailable for agricultural production at the same time, the gross value of lost agricultural production is predicted to be $1.4 Million per annum.

The potential gross value of agricultural water per ML removed is $415 and the net value is $101. The maximum gross value lost from agriculture due to Project water requirements is $410,562 per annum and the maximum net value lost is $99,956 per annum during open cut operations (Project Years 3-6).

The current gross value of agricultural production (land and water) predicted to be removed from agricultural production is estimated to be $2.66 M per annum. This represents 4.12% of the gross value of agricultural production in the Mid-Western Regional Council LGA, 0.02% of NSW and 0.005% of Australia.

As the overall agricultural contribution of the Project disturbance footprint is small when compared to the total agricultural production on a regional, state and national scale, the reduced availability and productivity of this land will have a minimal impact to the agricultural industry. In addition, the Project will not reduce the availability of land for agricultural purposes or affect the productivity of existing agricultural land outside the Project Boundary within the locality.

In reality this scenario will never occur as KEPCO is committed to returning appropriate areas within the Project disturbance footprint to agricultural land use practices as soon as possible following achievement of the stated rehabilitation goals.

To compensate for the direct and long-term impacts of the Project (associated with the open cut mining areas and OEAs) on Biophysical Strategic Agricultural Land, KEPCO has committed to progressively stripping and reinstating the Biophysical Strategic Agricultural Land (consistent with the mining schedule described in Volume 1 of the Environmental Impact Statement) as part of the rehabilitation strategy. Upon reinstatement, KEPCO will aim to adjoin or create connectivity with larger areas of in situ Biophysical Strategic Agricultural Land.

These reinstated Biophysical Strategic Agricultural Land areas will be contiguous with other Biophysical Strategic Agricultural Land areas to enhance the total agricultural productivity of the non-disturbed areas within the Project Boundary. Soil stripping and handling protocols for BSAL are provided in the EIS Rehabilitation and Decommissioning Strategy (SLR, 2015b).

It is proposed to establish a small trial area within the Class 4 and 5 rehabilitated lands to investigate the benefits of Natural Sequence Farming (or Soil Hydrology Management) that has been pioneered in the locality. This trial will be conducted in conjunction with local farming experience and expertise and may involve other organisations such as the Tom Farrell Institute centred at the University of Newcastle and the Outcomes Australia Soils for Life Program.

Other potential impacts on agricultural resources and enterprises in the locality, including air quality, noise, water usage, traffic and transport, and labour supply have been assessed as having minimal effect.

To maintain and where possible enhance the agricultural productivity of KEPCO owned land outside the Project Disturbance Footprint it is recommended that KEPCO:

- Develop and implement a weed and pest management plan to control the distribution of invasive species and feral animals over all KEPCO owned land;
- Minimise the time that disturbed areas are removed from agricultural production by progressively rehabilitating disturbed areas as soon as practical;
- Implement sustainable farming practices and management of land situated outside the Bylong disturbance footprint on all KEPCO owned agricultural land;
- Appoint a dedicated Farm Manager to ensure the long term productivity of KEPCO-owned agricultural lands; and
- Expand existing environmental monitoring network within the Project Boundary and in the locality to ensure that no unforseen environmental impacts occur that may deleteriously affect agricultural activities adjacent to the Project Boundary.

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APPENDIX 1

Assumptions for Agricultural Production within the Study Area

Appendix 1 Assumptions for Agricultural Production within the Study Area

Ag Domain		A	B	C	D	Total
Study Area	Ha	3975.00	3805.00	1919.00	618.00	10317.00
CURRENT	DSE/ha	16.03	6.20	2.11	0.00	
	TDM/ha	5.85	2.26	0.77	0.00	

Agricultural Production for Study Area

Agricultural Domain	Area	Enterprise	Area	Quantum of prdn Tonees/ha DSE/ha	Unit of production	Tonnes or Head	Animals sold per head	Gross income/ha or Gross Income/hd	VC/ha or VC/hd	GM/ha or GM/hd	Total quantum of production (Tonnes or Hd sold)	Gross Income	Variable Costs	Gross Margin
Project Area														
A	3975.00	**Livestock**												
		Young Cattle (15-20 Months)	1,243.71	13.52	DSE	887	0.79	$ 584.13	$ 149.47	$ 434.66	700.56	$ 409,216.78	$ 104,712.36	$ 304,504.42
		Young Cattle (15-20 Months)	106.41	11.85	DSE	67	0.28	$ 895.00	$ 500.00	$ 395.00	18.62	$ 16,667.07	$ 9,311.21	$ 7,355.86
		Steers (240-460kg)	354.71	13.07	DSE	521	0.98	$ 830.33	$ 582.80	$ 247.53	510.56	$ 423,937.18	$ 297,557.10	$ 126,380.08
		Steers (in 240 kg out 420kg)	310.37	8.25	DSE	321	1.47	$ 768.01	$ 577.22	$ 190.79	472.54	$ 362,918.46	$ 272,761.80	$ 90,156.65
		In 200-350kg out 680kg (Jap OX Ma	319.24	15.07	DSE	211	0.83	$ 744.06	$ 204.26	$ 539.80	174.81	$ 130,066.81	$ 35,706.05	$ 94,360.76
		Breeders (Inland weaners)	88.68	13.34	DSE	78	1.00	$ 403.53	$ 122.52	$ 281.01	77.59	$ 31,311.27	$ 9,506.75	$ 21,804.53
		EU Custom	303.72	22.77	DSE	769	0.83	$ 827.10	313.16	$ 513.94	638.51	$ 528,107.62	$ 199,954.28	$ 328,153.34
		Bulls	212.83	15.00	DSE	133	1	$ 4,600.00	$ 1,500.00	$ 3,100.00	133.02	$ 611,879.53	$ 199,525.93	$ 412,353.60
		Semen and Embryos	N/A	N/A	N/A	200 Straws 41Embryos	N/A	$ 950.00	$ 103.73	$ 846.27	241.00	$ 55,000.00	$ 25,000.00	30,000.00
		Cropping												
		Lucerne Dry Land	631.83	4.00	Tonnes	2527	n/a	$ 1,152.00	$ 780.52	$ 371.48	2527	$ 727,870.61	$ 493,157.61	$ 234,713.00
		Lucerne Irrigated	155.19	12.86	Tonnes	1995	n/a	$ 4,435.00	$ 3,400.19	$ 1,034.81	1995	$ 688,253.63	$ 527,664.73	$ 160,588.89
		Oaten/Cereal Hay	232.78	4.00	Tonnes	931	n/a	$ 990.00	$ 426.00	$ 564.00	233	$ 230,452.45	$ 99,164.39	$ 131,288.06
		Equine												
		Stockhorse Stud	15.52	N/A	N/A	35	0.04	$ 6,000.00	$ 2,653.67	$ 3,346.33	6	$ 36,000.00	$ 15,922.00	$ 20,078.00
B	3805.00	**Livestock**												
		Young Cattle (15-20 Months)	1,257.37	4.67	DSE	310	0.79	$ 584.13	$ 149.47	$ 434.66	244.51	$ 142,825.89	$ 36,546.98	$ 106,278.91
		Young Cattle (15-20 Months)	1,219.65	4.81	DSE	310	0.28	$ 895.00	$ 500.00	$ 395.00	86.66	$ 77,562.43	$ 43,330.97	$ 34,231.46
		Steers (240-460kg)	219.56	6.47	DSE	160	0.98	$ 830.33	$ 582.80	$ 247.53	156.40	$ 129,861.71	$ 91,148.58	$ 38,713.12
		Steers (in 240 kg out 420kg)	406.23	4.27	DSE	218	1.47	$ 768.01	$ 577.22	$ 190.79	319.90	$ 245,689.77	$ 184,655.22	$ 61,034.56
		In 200-350kg out 680kg (Jap OX Ma	92.85	7.14	DSE	29	0.83	$ 744.06	$ 204.26	$ 539.80	24.08	$ 17,919.57	$ 4,919.30	$ 13,000.28
		Breeders (Inland weaners)	135.41	5.99	DSE	53	1.00	$ 403.53	$ 122.52	$ 281.01	53.20	$ 21,466.38	$ 6,517.63	$ 14,948.75
		EU Cattle	401.39	4.33	DSE	193	0.83	$ 827.10	313.16	$ 513.94	160.56	$ 132,796.45	$ 50,279.94	$ 82,516.51
		Bulls	72.54	9.60	DSE	29	1	$ 4,600.00	$ 1,500.00	$ 3,100.00	29.02	$ 133,474.85	$ 43,524.41	$ 89,950.44
C	1919.00	**Livestock**												
		Young Cattle (15-20 Months)	802.22	1.70	DSE	72	0.79	$ 584.13	$ 149.47	$ 434.66	56.89	$ 33,229.87	$ 8,503.02	$ 24,726.85
		Young Cattle (15-20 Months)	631.67	1.90	DSE	63	0.28	$ 895.00	$ 500.00	$ 395.00	17.69	$ 15,829.54	$ 8,843.32	$ 6,986.22
		Steers (240-460kg)	181.92	1.85	DSE	38	0.98	$ 830.33	$ 582.80	$ 247.53	37.14	$ 30,840.06	$ 21,646.32	$ 9,193.74
		Steers (in 240 kg out 420kg)	227.399605	1.33	DSE	38	1.47	$ 768.01	$ 577.22	$ 190.79	55.71	$ 42,788.07	$ 32,158.60	$ 10,629.46
		Breeders (Inland weaners)	75.80	2.54	DSE	13	1.00	$ 403.53	$ 122.52	$ 281.01	12.63	$ 5,097.92	$ 1,547.83	$ 3,550.09
D	600.00	N/A												
TOTAL												5,281,063.93	2,823,566.33	2,457,497.59

APPENDIX 2

Assumptions for Agricultural Production within the Biodiversity Offset Areas

Appendix 2 Assumptions for Agricultural Production within the Biodiversity Offset Areas

Ag Domain		A	B	C	D	Total
Biodiversity Offset Areas	Ha	1440	1318	1324	0	4082
CURRENT	DSE/ha	16.03	6.20	2.11	0.00	
	TDM/ha	5.85	2.26	0.77	0.00	

Agricultural Production for Biodiversity Offset Areas

Agricultural Domain	Area	Enterprise	Area	Quantum of prdn Tonees/ha DSE/ha	Unit of productio n	Tonnes or Head	Animals sold per head	Gross income/ha or Gross Income/hd	VC/ha or VC/hd	GM/ha or GM/hd	Total quantum of production (Tonnes or Hd sold)	Gross Income	Variable Costs	Gross Margin
Project Area														
		Livestock												
		Young Cattle (15-20 Months)	450.55	13.52	DSE	321	0.79	$ 584.13	$ 149.47	$ 434.66	253.79	$ 148,244.57	$ 37,933.54	$ 110,311.04
		Young Cattle (15-20 Months)	38.55	11.85	DSE	24	0.28	$ 895.00	$ 500.00	$ 395.00	6.75	$ 6,037.88	$ 3,373.12	$ 2,664.76
		Steers (240-460kg)	128.50	13.07	DSE	189	0.98	$ 830.33	$ 582.80	$ 247.53	184.96	$ 153,577.24	$ 107,794.27	$ 45,782.97
		Steers (in 240 kg out 420kg)	112.44	8.25	DSE	116	1.47	$ 768.01	$ 577.22	$ 190.79	171.19	$ 131,472.35	$ 98,811.82	$ 32,660.52
		In 200-350kg out 680kg (Jap OX Mar	115.65	15.07	DSE	76	0.83	$ 744.06	$ 204.26	$ 539.80	63.33	$ 47,118.54	$ 12,935.02	$ 34,183.52
		Breeders (Inland weaners)	32.12	13.34	DSE	28	1.00	$ 403.53	$ 122.52	$ 281.01	28.11	$ 11,342.95	$ 3,443.95	$ 7,899.00
		EU Custom	110.03	22.77	DSE	279	0.83	$ 827.10	313.16	$ 513.94	231.31	$ 191,314.46	$ 72,436.27	$ 118,878.19
A	1440.00	Bulls	77.10	15.00	DSE	48	1	$ 4,600.00	$ 1,500.00	$ 3,100.00	48.19	$ 221,662.02	$ 72,281.09	$ 149,380.93
		Semen and Embryos	N/A	N/A	N/A	200 Straws 41Embryos	N/A	$ 950.00	$ 103.73	$ 846.27	241.00	$ 55,000.00	$ 25,000.00	30,000.00
		Cropping												
		Lucerne Dry Land	228.89	4.00	Tonnes	916	n/a	$ 1,152.00	$ 780.52	$ 371.48	916	$ 263,681.43	$ 178,653.32	$ 85,028.10
		Lucerne Irrigated	56.22	12.86	Tonnes	723	n/a	$ 4,435.00	$ 3,400.19	$ 1,034.81	723	$ 249,329.62	$ 191,154.02	$ 58,175.60
		Oaten/Cereal Hay	84.33	4.00	Tonnes	337	n/a	$ 990.00	$ 426.00	$ 564.00	84	$ 83,484.66	$ 35,923.70	$ 47,560.96
		Equine												
		Stockhorse Stud	5.62	N/A	N/A	13	0.04	$ 6,000.00	$ 2,653.67	$ 3,346.33	6	$ 36,000.00	$ 15,922.00	$ 20,078.00
		Livestock												
		Young Cattle (15-20 Months)	435.54	4.67	DSE	107	0.79	$ 584.13	$ 149.47	$ 434.66	84.70	$ 49,472.93	$ 12,659.37	$ 36,813.56
		Young Cattle (15-20 Months)	422.47	4.81	DSE	107	0.28	$ 895.00	$ 500.00	$ 395.00	30.02	$ 26,866.56	$ 15,009.25	$ 11,857.31
		Steers (240-460kg)	76.05	6.47	DSE	55	0.98	$ 830.33	$ 582.80	$ 247.53	54.17	$ 44,982.32	$ 31,572.62	$ 13,409.70
		Steers (in 240 kg out 420kg)	140.71	4.27	DSE	75	1.47	$ 768.01	$ 577.22	$ 190.79	110.81	$ 85,103.57	$ 63,962.04	$ 21,141.53
B	1318.00	In 200-350kg out 680kg (Jap OX Mar	32.16	7.14	DSE	10	0.83	$ 744.06	$ 204.26	$ 539.80	8.34	$ 6,207.09	$ 1,703.98	$ 4,503.12
		Breeders (Inland weaners)	46.90	5.99	DSE	18	1.00	$ 403.53	$ 122.52	$ 281.01	18.43	$ 7,435.66	$ 2,257.62	$ 5,178.04
		EU Cattle	139.04	4.33	DSE	67	0.83	$ 827.10	313.16	$ 513.94	55.61	$ 45,998.87	$ 17,416.28	$ 28,582.59
		Bulls	25.13	9.60	DSE	10	1	$ 4,600.00	$ 1,500.00	$ 3,100.00	10.05	$ 46,233.86	$ 15,076.26	$ 31,157.60
		Livestock												
		Young Cattle (15-20 Months)	553.48	1.70	DSE	50	0.79	$ 584.13	$ 149.47	$ 434.66	39.25	$ 22,926.71	$ 5,866.60	$ 17,060.11
	1324.00	Young Cattle (15-20 Months)	435.81	1.90	DSE	44	0.28	$ 895.00	$ 500.00	$ 395.00	12.20	$ 10,921.47	$ 6,101.38	$ 4,820.09
C		Steers (240-460kg)	125.51	1.85	DSE	26	0.98	$ 830.33	$ 582.80	$ 247.53	25.63	$ 21,277.88	$ 14,934.72	$ 6,343.16
		Steers (in 240 kg out 420kg)	156.8926926	1.33	DSE	26	1.47	$ 768.01	$ 577.22	$ 190.79	38.44	$ 29,521.31	$ 22,187.59	$ 7,333.72
		Breeders (Inland weaners)	52.30	2.54	DSE	9	1.00	$ 403.53	$ 122.52	$ 281.01	8.72	$ 3,517.27	$ 1,067.92	$ 2,449.36
D	0.00	N/A												
TOTAL												1,998,731.22	1,065,477.75	933,253.48

APPENDIX 3

Assumptions for Potential Value Production within the Mapped Equine CIC Scenario

Appendix 3 Assumptions for Potential Value Production within the Mapped Equine CIC Scenario

Ag Domain		A	B	C	Total
Bylong	Ha	1446.01	749.49	219.59	2415
	%	60	31	9	100
CURRENT	DSE/ha	14.63	5.66	0	
	TDM/ha	5.34	2.06	0.00	0.2

Potential Equine Production

Agricultural Domain	Area	Enterprise	Area	Quantum of prdn Tonees/ha DSE/ha	Unit of producti on	Tonnes or Head	Animals sold per head	Gross income/ha or Gross Income/hd	VC/ha or VC/hd	GM/ha or GM/hd	Total quantum of production (Tonnes or Hd sold)	Gross Income	Variable Costs	Gross Margin
Project Area														
		Cropping												
		Lucerne Dry Land	285.00	4.00	Tonnes	1140	n/a	$ 1,152.00	$ 780.52	$ 371.48	1140	$ 328,320.00	$ 222,448.20	$ 105,871.80
		Lucerne Irrigated	70.00	12.86	Tonnes	900	n/a	$ 4,435.00	$ 3,400.19	$ 1,034.81	900	$ 310,450.00	$ 238,013.30	$ 72,436.70
		Broodmare Farm												
A	1446.00	Broodmares Owned (80% prodgeny sold)	338.50	15.59	DSE	377	0.80	$ 8,000.00	$ 5,456.55	$ 2,543.45	302	$ 2,412,800.00	$ 1,645,695.48	$ 767,104.52
		Broodmares Agisted (Wet Mares)	169.25	15.63	DSE	189	1.00	$ 9,490.00	$ 3,456.55	$ 6,033.45	189	$ 1,793,610.00	$ 653,287.95	$ 1,140,322.05
		Broodmares Agisted (Dry Mares)	169.25	15.63	DSE	189	1.00	$ 8,760.00	$ 2,945.55	$ 5,814.45	189	$ 1,655,640.00	$ 556,708.95	$ 1,098,931.05
		Cattle Grazing Program												
		Cattle Grazing Program	414.00	15.11	DSE	330	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Equine												
		Broodmares Owned (80% prodgeny sold)	224.50	5.43	DSE	87	0.80	$ 8,000.00	$ 5,456.55	$ 2,543.45	70	$ 556,800.00	$ 379,775.88	$ 177,024.12
		Broodmares Agisted (Wet Mares)	112.25	5.49	DSE	44	1.00	$ 9,490.00	$ 3,456.55	$ 6,033.45	44	$ 417,560.00	$ 152,088.20	$ 265,471.80
B	749.00	Broodmares Agisted (Dry Mares)	112.25	5.49	DSE	44	1.00	$ 8,760.00	$ 2,945.55	$ 5,814.45	44	$ 385,440.00	$ 129,604.20	$ 255,835.80
		Cattle Grazing Program												
		Cattle	300	5.06	DSE	80	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Cattle Grazing Program												
C	220.00	Cattle	220	1.72	DSE	20	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL												7,860,620.00	3,977,622.16	3,882,997.84

APPENDIX 4

Assumptions for Value and Quantum of Agricultural Water

Appendix 4 **Assumptions for water removed from agriculture**
Assumptions

Maximum potential

Irrigation

ML	2,535	Potential Irrigation water										
	0											
	2,535											
Rotation	Years	%	ML/ha	Weight ML/ha								
Lucerne	5	71%	8.0	5.7								
Maize	2	29%	7.2	2.1								
				7.8								
Ha in rotation	326.2											
	Lucerne	Maize	Total	$/ML								
Yield (t)	4,194	932										
Gross Value	$ 1,145,419	$ 249,772	$ 1,395,191	$ 550								
Net value	$ 265,168	$ 104,695	$ 369,863	$ 146								

Dryland

ML	0											
Rotation	Years	%										
Lucerne	5	71%										
Sorghum	2	29%										
Ha in rotation	326.2											
	Lucerne	Sorghum	Total	$/ML removed								
Yield (t)	932	419										
Gross Value	$ 268,412	$ 75,491	$ 343,903	$ 415								
Net value	$ 86,553	$ 27,361	$ 113,915	$ 101								

Actual

Irrigation

ML	750	Actual Irrigation Water										
	0											
	750											
Rotation	Years	%	ML/ha	Weight ML/ha								
Lucerne	5	71%	8.0	5.7								
Maize	2	29%	7.2	2.1								
				7.8								
Ha in rotation	96.5											
	Lucerne	Maize	Total	$/ML								
Yield (t)	1,241	276										
Gross Value	$ 338,881	$ 73,897	$ 412,778	$ 550								
Net value	$ 78,452	$ 30,975	$ 109,427	$ 146								

Dryland

ML	0											
Rotation	Years	%										
Lucerne	5	71%										
Sorghum	2	29%										
Ha in rotation	96.5											
	Lucerne	Sorghum	Total	$/ML removed								
Yield (t)	276	124										
Gross Value	$ 79,412	$ 22,335	$ 101,746	$ 415								
Net value	$ 25,608	$ 8,095	$ 33,703	$ 101								

Impact

		Potential*	Actual**	Difference
Volume of irrigation water	ML	2,535	750	1,785
Area	Ha	326.2	96.5	230
Loss of Lucerne	T	3,262	965	2,297
Loss of grain	T	513	152	361
Loss Gross Income	$	$ 1,051,289	$ 311,032	740,257
Loss Net Income	$	$ 255,948	$ 75,724	180,224

* Potential water available for agricultural production being 100% of KEPCOs water allocation
** Actual water currently utilised onsite. This scenario is representative of current land use practices

APPENDIX 5

KEPCO Risk Matrix

BYLONG COAL PROJECT
KEPCO Risk Assessment Tools
Risk Assessment Matrix

Probability Matrix

LIKELIHOOD DESCRIPTORS (Continuous Exposure)	**Benchmark**	**Indicative Probability**
ALMOST CERTAIN		0.97 (1 in 1)
LIKELY	Human Error (Stressed)	0.3 (1 in 3)
POSSIBLE	Engineering SIL1 (Probability of failure on demand (PFD))	0.1 (1 in 10)
UNLIKELY		0.03 (1 in 30)
RARE	Human Error (routine task omission) Engineering SIL 2 (PFD)	$0.01 / 10^{-2}$ (1 in 100)
IMPROBABLE	Human Error (checklist procedure provided) Engineering SIL 3 (PFD)	$0.001 / 10^{-3}$ (1 in 1000)
	Motor vehicle fatality	$0.0001 / 10^{-4}$ (1 in 10,000)
	Engineering SIL 1 Rated (Continuous operation (CO))	$0.00001 / 10^{-5}$ (1 in 100,000))
	Engineering SIL 2 Rated (CO)	$0.000001 / 10^{-6}$ (1 in 1,000,000)
	Engineering SIL 3 Rated (CO), e.g. Lighting strike fatality	$0.0000001 /10^{-7}$ (1 in 10,000,000)

Consequence Severity Matrix

Focus on high severity risk issues

SEVERITY TYPE	CONSEQUENCE SEVERITY (Severity Factor)				
	Minor (1)	**Moderate (3)**	**Serious (10)**	**Major (30)**	**Catastrophic (100)**
HEALTH & SAFETY	Low level symptoms requiring first aid treatment only	Medical treatment injury	Serious injury and / or severe permanent disability or impairment to one or more persons	Single fatality events Severe permanent health impacts to >10 persons	Multiple fatalities from single event or long term health effects Severe permanent health impacts to >50 people
ENVIRONMENT	Limited damage to a localised area. No lasting effects	Localised short to medium term damage to an area of minor local significance	Localised medium term damage to an area of local value	Wide spread long to medium term damage to valued area	Significant, extensive detrimental long term impact affecting sustainability of an ecosystem
REPUTATION	Local public concern / complaints. Minor technical non-compliance	Negative publicity and attention from local media. Moderate breach of regulations	Attention from media, negative regional publicity. Serious breach of regulations with fine.	Significant negative attention, national publicity. Major breach of regulation. Reputation tarnished	Negative international publicity. Very serious litigation. Reputation severely tarnished. Company value may be affected
FINANCIAL LOSS/ GAIN ($US)	< $0.5M	$0.5M to $5M	$5M to $50M	$50 to $500M	>$500M
IRRECOVERABLE BUSINESS PLAN PRODUCTION LOSS	< 3 hrs	3hrs to 1 day	1 to 10 days	10 to 100 days	> 100 days
PROJECT DELAY (NPV Impact)	<8 hrs	8 hrs to 3 days	3 to 30 days	30 days to 1 year	> 1 year
LEGAL	Minor non-compliances and breaches of regulations	Minor legal issues, moderate non-compliances and breaches of regulations	Serious breach of regulation with prosecution or moderate fine possible	Major breach of regulation. Major litigation	Significant prosecution and fines. Very serious litigation including class action or government action
OPPORTUNITIES (As per Financial, reputation as stated)	Low Value contribution. Benefit to local reputation but limited for the Corporation	Minor contribution to Project. Large benefit to local reputation and some minor Corporate image benefit	Attractive value to Project. Discernable enhancement of Corporate reputation amongst peers	Very attractive value to the Corporation. Enhanced Corporate national public reputation	Exceptional value to the Corporation. Significant enhanced Corporate global enhanced reputation

Downside Risk Matrix

		CONSEQUENCE SEVERITY (Severity Factor)				
		Minor (1)	Moderate (3)	Serious(10)	Major (30)	Catastrophic (100)
LIKELIHOOD (Exposure x Probability)	**Almost Certain (≥0.97)**	1	3	10	30	100
	Likely (0.3)	0.3	0.9	3	9	30
	Possible (0.1)	0.1	0.3	1	3	10
	Unlikely (0.03)	0.03	0.09	0.3	0.9	3
	Rare (0.01)	0.01	0.03	0.1	0.3	1
	Improbable (≤0.001)	<0.001	0.003	0.01	0.03	0.1

Risk Acceptability Criteria (downside risk)

Risk Category	Risk Rating	HSE Risk Treatment	Non-HSE Risk Treatment
Critical	>10	HSE risks in this range shall not be tolerated under any circumstances. Operation in the affected area/ process shall not commence/ proceed until the HSE risk has been reduced to an acceptable level by the implementation of robust controls.	Financial and reputational risks in this range are inconsistent with Corporate expectations and shall only be accepted with written Board approval.
High	≥3 and ≤10	HSE risks in this range are highly undesirable and should not be tolerated. Operation in the affected area/ process should not continue unless the HSE risk has been proven to be reduced to an acceptable level by the implementation of intensive management controls authorised by the Senior Executive for a limited period of time.	Financial and reputational risks in this range are inconsistent with Corporate values and can only be accepted with written CEO approval.
Moderate	≥0.3 and <3	Potential catastrophic and major severity HSE risks in this range shall be verified through formal governance programs.	Financial and reputational risks in this range must be managed by formal systems.
Low	<0.3	Risks occurring in this area acceptable to The Corporation provided control systems are operating effectively.	

Risk Quantification

Risk Type	Description	Likelihood	Consequences	Overall Rating (without mitigation measures)
Availability and productivity of agricultural land	Project will result in large areas of productive land being removed from agriculture for at least the life of the open mining cut operations	Likely (0.3)	Serious (10)	High (3)
	Biodiversity Offsets will result in large areas of productive land being removed from agriculture	Likely (0.3)	Serious (10)	High (3)
	Project will impact on highly productive alluvial soils	Likely (0.3)	Serious (10)	High (3)
Availability of water for agricultural production	Project affects groundwater availability (depth) increasing cost of stock and irrigation water pumping	Possible (0.1)	Major (30)	High (3)
	Increased competition and cost for water resources and licensing	Unlikely (0.03)	Serious (10)	Moderate (0.3)
Surface water and groundwater	Project affects downstream surface water quality	Possible (0.1)	Major (30)	High (3)
	Project affects downstream groundwater quality	Possible (0.1)	Major (30)	High (3)
	Coarse rejects and fine rejects emplacement affects the groundwater quality	Possible (0.1)	Major (30)	High (3)
	Project will result in new landforms which will affect drainage and cause an aflux in flood events	Possible (0.1)	Major (30)	High (3)
Subsidence	Project will result in large areas of productive land being removed from agriculture for at least the life of the underground mining operations	Unlikely (0.03)	Major (30)	Moderate (0.9)
Traffic and transport	Change in traffic and support infrastructure impacts on efficiency of agricultural operations	Possible (0.1)	Major (30)	High (3)
	Increase in coal rail movements affects agricultural rail movements	Unlikely (0.03)	Serious (10)	Moderate (0.3)
Noise	Noise levels have adverse impacts on animal behaviour and production	Unlikely (0.03)	Serious (10)	Moderate (0.3)
Air quality	Dust from Project will affect plant growth and or quality or impact on animal performance	Unlikely (0.03)	Serious (10)	Moderate (0.3)
Soils and Land Capability	Project will result in large areas of reduced land capability	Possible (0.1)	Serious (10)	Moderate (0.1)

Impacts on Biophysical Strategic Agricultural Land	Project will result in large areas of Biophysical Strategic Agricultural Land being removed from agriculture for at least the life of the open mining cut operations	Possible (0.1)	Serious (10)	Moderate (0.1)
Visual and lighting	Visual impact on mine affects the marketability of agricultural production or enterprises in locality	Unlikely (0.03)	Moderate (3)	Low (0.09)
Business and Infrastructure	Project will result in a negative flow-on impact to agricultural infrastructure and businesses in the locality by removing productive land from agriculture	Unlikely (0.03)	Moderate (3)	Low (0.09)
Impacts on Critical Industry Cluster	Project will result in a negative flow-on impact to the Equine Critical Industry Cluster	Unlikely (0.03)	Moderate (3)	Low (0.09)
Rehabilitation and Final Land Use and Closure	Productive land will not be reinstated post-mining	Unlikely (0.03)	Serious (10)	Moderate (0.3)
Labour	Removed labour resources from agriculture	Possible (0.1)	Moderate (3)	Moderate (0.3)
	Increased competition and cost for agricultural labour resources	Possible (0.1)	Moderate (3)	Moderate (0.3)
Weed Management	Increased vehicle and personnel movements encourage importation of weeds	Possible (0.1)	Moderate (3)	Moderate (0.3)
Bushfire	Project will increase bushfire risk to property due to changes in land use	Possible (0.1)	Serious (10)	Moderate (1)

APPENDIX 6

Assumptions for Agricultural Production within the Project Disturbance Boundary

Appendix 6 Assumptions for Agricultural Production within the Project Disturbance Boundary

Ag Domain		A	B	C	D	Total
Disturbance Boundary	Ha	451.00	694.00	15.00	0.00	1160.00
CURRENT	DSE/ha	16.03	6.20	2.11	0.00	
	TDM/ha	5.85	2.26	0.77	0.00	

Agricultural Production for Disturbance Boundary

Agricultural Domain	Area	Enterprise	Area	Quantum of prdn Tonees/ha DSE/ha	Unit of production	Tonnes or Head	Animals sold per head	Gross income/ha or Gross Income/hd	VC/ha or VC/hd	GM/ha or GM/hd	Total quantum of production (Tonnes or Hd sold)	Gross Income	Variable Costs	Gross Margin
Project Area														
A	451.00	**Livestock**												
		Young Cattle (15-20 Months)	141.11	13.52	DSE	101	0.79	$ 584.13	$ 149.47	$ 434.66	79.48	$ 46,429.38	$ 11,880.57	$ 34,548.80
		Young Cattle (15-20 Months)	12.07	11.85	DSE	8	0.28	$ 895.00	$ 500.00	$ 395.00	2.11	$ 1,891.03	$ 1,056.44	$ 834.59
		Steers (240-460kg)	40.25	13.07	DSE	59	0.98	$ 830.33	$ 582.80	$ 247.53	57.93	$ 48,099.54	$ 33,760.57	$ 14,338.97
		Steers (in 240 kg out 420kg)	35.21	8.25	DSE	36	1.47	$ 768.01	$ 577.22	$ 190.79	53.61	$ 41,176.41	$ 30,947.31	$ 10,229.09
		In 200-350kg out 680kg (Jap OX Market)	36.22	15.07	DSE	24	0.83	$ 744.06	$ 204.26	$ 539.80	19.83	$ 14,757.27	$ 4,051.18	$ 10,706.09
		Breeders (Inland weaners)	10.06	13.34	DSE	9	1.00	$ 403.53	$ 122.52	$ 281.01	8.80	$ 3,552.55	$ 1,078.63	$ 2,473.92
		EU Custom	34.46	22.77	DSE	87	0.83	$ 827.10	313.16	$ 513.94	72.44	$ 59,918.63	$ 22,686.64	$ 37,231.99
		Bulls	24.15	15.00	DSE	15	1	$ 4,600.00	$ 1,500.00	$ 3,100.00	15.09	$ 69,423.31	$ 22,638.04	$ 46,785.28
		Cropping												
		Lucerne Dry Land	71.69	4.00	Tonnes	287	n/a	$ 1,152.00	$ 780.52	$ 371.48	287	$ 82,583.56	$ 55,953.23	$ 26,630.33
		Lucerne Irrigated	17.61	12.86	Tonnes	226	n/a	$ 4,435.00	$ 3,400.19	$ 1,034.81	226	$ 78,088.65	$ 59,868.38	$ 18,220.27
		Oaten/Cereal Hay	26.41	4.00	Tonnes	106	n/a	$ 990.00	$ 426.00	$ 564.00	26	$ 26,146.93	$ 11,251.10	$ 14,895.83
		Equine												
		Stockhorse Stud	1.76	N/A	N/A	4	0.04	$ 6,000.00	$ 2,653.67	$ 3,346.33	6	$ 36,000.00	$ 15,922.00	$ 20,078.00
B	694.00	**Livestock**												
		Young Cattle (15-20 Months)	229.33	4.67	DSE	56	0.79	$ 584.13	$ 149.47	$ 434.66	44.60	$ 26,050.24	$ 6,665.86	$ 19,384.38
		Young Cattle (15-20 Months)	222.45	4.81	DSE	56	0.28	$ 895.00	$ 500.00	$ 395.00	15.81	$ 14,146.73	$ 7,903.20	$ 6,243.53
		Steers (240-460kg)	40.05	6.47	DSE	29	0.98	$ 830.33	$ 582.80	$ 247.53	28.53	$ 23,685.68	$ 16,624.73	$ 7,060.95
		Steers (in 240 kg out 420kg)	74.09	4.27	DSE	40	1.47	$ 768.01	$ 577.22	$ 190.79	58.35	$ 44,811.74	$ 33,679.55	$ 11,132.19
		In 200-350kg out 680kg (Jap OX Market)	16.94	7.14	DSE	5	0.83	$ 744.06	$ 204.26	$ 539.80	4.39	$ 3,268.38	$ 897.24	$ 2,371.14
		Breeders (Inland weaners)	24.70	5.99	DSE	10	1.00	$ 403.53	$ 122.52	$ 281.01	9.70	$ 3,915.29	$ 1,188.76	$ 2,726.53
		EU Cattle	73.21	4.33	DSE	35	0.83	$ 827.10	313.16	$ 513.94	29.28	$ 24,220.95	$ 9,170.64	$ 15,050.32
		Bulls	13.23	9.60	DSE	5	1	$ 4,600.00	$ 1,500.00	$ 3,100.00	5.29	$ 24,344.69	$ 7,938.49	$ 16,406.20
C	15.00	**Livestock**												
		Young Cattle (15-20 Months)	6.27	1.70	DSE	1	0.79	$ 584.13	$ 149.47	$ 434.66	0.44	$ 259.74	$ 66.46	$ 193.28
		Young Cattle (15-20 Months)	4.94	1.90	DSE	0	0.28	$ 895.00	$ 500.00	$ 395.00	0.14	$ 123.73	$ 69.12	$ 54.61
		Steers (240-460kg)	1.42	1.85	DSE	0	0.98	$ 830.33	$ 582.80	$ 247.53	0.29	$ 241.06	$ 169.20	$ 71.86
		Steers (in 240 kg out 420kg)	1.777485188	1.33	DSE	0	1.47	$ 768.01	$ 577.22	$ 190.79	0.44	$ 334.46	$ 251.37	$ 83.09
		Breeders (Inland weaners)	0.59	2.54	DSE	0	1.00	$ 403.53	$ 122.52	$ 281.01	0.10	$ 39.85	$ 12.10	$ 27.75
D	600.00	N/A												
TOTAL												673,509.80	355,730.81	317,778.98