Agricultural Impact Statement

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Drayton South Coal Project
Agricultural Impact Statement

Report prepared for Hansen Bailey Environmental Consultants on behalf of Anglo American Metallurgical Coal Pty Ltd

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Executive Summary

Scott Barnett & Associates was commissioned by Hansen Bailey Environmental Consultants on behalf of Anglo American Metallurgical Coal Pty Ltd to undertake an agricultural impact statement for the Drayton South Coal Project (the Project). The purpose of the assessment is to form part of an Environmental Assessment being prepared by Hansen Bailey to support an application for a contemporary Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* to facilitate the continuation of the existing Drayton Mine by the development of an open cut and highwall mining operation and associated infrastructure within the Drayton South area.

The Project is situated in the Upper Hunter region, which has a long history of rural land use for a variety of agricultural and industrial activities, predominantly grazing and coal mining. The current dominant land uses within and adjacent to Drayton South include open cut coal mining, power generation, thoroughbred horse breeding, viticulture, dairying and cattle grazing.

Biophysical Strategic Agricultural Land in proximity to Drayton South includes the Hunter Regulated River Water Source (Hunter River) and the Hunter Alluvial soil landscape grouping (DP&I, 2012). The Hunter River is located to the south of the Project Boundary and meanders from north-west to south-east. The river is a major agricultural asset for the locality and the region in general, serving as a highly reliable water source for industries (mining and power generation), town water, irrigation and stock and domestic supply.

Two of NSW premier thoroughbred studs (Coolmore Stud and Woodlands Stud) operated by Coolmore Australia and Darley Australia respectively, along with five other thoroughbred studs are in the locality of Drayton South. These enterprises have been identified as part of the equine Critical Industry Cluster, as mapped in the *Strategic Regional Land Use Plan – Upper Hunter* (DP&I, September 2012).

Several other agricultural enterprises operate within the locality of Drayton South, including:

- 11 dairies;
- Four vineyards (three with wineries), including Arrowfield Estate, immediately to the south of Drayton South, which was previously operated under the Arrowfield brand and now under the management of Hollydene Estate. These enterprises have been identified as part of the viticulture Critical Industry Cluster as described in the *Strategic Regional Land Use Plan – Upper Hunter* (DP&I, September 2012); and
- An olive grove and olive processing plant.

The Project is not directly situated on Biophysical Strategic Agricultural Land or land operated by thoroughbred breeding and viticulture enterprises; however, part of the Project corresponds with the equine and viticulture Critical Industry Cluster as mapped in the *Strategic Regional Land Use Plan – Upper Hunter* (DP&I, September 2012).

The agricultural industry in the Upper Hunter region, which includes the Singleton, Muswellbrook, Upper Hunter, Dungog, Gloucester and the Great Lakes LGA, is suggested to have a total regional export output of approximately $403 M and employs approximately 5,039 people (Buchan Consulting, 2011).

The land that comprises Drayton South (4,597 ha) is owned by Anglo American and licensed to two landholders who use the land for beef production. One licensee also operates opportune horse agistment during the thoroughbred breeding season when demand dictates.

The current gross value of beef production from Drayton South is estimated to be $701,208 per annum turning off 1,140 head of cattle per year. With further development of the property this could rise to $1,229,543 per annum turning off 1,998 head of cattle per year. Not all of Drayton South will be removed from agriculture. The area that will be removed from agriculture (Drayton South disturbance footprint) is approximately 1,928 ha and is predominantly the least productive land within Drayton South. The gross value of production from the beef enterprises within this area is estimated to be $257,110 per annum.

As part of the Project's Biodiversity Offset Package, land located near Murrurundi in the Liverpool Plains LGA, approximately 70 km north of the Project, is proposed to be conserved in perpetuity. The proposed offsite biodiversity offset (2,079 ha) runs merino wethers and beef breeders. Gross value of production from wool and livestock sales is $500,828 per annum. Further development of the property could see this increase to $688,048 per annum through the running of wethers alone.

The value of agricultural production from the combined area lost to agriculture (the Drayton South disturbance footprint and offsite biodiversity offset) is predicted to be $0.8 M per annum. This represents 0.225% of the gross value of agricultural production in the Hunter region, 0.008% of NSW and 0.002% of Australia.

As the overall agricultural contribution of the Drayton South disturbance footprint and the offsite biodiversity offset 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. 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.

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

Moderate to high visual impacts are anticipated at sensitive receptors to the south of the Project Boundary for a period of 16 months during the construction of the Houston visual bund. This structure will ultimately shield views into the Houston and Whynot mining areas. Following the construction and rehabilitation of the visual bund, visual aesthetics will be restored, as far as practical, and the impact of the Project from this aspect will be reduced to moderate to low.

To maintain and where possible enhance the agricultural productivity of land outside the Drayton South disturbance footprint it is recommended that Anglo American:

- Develop and implement a weed and pest management plan to control the distribution of invasive species and feral animals at Drayton South and the offsite biodiversity offset;
- Consult with Hunter Livestock Health and Pest Authority as to the appropriateness of the weed and pest management plan;
- Implement sustainable farming practices in available areas outside of the Drayton South disturbance footprint including implementation of measures as proposed by the Catchment Management Authority for the restoration of Saddlers Creek;

- Continue with arrangements for sustainable farming practices and management of land situated outside the Drayton South disturbance footprint but within other areas of the Project Boundary; and
- Implement sustainable farming practices on the offsite biodiversity offset should the property be managed in part for agricultural purposes.

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1 Introduction

Scott Barnett & Associates (SBA) was commissioned by Hansen Bailey Environmental Consultants on behalf of Anglo American Metallurgical Coal Pty Ltd (Anglo American) to undertake an agricultural impact statement for the Drayton South Coal Project (the Project). The purpose of the assessment is to form part of an Environmental Assessment (EA) being prepared by Hansen Bailey to support an application for Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to facilitate the continuation of the existing Drayton Mine by the development of an open cut and highwall mining operation and associated infrastructure within the Drayton South area.

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

- Addressing the Director-General's Environmental Assessment Requirements (EARs) relating to agriculture, issued on 3 August 2011 and the supplementary Director-General's EARs, issued on 30 April 2012;
- 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 potential domains of the land within Drayton South and the offsite biodiversity offset;
- 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 Drayton South 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 potential loss of agricultural activities from within the offsite biodiversity offset in terms of value of agricultural production and downstream activities within the value chain and support activities;
- Assessing the use of the regulated water supply for the Project in comparison to it being used for agricultural purposes within the regulated system;
- Assessing the potential impacts on the agricultural resources and enterprises within the locality; and
- Providing appropriate mitigation and management measures.

1.1 Project Description

Drayton Mine is managed by Anglo Coal (Drayton Management) Pty Ltd, which is owned by Anglo American. Drayton Mine commenced production in 1983 and currently holds Project Approval 06_0202 (dated 1 February 2008) that expires in 2017 at which time the operation will have to close.

The Project will allow for the continuation of mining at Drayton Mine by the development of open cut and highwall mining operations within the Drayton South mining area while continuing to utilise the existing infrastructure and equipment from Drayton Mine.

The Project is located approximately 10 km north-west of the village of Jerrys Plains and approximately 13 km south of the township of Muswellbrook in the Upper Hunter Valley of New South Wales (NSW). The Project is predominately situated within the Muswellbrook Shire Local Government Area (LGA), with the south-east portion falling within the Singleton Shire LGA. **Figure 1** illustrates the location of the Project. The Project is located adjacent to two thoroughbred horse studs, two power stations and several existing coal mines.

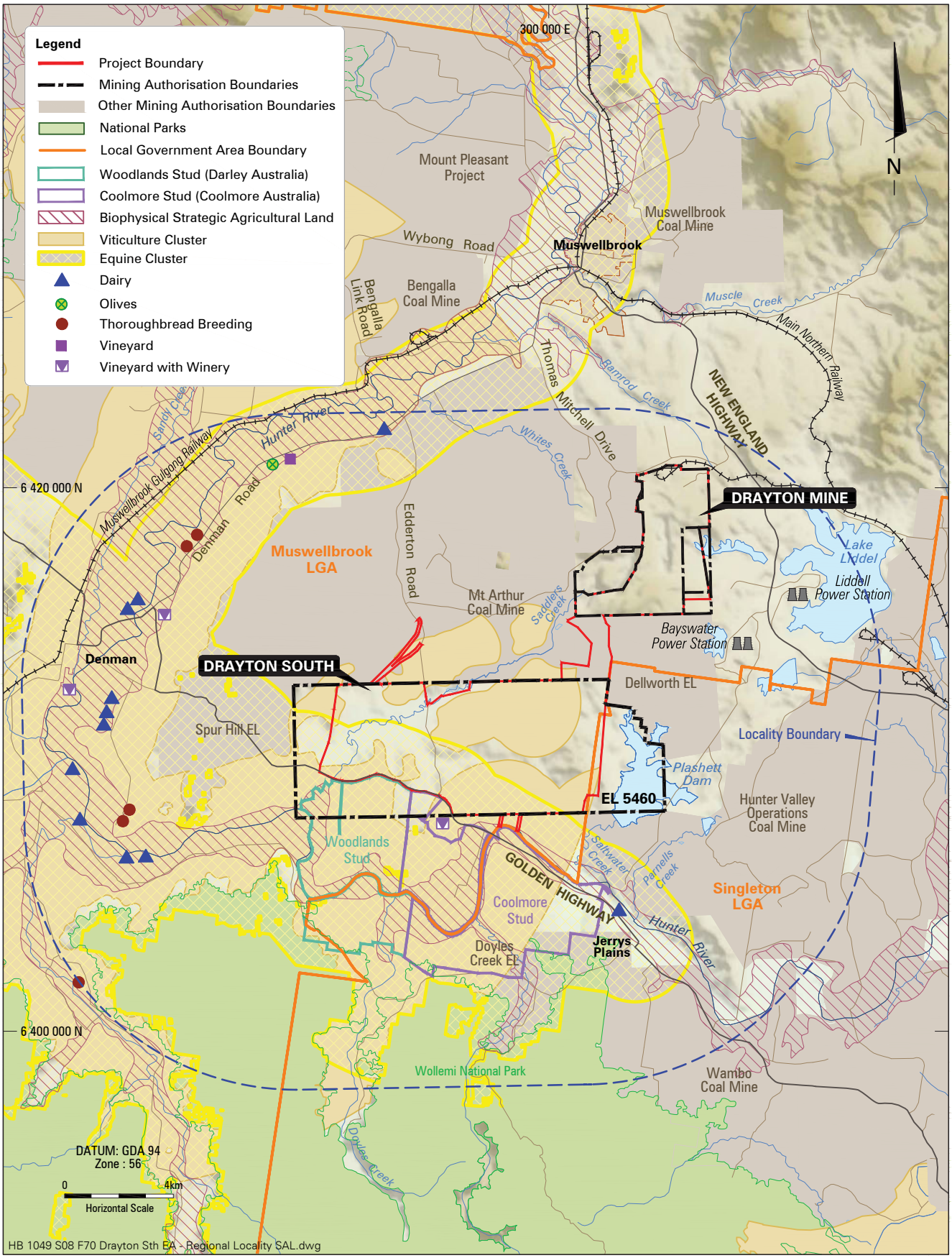
The Project will extend the life of Drayton Mine by a further 27 years ensuring the continuity of employment for its workforce, the ongoing utilisation of its infrastructure and the orderly rehabilitation of Drayton Mine's completed mining areas.

Anglo American is seeking Project Approval under Part 3A of the EP&A Act 1979 to facilitate the extraction of coal by both open cut and highwall mining methods within Exploration Licence (EL) 5460 for a period of 27 years. The Project Application Boundary (Project Boundary) is shown in **Figure 1**.

The Project generally comprises:

- The continuation of operations at Drayton Mine as presently approved with minor additional mining areas within the East, North and South Pits;
- The development of an open cut and highwall mining operation extracting up to 7 Mtpa of Run of Mine (ROM) coal over a period of 27 years;
- The utilisation of the existing Drayton Mine workforce and equipment fleet (with an addition of a highwall miner and coal haulage fleet);
- The Drayton Mine fleet consists of at least a dragline, excavators, fleet of haul trucks, dozers, graders, water carts and associated supporting equipment;
- The use of Drayton Mine's existing voids for rejects and tailings disposal and water storage to allow for the optimisation of the Drayton Mine final landform;
- The utilisation of the existing Drayton Mine infrastructure including the Coal Handling and Preparation Plant (CHPP), rail loop and associated loadout infrastructure, workshops, bath houses and administration offices;
- The construction of a transport corridor between Drayton South and Drayton Mine;
- The utilisation of the Antiene Rail Spur off the Main Northern Railway to transport product coal to the Port of Newcastle for export;
- The realignment of a section of Edderton Road; and
- The installation of water management and power reticulation infrastructure at Drayton South.

The conceptual layout of the Project is shown in **Figure 2**.

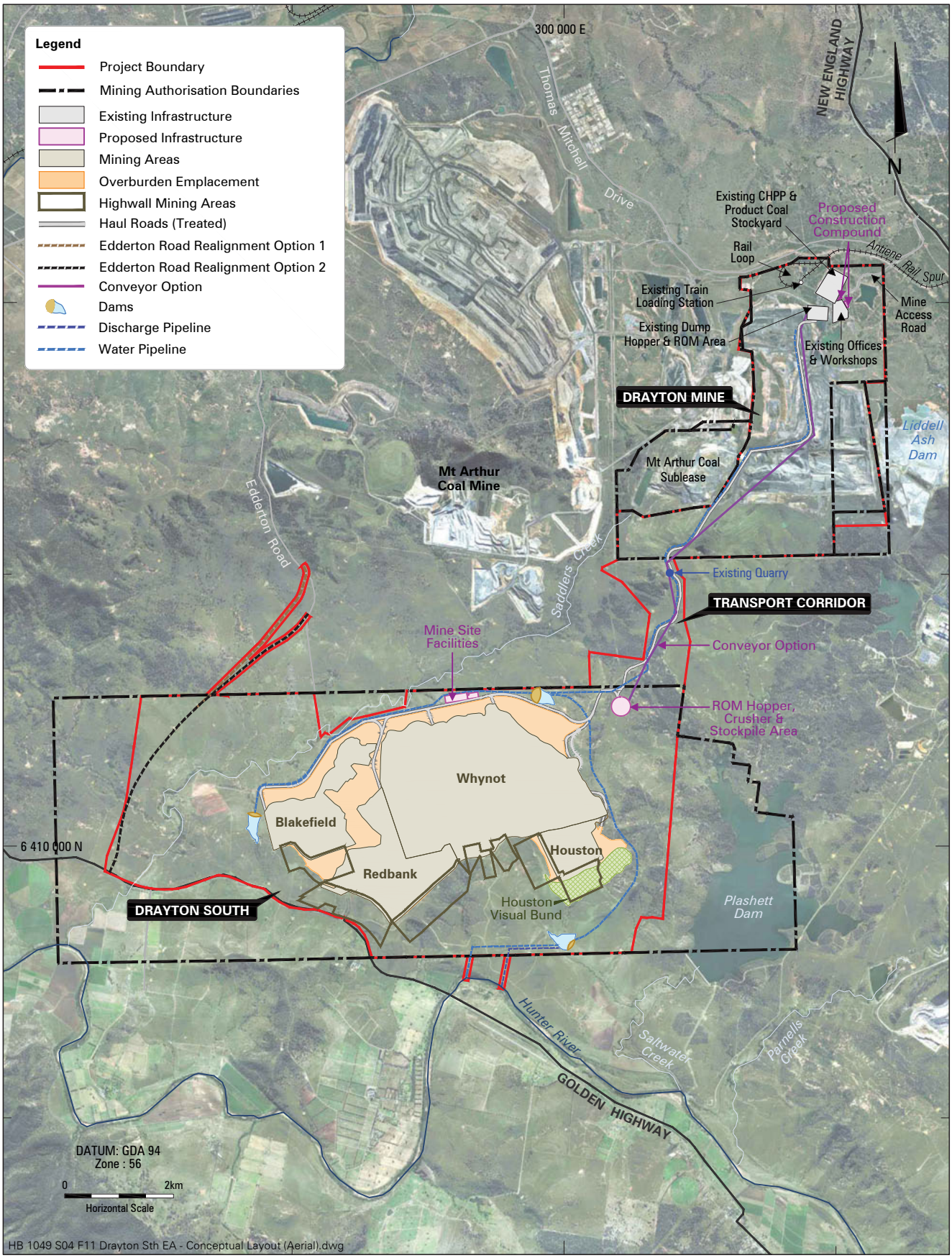


DRAYTON SOUTH COAL PROJECT

Regional Locality Plan

FIGURE 1

Scott Barnett & Associates



DRAYTON SOUTH COAL PROJECT

Conceptual Project Layout

FIGURE 2

Scott Barnett & Associates

1.2 Study Area

The study area for the agricultural impact statement comprises three components:

- An overall area of 4,597 ha and includes the Drayton South disturbance footprint and the transportation corridor (Drayton South) (see **Figure 1**);
- Agriculture in the general locality, which is defined as the land within a 10 km radius of Drayton South (see **Figure 1**), including State significant agricultural resources; and
- Land located near Murrurundi in the Liverpool Plains LGA, approximately 70 km north of the Project, proposed to be conserved as part of the Project's Biodiversity Offset Package (BOP) (referred to as the offsite biodiversity offset) (**Figure 5**).

The assessment does not address Drayton Mine, which is an existing approved mining operation.

1.3 Related Studies

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

- The EA soil and land capability impact assessment;
- The EA ecology impact assessment;
- The EA surface water impact assessment;
- The EA groundwater impact assessment;
- The EA air quality and greenhouse gas impact assessment;
- The EA acoustic impact assessment;
- The EA equine health impact assessment;
- The EA visual impact assessment;
- The EA traffic and transport impact assessment;
- The EA social impact assessment; and
- The EA economic impact assessment.

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.

Part 3A of the EP&A Act provides an approvals regime for all 'major projects'. Major projects are defined under Schedule 1 of the *State Environmental Planning Policies (Major Development) 2005* (SEPP (Major Development)) and are identified by way of declaration as a listed project or by notice in the NSW government gazette. The Minister is the consent authority for all projects to which Part 3A applies. Under Part 3A, the Minister was able to issue a project approval or a concept approval following consultation with the community and relevant State government agencies. The requirement for certain other permits and licences is removed under Part 3A.

In October 2011, Part 3A of the EP&A Act was repealed. However, the Project has been granted the benefit of transitional provisions and despite the recent repeal is a development to which Part 3A applies.

All applications for Project Approval under Part 3A of the EP&A Act must be supported by an EA. The EA is to be prepared in accordance with the Director-General's EARs. This assessment, which forms part of the EA, addresses the EARs relating to agriculture. **Table 1** lists the EARs that are relevant to this assessment and the sections in this report where these EARs are addressed.

Table 1 Director General's Environmental Assessment Requirements

Key Issue	Requirement	Report Section Where Addressed
Agricultural Productivity	A description of the agricultural resources (especially soils and water resources used or capable of being used for agriculture) and agricultural enterprises in the locality.	3.3, 3.4, 4.1 and 4.2
	Identification of any regionally or state significant agricultural resources in the locality, with particular reference to the thoroughbred breeding industry.	4.1.2 and 4.2
	A detailed assessment of the potential impacts of the project on agricultural resources and agricultural enterprises on the site and in the locality, with particular reference to the thoroughbred breeding industry.	2.2 and 8.0
	Management measures to avoid, reduce or mitigate impacts on agricultural resources and enterprises, with particular reference to the thoroughbred breeding industry.	9.0
	Justification for significant long term changes to agricultural resources and post mining agricultural land use options, particularly if highly productive agricultural resources (eg thoroughbred horse studs and alluvial lands) are proposed to be affected by the project.	10.0
	An Agricultural Impact Statement that includes a specific focused assessment of the impacts of the proposal on strategic agricultural land, having regard to the gateway criteria in the Upper Hunter Strategic Regional Land Use Plan.*	2.2

** Supplementary requirement issued by the Director General on 30 April 2012.*

2.2 Strategic Regional Land Use Plan – Upper Hunter

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

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

2.2.1 Biophysical Strategic Agricultural Land

The SRLUP maps and prescribes criteria for BSAL as outlined in **Table 2**. Drayton South has been assessed against the mapping and criteria outlined in the SRLUP and validated as part of the soil and land capability impact assessment (Appendix Q of the EA) (EES, 2012) to gain an appreciation of the extent and likely impact of the Project on potential BSAL.

In accordance with the mapping illustrated in the SRLUP, the Drayton South disturbance footprint is not situated on BSAL. Furthermore, **Table 2** validates that the Drayton South area, which includes the Drayton South disturbance footprint, does not trigger all relevant criteria required to represent BSAL. As such, the Project will not impact on BSAL and is not required to be assessed against the relevant Gateway criteria.

Table 2 Biophysical Strategic Agricultural Land Criteria Assessment

Criteria	Validation
Land that falls under soil fertility classes 'high' or 'moderately high' under the Draft Inherent General Fertility of NSW (OEH), and	The Drayton South disturbance footprint is situated on land identified as soil fertility class 'moderately low' and 'moderate' as mapped by the *Draft Inherent Soil Fertility of NSW Map* (OEH). The criterion is not triggered.
Land capability classes I, II or III under the Land and Soil Capability Mapping of NSW (OEH), and	The Drayton South disturbance footprint is situated on land identified as land capability Class IV, V, VI and VII as verified by the soil and land capability impact assessment (EES, 2012) (Appendix Q of the EA) . The criterion is not triggered.
Reliable water of suitable quality, characterised by having rainfall of 350mm or more per annum (9 out of 10 years); or Properties within 150m of a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers; or Groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5L/s and total dissolved solids of less than 1,500mg/L	As confirmed by the surface water impact assessment (WRM, 2012) (Appendix M of the EA) and groundwater impact assessment (AGE, 2012) (Appendix N of the EA): • The Drayton South disturbance footprint receives 350mm or more rainfall per annum (9 out of 10 years); • The land within the Drayton South disturbance footprint is further than 150m from the Hunter River, which is a regulated river; • The land within the Drayton South disturbance footprint is within 150m of Saddlers Creek, which is an unregulated watercourse, however, does not flow at least 95% of the time; and • The land within the Drayton South disturbance footprint does not overlie significant groundwater aquifers, such as that of the Hunter River. The criterion is triggered by the available rainfall only and does not meet the other criterion.
Or	
Land that falls under soil fertility classes 'moderate' under the Draft Inherent General Fertility of NSW (OEH), and	The Drayton South disturbance footprint is situated on land identified as soil fertility class 'moderately low' and 'moderate' as mapped by the *Draft Inherent Soil Fertility of NSW Map* (OEH). The criterion is triggered.
Land capability classes I or II under the Land and Soil Capability Mapping of NSW (OEH), and	The Drayton South disturbance footprint is situated on land identified as land capability Class IV, V, VI and VII as verified by the soil and land capability impact assessment (EES, 2012) (Appendix Q of the EA). The criterion is not triggered.
Reliable water of suitable quality, characterised by having rainfall of 350mm or more per annum (9 out of 10 years); or Properties within 150m of a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers; or Groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5L/s and total dissolved solids of less than 1,500mg/L	As confirmed by the surface water impact assessment (WRM, 2012) (Appendix M of the EA) and groundwater impact assessment (AGE, 2012)(Appendix N of the EA): • The Drayton South disturbance footprint receives 350mm or more rainfall per annum (9 out of 10 years); • The land within the Drayton South disturbance footprint is further than 150m from the Hunter River, which is a regulated river; • The land within the Drayton South disturbance footprint is within 150m of Saddlers Creek, which is an unregulated watercourse, however, does not flow at least 95% of the time; and • The land within the Drayton South disturbance footprint does not overlie significant groundwater aquifers, such as that of the Hunter River. The criterion is triggered by the available rainfall only and does not meet the other criterion.

To compensate for the residual impacts on biodiversity that cannot be fulfilled on site, an offsite biodiversity offset has been selected. The offsite biodiversity offset may:

- No longer be available for agricultural purposes and reserved in perpetuity for the conservation of ecological values; or
- Managed in part for agricultural purposes, where current land practices apply, in conjunction with the conservation of ecological values in perpetuity.

The offsite biodiversity offset is not located on mapped BSAL. The Project will not reduce the agricultural productivity of the land but rather change the current land use.

2.2.1 Critical Industry Clusters

Under the SRLUP a CIC is 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 state, 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 State government is in the process of undertaking a regional-scale verification of CICs as provided in the SRLUP. As a provisional measure, Drayton South has been assessed against the mapping provided in the SRLUP to gain an appreciation of the extent and likely impact of the Project on potential CICs.

The Project is situated on land identified as a potential CIC for the equine and viticulture enterprises. As such, the Project has been assessed in accordance with the relevant Gateway criteria (see **Table 3**).

Table 3 Critical Industry Cluster Gateway Criteria Assessment

Gateway Criteria	Report Section Where Addressed
Whether the proposal would lead to significant impacts on the critical industry cluster through:	
(a) Surface area disturbance	No impacts. The Project is not directly situated on land occupied by equine or viticulture enterprises.
(b) Subsidence	No impacts. Proposed mining techniques for the Project will not cause subsidence.
(c) Reduced access to agricultural resources	8.1 and 8.2
(d) Reduced access to support services and infrastructure	8.7
(e) Reduced access to transport routes	8.7
(f) Loss of scenic and landscape value	8.6

The offsite biodiversity offset is not located on mapped CICs.

2.3 Guideline for Agricultural Impact Statements

The Guidelines for Agricultural Impact Statements released by DP&I in March 2012 outlines the requirements for the assessment of agricultural impacts associated with all State Significant Development applications, particularly coal mining and petroleum proposals (see

Table 4). It is a supplementary document to the SRLUP.

Table 4 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	3.0, 5.3, 5.4, 8.1.1, 8.1.2 and 8.1.3
Identification of the agricultural resources and current agricultural enterprises within the surrounding locality of the project area	3.1.1, 3.2.1, 3.3.1, 3.4, 4.1.2, 4.2, 4.3 and 4.4
Identification and assessment of the impacts of the project on agricultural resources or industries	7.0
Account for any physical movement of water away from agriculture	8.2
Assessment of socio-economic impacts	8.5, 8.6 and 8.7
Identification of options for minimising adverse impacts on agricultural resources, including agricultural lands, enterprises and infrastructure at the local and regional level	9.0
Document consultation with adjoining land users and government departments	6.0

This assessment has been prepared in accordance with the *Guidelines for Agricultural Impacts Statements.*

2.4 Water Management Act 2000

The objective of the *Water Management Act 2000* (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.

The Hunter Regulated River Water Sharing Plan (DIPNR, 2004), commenced on 1st July 2004 and applies for a period of 10 years to 30 June 2014. It is a legal document made under the WM Act. The Hunter Regulated River Water Sharing Plan contains rules governing how water is shared between the environment and water users and different categories of licences.

The Hunter Regulated River Water Source extends from Glenbawn Dam downstream to the estuary of the Hunter River (below Greta) and includes Glennies Creek, from Glennies Creek Dam to the junction of Glennies Creek with the Hunter River and is fed by several tributaries. Two regulated storages, Glenbawn Dam on the Hunter River and Glennies Creek Dam on Glennies Creek, are used to store and regulate flows for irrigation, power generation, industrial and urban usage as well as flood mitigation purposes.

The Project is situated in an area where a potential source of water is from the Hunter River which is covered by the Hunter Regulated River Water Sharing Plan and is therefore subject to the provisions of the WM Act.

2.5 Aquifer Interference Policy

The provisions of the *Aquifer Interference Policy* (AIP) (NOW, September 2012) have been addressed as part of the groundwater impact assessment prepared for the EA, a summary of which is included as relevant to this assessment in **Section 8.2.2**.

3 Existing Environment

This chapter describes the existing environment of the study area for the agricultural impact statement.

3.1 Climate

3.1.1 Drayton South and Surrounding Locality

The climate is dominated by continental influences and is generally described as having hot summers with mild winters. The Bureau of Meteorology (BOM) (2012) records for Jerrys Plains indicate that the mean maximum temperature over summer ranges between 31.3°C and 31.7°C. In winter the mean minimum temperature ranges between 3.8°C and 5.3°C.

Rainfall in the area averages 644.7 mm per annum. Summer rainfall events are dominant and generate mean monthly levels between 67.9 mm and 77.0 mm, whilst in winter rainfall levels range between 36.5 mm and 48.1 mm.

3.1.2 Offsite Biodiversity Offset

Due to its location near Murrurundi in the Liverpool Plains LGA, the climate of the offsite biodiversity offset is strongly influenced by its elevation. Climate data for Murrurundi (BOM, 2012) indicates that the mean maximum temperature during summer ranges between 29.7 and 30.8°C. In winter, the mean minimum temperature ranges between 2.0 and 3.2°C.

Rainfall for the area averages 830.6 mm per annum. During summer, the mean monthly rainfall varies between 78.2 and 90.8 mm, whilst in winter the mean monthly rainfall decreases to between 61.8 and 69.8 mm.

3.2 Topography

3.2.1 Drayton South and Surrounding Locality

The general topography consists of undulating to rolling hills with elevations ranging from 110 m to 260 m, which slope towards the river terraces associated with the Hunter River and its tributaries at elevations between 100 m and 120 m. To the south of the Hunter River steep rocky gorges occur. These areas are primarily associated with the Wollemi National Park.

3.2.2 Offsite Biodiversity Offset

The elevation of the offsite biodiversity offset is between 600 m and 1050 m. It primarily has a west to north-west aspect. The terrain is steep with slopes generally greater than 25%, and rock outcrops. There are areas of lower slopes (10 to 25%) with less frequent rock outcrop occurrences.

3.3 Soils

3.3.1 Drayton South and Surrounding Locality

Environmental Earth Sciences (EES) (2012) prepared a comprehensive soil and land capability impact assessment of Drayton South (Appendix Q of the EA). The impact assessment indicates that the soils in the majority of Drayton South are characterised by the Brays Hill soil landscape. Land in the north-west of Drayton South associated with Saddlers Creek and its tributaries are underlain by soils of the Bayswater landscape grouping (1:250,000 Singleton Soil Landscape Series Sheet (SI 56-1)).

The Brays Hill landscape grouping is characterised by red clays (Vertosol) on the mid-slopes, black earths on steeper slopes, and grey and brown clays (Vertosols) with linear gilgai (small ephemeral water bodies) and yellow solodic soils (soils with a strong texture contrast between the A and B horizon and a bleached A2 horizon (Sodosols)) on some lower slopes. Crests and upper slopes are characterised by red-brown earths (Chromosols and Dermosols) and alluvial soils are present in drainage lines.

The Bayswater landscape grouping is characterised by yellow solodic soils (Sodosols) and yellow and brown podzolic soils (Chromosols) on slopes with alluvial soils in drainage lines. Yellow solodic soils and red-brown earth (Chromosols and Dermosols) intergrades are also known to occur. Brown and yellow earths and prairie soils (a soil type occurring in temperate areas formerly under prairie grasses and characterized by a black A horizon) are present in some drainage lines.

The soils within the Brays Hill landscape grouping and Bayswater landscape grouping at Drayton South were further categorised by EES following a comprehensive field survey. The key soil types identified included:

- Mottled and Pedaric Brown Sodosol Complex;
- Pedaric Brown Dermosol Complex;
- Brown Vertosol Complex; and
- Orthic Tenosols.

The majority of Drayton South is composed of the Mottled and Pedaric Brown Sodosol Complex (2,513 ha or 54.7%), followed by the Pedaric Brown Dermosol Complex (1,174 ha or 25.5%) and the Brown Vertosol Complex (712 ha or 15.5%). Orthic Tenosols have a limited distribution within Drayton South covering an area of 198 ha (4.3%).

The topsoil within Drayton South is largely non-saline and non-sodic in nature and contains aggregates that exhibit a degree of soil stability. The prevalence of plant roots and lack of mottling is indicative of the effective infiltration and aeration of the topsoil and suitability for vegetation establishment. In comparison, the subsoil is generally saline, sodic, dispersive and has a tendency to slake when exposed to moisture. Such characteristics are evident through the presence of surface erosion, including gully and rill formations and slumping.

Based on the characteristics of the soil and landscape, the key constraining factors limiting the land capability within Drayton South relates to slope, salinity, acidity and soil structure decline (dispersivity). Based upon the survey of land capability completed by EES, there are no zones of Class I, II or III land within Drayton South. The dominant land capability classification within Drayton South is Class VI and VII covering an area of 1,749 and 1,863, respectively. Further details and a figure illustrating the land capability within Drayton South are provided in the soil and land capability impact assessment prepared for the Project (see Section 6 and Figure 5 in Appendix Q of the EA).

Further abroad, Kovac *et al.* (1991) identified a number of soil landscape groupings in the locality of Drayton South, in addition to the Brays Hill and Bayswater soils landscape groupings (see **Figure 3**).

The Hunter Alluvial soil landscape grouping underlies the floodplains of the Hunter River and its tributaries. This grouping is characterised by brown clays and black earths along watercourses and drainage lines typically adjacent to the Dartbrook and Brays Hill soil landscapes groupings.

Red podzolic soils and lateritic soils are known to occur on terraces, with the presence of non-calcic brown soils and yellow solodic soils in some drainage lines (Kovac *et al.*, 1991).

The Dartbrook soil landscape grouping typically underlies low rolling to undulating hills. This grouping is characterised by prairie soils on the alluvial flats with brown earth intergrades and non-calcic brown soils on the mid to lower slopes. Brown clays with some black and brown earth intergrades are known to occur on mid slopes while red-brown earths are present on upper slopes (Kovac *et al.*, 1991).

The Liddell soil landscape grouping typically underlies low rolling to undulating hills. This grouping is characterised by yellow soloths and some yellow solodic soils on slopes with earthy and silaceaous sands on mid to lower slopes. Red soloths, solodic soils and podzolic soils are also known to occur within this landscape (Kovac *et al.*, 1991).

The most agricultural significant soils are the Hunter Alluvials. These moderately to highly fertile soils are generally well drained with low to moderate water holding capacity and are suited to irrigation. These soils are listed as BSAL in the SRLUP and are situated primarily outside of the Project Boundary.

3.3.2 Offsite Biodiversity Offset

The Soil Landscapes of Murrurundi (McInnes-Clarke, 2002) shows that the predominant soil landscape underlying the offsite biodiversity offset is Slippery Rock; a colluvial soil landscape grouping. It has soils that are highly variable over short distances, with individual soil types difficult to predict. The soils are moderately fertile with good nutrient holding capacity.

Slippery Rock can be characterised by well to poorly drained brown and red dermosols on crests and side slopes. Well-drained, brown earths and lithosols on upper slopes, and poorly to imperfectly drained black dermosols are occasionally formed in this landscape. Poorly drained, black kandosols (alluvial soils) are also known to occur in drainage lines.

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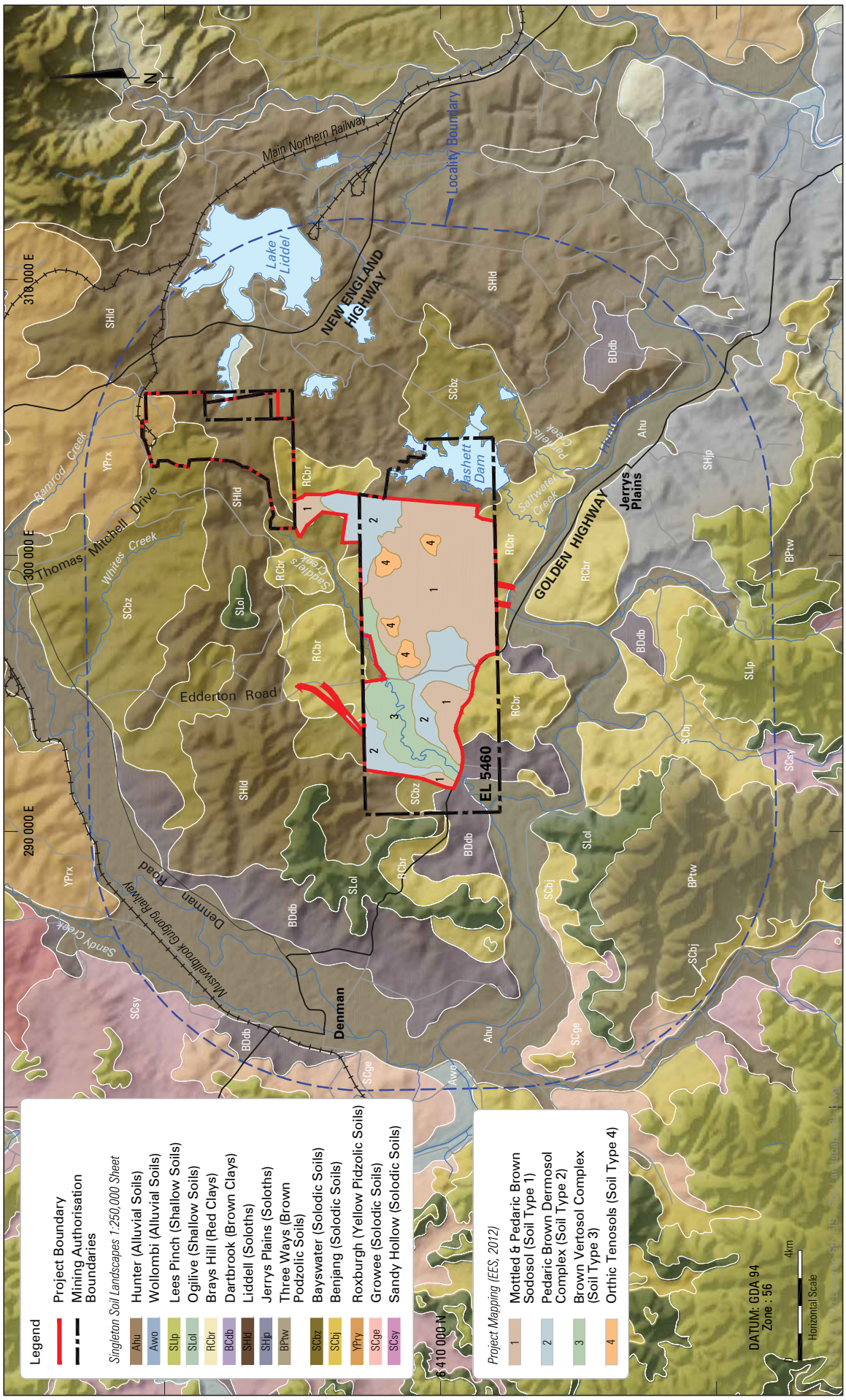
Soil Landscape

FIGURE 3



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3.4 Hunter Regulated River Water Source

The Hunter River is situated to the south of Drayton South and is a source of highly reliable irrigation water, which is utilised on adjacent river flats and also used for industrial purposes (coal mining and power generation), basic landholder rights (stock and domestic) and urban water use.

The Hunter Regulated River Water Source extends from Glenbawn Dam downstream to the estuary of the Hunter River (below Greta) and includes Glennies Creek, from Glennies Creek Dam to the junction of Glennies Creek with the Hunter River and is fed by several tributaries. Two regulated storages, Glenbawn Dam on the Hunter River and Glennies Creek Dam on Glennies Creek, are used to store and regulate flows for irrigation, power generation, industrial and urban usage as well as flood mitigation purposes. Inflows into Glenbawn Dam can be supplemented by the Barnard Scheme.

The Barnard Scheme allows for water to be pumped from the upper catchment of the Manning River into the Hunter River. Its purpose is to allow Bayswater and Liddell Power Stations to utilise water from the Manning catchment to ensure adequate water supply for power generation in times of severe drought.

The Hunter Regulated River Water Sharing Plan, which was developed under the WM Act provides for 22,159 unit shares of high security water and 128,163 unit shares of general security water. At 100% allocation, one unit share is equivalent to 1.0 ML of water.

Since the implementation of the Hunter Regulated River Water Sharing Plan in 2004, the general security final allocation has been 100% except in the 2006/07 water year when the final allocation was 35% (high security allocation was 92%). This is the only time since Glenbawn Dam was enlarged in 1987 that the general security final allocation has been less than 100%. In seven of the years since enlargement of the dam the final allocation has been 120%.

The Project is located in zone 1 under the Hunter Regulated River Water Sharing Plan. Zone 1 covers the Hunter River upstream of the Glennies Creek junction. Access licence rules provide for restrictions to dealings which would over commit the reliability of allocations within zone 1 (assignment of allocations from downstream of Glennies Creek junction into zone 1).

4 Existing Agricultural Enterprises and Resources

This chapter identifies and describes the existing agricultural resources and enterprises within Drayton South and the surrounding locality.

4.1 Agricultural Enterprises

4.1.1 Drayton South

Drayton South is currently managed as agricultural land and operated by two licensees who occupy the land, which is owned by Anglo American. The licensees also operate other land holdings.

The predominant agricultural land use at Drayton South is extensive beef cattle grazing with the major enterprise being beef cattle breeding for the weaner and domestic market. The estimated number of cattle carried on Drayton South in winter 2011 was 1,140 head. There is also some winter fodder cropping on the flats and lower slopes (around 10% slope) adjacent to Saddlers Creek. This fodder cropping is used for finishing weaner cattle for the domestic market.

An opportune land use undertaken at Drayton South is thoroughbred dry mare agistment. The enterprise involves agisting dry mares that come into the area to be serviced by stallions standing at one of the local thoroughbred breeding studs. The demand for this service is driven by the number of mares coming into the district that are not in foal. If an associated enterprise has an overflow of mares, agistment can be arranged on part of the land within Drayton South. The demand occurs from late winter into early summer (early August to late December).

4.1.2 Surrounding Locality

Some of the major landholders in the locality are coal mining and power generation operations, including:

- Mount Arthur Coal Mine;
- Hunter Valley Operations;
- NuCoal;
- Mangoola;
- Bayswater Power Station; and
- Liddell Power Station.

All the above operations have agricultural enterprises occurring on their non-operational land. These land holdings are usually under licensee or lessee arrangements.

One of the major agricultural land uses within the locality of Drayton South is beef cattle grazing. Common beef cattle enterprises include:

- Weaner production;
- Vealer production;
- Yearling production;
- Feeder steer production;
- Jap Ox production; and

- EU cattle production.

Beef production occurs across all soil types and topography within the locality, including the Hunter River flats (BSAL), improved and unimproved dryland pasture and irrigated land. The thoroughbred breeding enterprises also tend to have an associated beef operation to utilise excess grass growth and lower quality land not assigned for horses.

Two of NSW's premier thoroughbred studs (Coolmore Stud and Woodlands Stud) operated by Coolmore Australia and Darley Australia respectively, along with five other thoroughbred studs are in the locality of Drayton South (See **Figure 1**). These enterprises have been identified as part of the equine CIC as described in the SRLUP.

Several other agricultural enterprises operate within the locality of Drayton South, including:

- 11 dairies;
- Four vineyards (three with wineries), including Arrowfield Estate immediately to the south of Drayton South, which was previously operated under the Arrowfield brand and now under the management of Hollydene Estate. These enterprises have been identified as part of the viticulture CIC as described in the SRLUP; and
- An olive grove and olive processing plant.

The location of each agricultural enterprise within the locality of Drayton South is shown on **Figure 1**. This illustrates that the Project is not directly situated on BSAL or land operated by the thoroughbred breeding and viticulture enterprises; however, part of the Project corresponds with the equine and viticulture CICs as mapped in the SRLUP.

4.1.3 Supporting Infrastructure and Services

Agricultural enterprises in the locality of Drayton South are supported by a range of general and specialist services and infrastructure.

The thoroughbred breeding enterprises of the Hunter Valley are supported by a sophisticated network of support services, including the Scone Equine Hospital and Satur Veterinary Hospital, feeder farms (such as specialist Lucerne producers), farriers and specialised horse transport companies. Larger horse enterprises such as Coolmore Australia and Darley Australia have veterinaries on site, either employed or contracted from the major horse practices.

Cattle production in the locality relies on the livestock sale yards at Scone and Singleton. These sale yards hold weekly fat sales and monthly store sales, which are serviced by livestock agents in the area. To a lesser extent, the Denman sale yard is utilised to hold a monthly store sale.

Various agricultural producers supplying hay, silage and green crop, support select dairy enterprises in the area. Other agricultural enterprises in the locality rely on a range of services provided in the Singleton and Muswellbrook LGAs, including veterinary practices, input suppliers (fertiliser, seed, chemicals, and agricultural hardware), irrigation suppliers and technicians, and heavy and light engineering works.

Key routes utilised by most agricultural enterprises to access supporting services within the local area and further abroad are typically via the Golden Highway, the New England Highway and Edderton Road.

4.2 Agricultural Resources

The significant agricultural resources in the locality of Drayton South, include:

- Hunter Regulated River Water Source (Hunter River); and
- Hunter Alluvial soil landscape grouping.

The Hunter River Regulated River Water Source and associated aquifers together with the Hunter Alluvial soil landscape grouping contribute to the BSAL identified in the SRLUP.

4.3 Agricultural Value

The agricultural industry for the Upper Hunter region, which includes the Singleton, Muswellbrook, Upper Hunter, Dungog, Gloucester and the Great Lakes LGA, is estimated to have a total regional export output of approximately $403 M (Buchan Consulting, 2011). The contribution of each agricultural enterprise is listed in **Table 5**.

Table 5 Upper Hunter Agricultural Industry Export Values

Enterprise	Output Value
Beef, dairy and some crops	$248M
Equine	$100M
Wine and grapes	$55 M

Source: Buchan Consulting, 2011

The majority of the Project is situated within in the Muswellbrook LGA. From the census data of 2006, the total gross value of agriculture production for this area was $34 M, excluding equine and wine (ABS, 2006).

4.4 Employment

The agricultural industry in the Upper Hunter region employs approximately 5,039 people (Buchan Consulting, 2011). Employment for each agricultural enterprise is listed in **Table 6**.

Table 6 Upper Hunter Agricultural Industry Employment

Enterprise	Employment
Beef, dairy and some crops	886 (direct)
Equine	3,753 (direct and support)
Wine and grapes	400 (direct)

Source: Buchan Consulting, 2011

As shown in **Table 7**, in the Muswellbrook LGA, the highest proportion of employment associated with agriculture lies with the beef, equine and wine enterprises (ABS, 2006).

Table 7 Muswellbrook Local Government Area Agricultural Industry Employment

Enterprise	Muswellbrook LGA	
	No. Persons	%
Beef	166	17.7
Sheep	11	1.2
Dairy	81	8.6
Other Livestock	6	0.6
Equine	274	29.2
Poultry	23	2.4
Wine	171	18.2
Fruit and Vegetables	6	0.6
Grains	22	2.3
Flowers	10	1.1
Forestry and Timber	3	0.3
Fishing and Aquaculture	0	0.0
Other Agriculture	31	3.3
Agriculture Support	90	9.6
Food Processing	45	4.8
Total	**939**	**100**

Source: ABS, 2006

5 Agricultural Assessment

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

5.1 Methodology

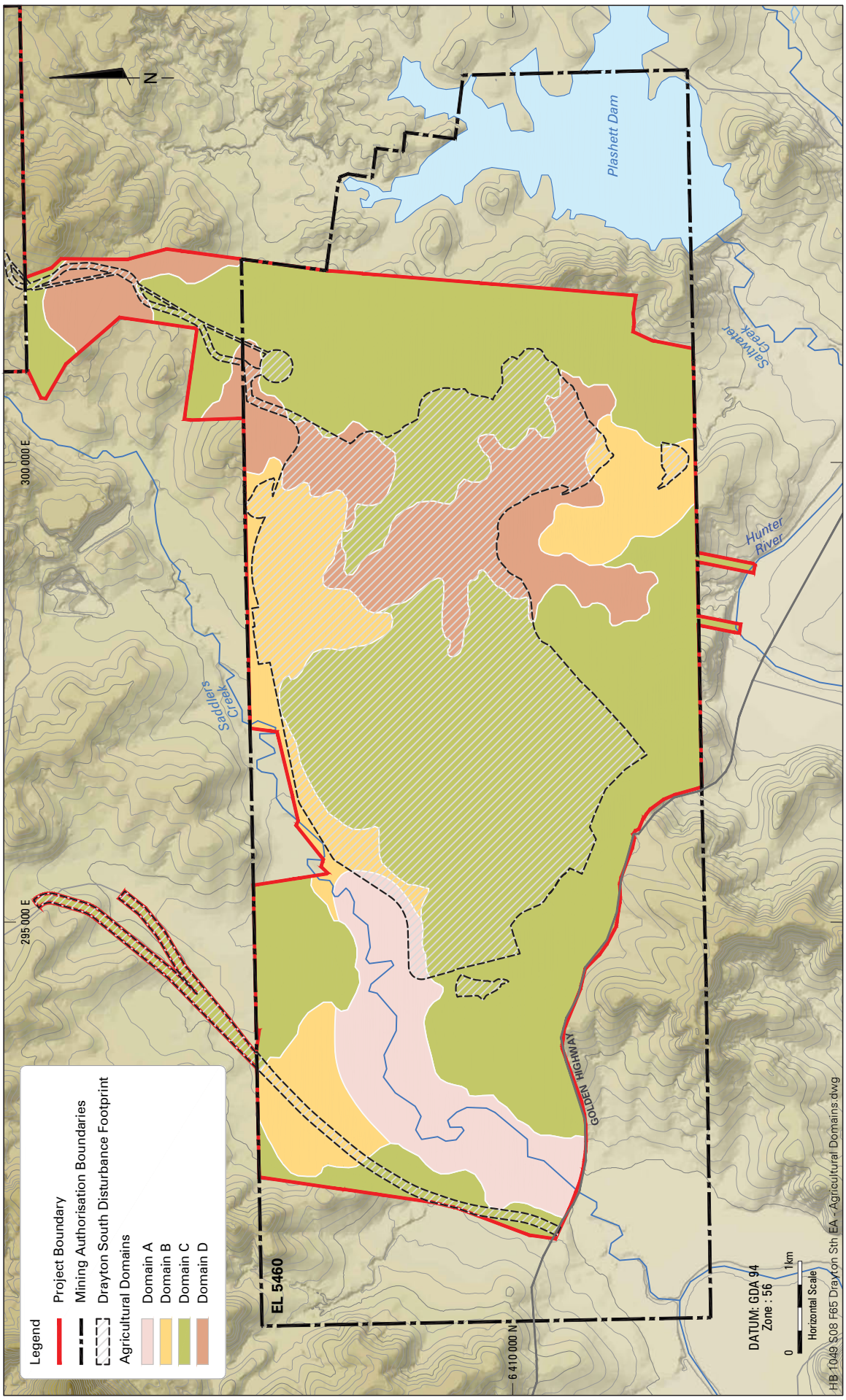
The assessment methodology comprised:

- A review of the EA soil and land capability impact assessment prepared by EES (2012);
- A review of the EA surface water impact assessment by WRM Water and Environment (WRM)(2012);
- A review of the EA ecology impact assessment by Cumberland Ecology (2012);
- A site visit to Drayton South to assist in reviewing EES's soil and land capability impact assessment and to inspect the current agricultural production at Drayton South and in the locality;
- A site visit to the offsite biodiversity offset, including an interview with the property manager, to ascertain the current and potential agricultural production of the property and to determine if any land should be held from the BOP;
- An interview with Anglo American's Rural Property Specialist to confirm current agricultural enterprises carried out by the Licensees to occupy Drayton South;
- Desktop analysis of the value of agricultural production from Drayton South, offsite biodiversity offset and enterprises in the 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 BSAL and identified CICs as defined by the SRLUP.

5.2 Agricultural Domains

5.2.1 Drayton South

Drayton South was dissected into agricultural domains based on the soil and land capability impact assessment (EES, 2012) and SBA's own observations. The domains are shown in **Figure 4**.



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Drayton South Agricultural Domains

FIGURE 4

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Table 8 provides an overview of each of the agricultural domains and their quantitative distribution at Drayton South.

Table 8 Drayton South Agricultural Domains

Agricultural Domain	Description	Area (ha)	Area (%)
A	Area associated with the creek flats of Saddlers Creek and lower slopes, dryland country suited to fodder cropping as part of a fodder cropping improved pasture rotation or grazed as unimproved pasture	376	8.2
B	Area associated with creeks flats and lower slopes suited to occasional fodder cropping or pasture improvement or grazed as unimproved pasture	749	16.2
C	Area associated with lower to mid slopes, require soil conservation works/minimum tillage techniques to establish improved pastures or grazed as unimproved pasture	2,780	60.5
D	Area associated with steeper slopes, not suited to any cultivation due to erosion risk, restricted to native pasture or aerial semi improved pasture improvement	692	15.1
Total		**4,597**	**100.0**

Table 8 shows that the vast majority (2,780 ha or 60.5%) of Drayton South is composed of land classed as Agricultural Domain C. This land is suited to grazing by beef cows for weaner production. This land primarily coincides with the following from the EA soil and land capability impact assessment (EES, 2012):

- Soil types 1 and 2 and small areas of soil type 4;
- Land capability classes V, VI and VII; and
- Agricultural land suitability class 4.

Agricultural Domain A is the highest quality agricultural land and least abundant at Drayton South, comprising an area of approximately 376 ha (8.2%). 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 following from the EA soil and land capability impact assessment (EES, 2012):

- Soil type 3 and small areas of soil type 1 and 2;
- Land capability classes IV and V; and
- Agricultural land suitability class 3.

Agricultural Domain B covers an area of 749 ha (16.2%) and is 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 following from the EA soil and land capability impact assessment (EES, 2012):

- Soil types 2 and 3 and small areas of soil type 1 and 4;
- Land capability classes V and VI; and
- Agricultural land suitability class 3.

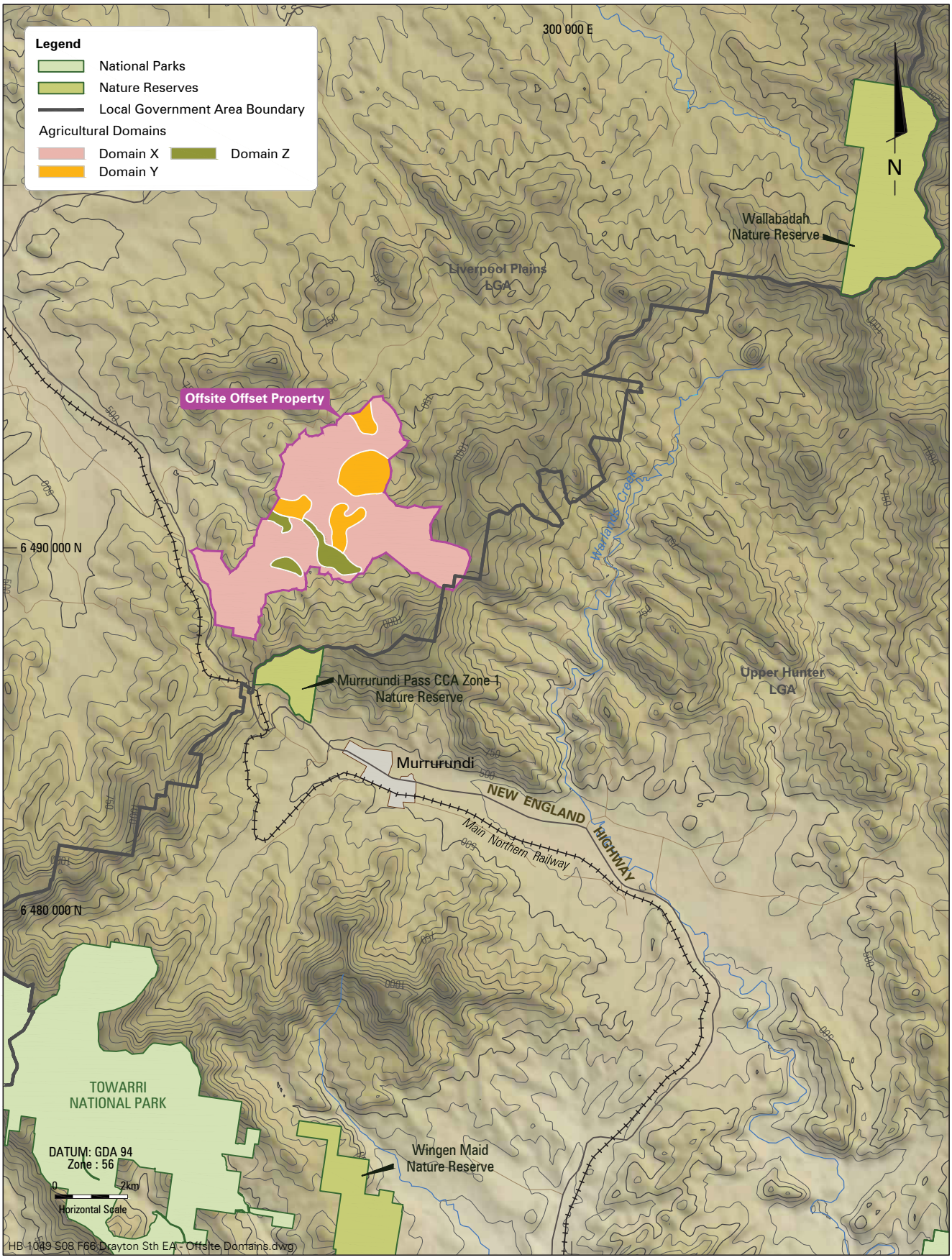
Agricultural Domain D covers an area of 692 ha (15.1%) and is suited to extensive grazing by beef breeders to produce weaner cattle (unfinished). The agricultural value of this land is limited by its slope, preventing or limiting the level of pasture improvement and requiring careful management to avoid over grazing. This land primarily coincides with the following from the EA soil and land capability impact assessment:

- Soil types 1 and 2 and small areas of soil type 4;
- Land capability classes VI and VII; and
- Agricultural land suitability class 5.

5.2.2 Offsite Biodiversity Offset

The offsite biodiversity offset was dissected into agricultural domains based on SBA's observations and an aerial photo showing land capability classes prepared previously by the then NSW Soil Conservation Service. The domains are shown in **Figure 5**.

The Land capability classes are based on Cunningham *et al.* (1988). The agricultural suitability classes are based on Humle *et al.* (2002).



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Offsite Biodiversity Offset Property
Agricultural Domains

FIGURE 5

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Table 9 provides an overview of each of the agricultural domains and their quantitative distribution within the offsite biodiversity offset.

Table 9 Offsite Biodiversity Offset Agricultural Domains

Agricultural Domain	Description	Area (ha)	Area (%)
X	Area associated with hill slopes and rock outcrops. Shows signs of semi-improved pasture. Suited only to pasture improvement (seeding and fertilising) by aerial means.	1,646	79.1
Y	Area associated with plateau style areas with improved pastures (such as *Pharalisspp*). Suited to pasture improvement with limited soil disturbance. Some rock outcrops occur.	333	16.0
Z	Area associated with timbered steeper drainage lines. Not suited to pasture improvement but offering stock shelter.	100	4.9
Total		**2,079**	**100.0**

Table 9 shows that the vast majority (1,646 ha or 79.1%) of the land is Agricultural Domain X. The land is bested suited to extensive grazing by sheep for breeding (merino and first cross lambs) and wool (wethers) and cattle for breeding. It is not fattening or finishing country. This land primarily coincides with the following:

- Land capability class VI: and
- Agricultural suitability class 4.

Agricultural Domain Y covers an area of 333 ha (16.0%) and is suited to pasture improvement with limited soil disturbance. This land is capable of supporting moderate levels of pasture production and such can be used for sheep production (wool and breeding) and beef cattle grazing for breeding. This land primarily coincides with:

- Land capability classes IV and V; and
- Agricultural land suitability class 4.

Agricultural Domain Z covers only 100 ha (4.9%) and is suited to limited grazing only offering shelter for stock. Pasture production from these areas is negligible. This land primarily coincides with:

- Land capability class VII: and
- Agricultural land suitability class 5.

The offsite biodiversity offset is typical of the agricultural pursuits in its locality. It is in part a grazing property, capable of sustainable operation but limited by topography (steepness), rocky outcrops and variable soils, which are easily erodible. It is not BSAL, either for cropping or grazing.

5.3 Agricultural Production and Value

5.3.1 Drayton South

To examine the quantum and value of the agricultural production from Drayton South, information as to the current agricultural practices and the number of livestock the Licensees to Occupy are allowed to carry under their licenses was obtained from Anglo American. It is noted that the current operators' Licenses to Occupy include land outside Drayton South.

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 Drayton South on an annual basis.

The enterprises used for each agricultural domain is shown in **Table 10**.

Table 10 Current Enterprises per Agricultural Domain within Drayton South

Agricultural Domain	Carrying Capacity (DSE/ha)*	Area (ha)	Description of Agricultural Enterprise	Stocking Rate (ha/Breeding Cow)
A	8	376	Cattle breeding enterprise producing vealers for domestic trade	2.0
B	6	749	Cattle breeding enterprise producing vealers for domestic trade	2.7
C	4	2,780	Cattle breeding enterprise producing inland store weaners	3.7
D	2	692	Cattle breeding enterprise producing inland store weaners	7.4

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

The production value of the four agricultural domains per hectare and total value on an annual basis is summarised in **Table 11**.

Table 11 Value of Current Agricultural Production within Drayton South

Agricultural Domain	Enterprise	Number Animals Sold*	Gross Value of Production	Net Value of Production
A	Vealers	178	$125,271	$54,375
B	Vealers	265	$186,891	$81,122
C	Inland weaners	620	$345,973	$264,102
D	Inland weaners	77	$43,073	$32,880
Total		**1,140**	**$701,208**	**$ 432,479**

** Includes culled breeding stock.*

Table 11 shows that the gross value of agriculture (beef cattle) production from Drayton South, based on the current land use, is $701,208 per annum ($10.0 M present value at 7% discount rate). This present value assumes that Drayton South is removed from agricultural production in perpetuity. The net value of agricultural production is $432,479 per annum ($6.2 M present value at 7% discount rate) (Gillespie Economics, 2012). This is from the sale of 1,140 head of cattle per annum (weaner and fattened weaners, cull cows and bulls).

The two closest regional sale yards with weekly prime sales are at 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 2011 (MLA, 2011) shows that the Scone and Singleton sale yard had a throughput of 76,402 and 56,903 head, respectively. During this period, the Scone sale yard was ranked 8th and the Singleton sale yard was ranked 11th in NSW for cattle sold by auction through the sale yard system. The National Livestock Reporting Service NSW Cattle Saleyard Survey (MLA, 2011a) reports a total of 1,847,555 cattle sold through NSW sale yards in 2011.

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 2011 nor was it ranked amongst NSW sale yards. The 2010 NSW Cattle Saleyard Survey did report Denman sale yards, which was ranked 53 out of 54 yards listed.

If it is assumed that all cattle from Drayton South are sold through the Scone and Singleton sale yards, the expected number to be turned off represents 1.49% of Scone's throughput or 2.00% of Singleton's throughput. The turn off represents 0.86% of the combined cattle throughput (prime and store) through both the Scone and Singleton sale yards.

Based on the Upper Hunter Shire Council's yard charges of $8.18 per head (financial year 2011/12), the 1,140 head sold from Drayton South would contribute $9,325 of income to the Scone sale yards (if all were sold through Scone). Yard charges for Singleton 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.

There are local cattle abattoirs at Scone and Singleton, however, cattle from the Upper Hunter are often processed outside the region at abattoirs such as at Wingham NSW, Casino NSW and Dinmore Queensland. **Table 12** shows the value of the regional, State and National beef slaughtering on an annual basis. It illustrates the relatively small magnitude the agricultural output of Drayton South compared to regional, State and National production.

Table 12 Value of Beef Slaughtering

Enterprise	Drayton South	Hunter Region	NSW	Australia
Beef Slaughtering	$ 0.7 M	$ 95.5 M	$ 1,487.6 M	$ 6,550.5 M
Total Agricultural Production	$ 0.7 M	$ 311.7M	$ 8,359.2 M	$ 39,645.1 M

Source: ABS, 2008; ABS, 2011

In addition to the enterprises outlined in **Table 11** one of the licensees on Drayton South also undertakes opportune dry mare agistment during the thoroughbred breeding season as demand dictates. This enterprise takes excess mares from the licensee's own property where they run a dry mare farm.

Operational costs obtained from a survey of brood mare farms (Scott Barnett & Associates, 2011, Unpublished data) are listed in **Table 13**. Mares are assumed to be on the farm at an average of 100 days. The amount of hand feeding is determined by season and paddock feed availability.

Table 13 Operation Costs of Brood Mare Farms

Activity	Cost/Unit
Daily agistment	$24.00/day
Under full hand feeding (hay)	4 kg/day (assume 15% wastage) @ $0.35/kg ($350/tonne)
Under full hand feeding (pellets)	4 kg/day @ $0.70 per kg ($700/tonne)
Cost full hand feed	$4.45/day
Margin over feed costs at full hand feeding	$19.55/day
Labour	$6.67/day (20 minutes per mare per day @ $20.00/hr)
Gross income per mare	$2,400.00/100 days
Feed Costs per mare under full hand feeding	$445.00/100 days
Margin over feed costs per mare under full hand feeding	$1,955.00/100 days
Margin over feed and labour per mare	$1,288.00/100 days

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

The gross income per mare, feed costs per mare and margins over feed costs per mare and labour, assumes full hand feeding. The demand for opportune dry mare agistment is from August to December during the thoroughbred breeding season. This corresponds with the spring and early summer when in "*normal seasons*" paddock feed would be expected to provide most, if not all, the feed requirements of the dry mares.

Other costs such as animal health and veterinary services, shodding and feet trimming, 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 14**). The cost of the service fee varies greatly depending on stallion and inducements available to the mare owner.

Table 14 Additional Operation Costs of Brood Mare Farms

Activity	Cost/Unit	Frequency
Drenching	$30.00/per mare	6 weeks
Foot trimming	$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 agricultural or seasonal conditions.

5.3.2 Offsite Biodiversity Offset

To examine the quantum and value of agricultural production from the offsite biodiversity offset, information regarding the current agricultural practices and the number of livestock run under current management was obtained. This information was used in association with DTIRIS (Primary Industries) (2011) gross margin budgets to calculate the quantum and value of agricultural production from the offsite biodiversity offset on an annual basis.

The enterprises used for each agricultural domain is shown in **Table 15**.

Table 15 Current Enterprises per Agricultural Domain within the Offsite Biodiversity Offset

Domain	Carrying capacity (DSE/ha)*	Area (ha)	Description of Agricultural Enterprise	Stocking Rate (ha/Wether)	Stocking rate (ha/Breeding Cow)
X	3.5	1,646	Merino wethers (18 micron) and beef cattle breeding enterprise producing weaners	0.3	4.3
Y	6.5	333	Merino wethers (18 micron) and beef cattle breeding enterprise producing weaners	0.2	3.3
Z	0	100	Shelter country only	-	-

The production value of the offsite biodiversity offset as a whole on an annual basis is summarised in **Table 16**.

Table 16 Value of Current Agricultural Production within the Offsite Biodiversity Offset

Enterprise	Number Animals Sold*	Wool Sold (including Crutchings) (kg)	Gross Value of Production	Net Value of Production
Wethers	940	43,766	$ 365,400	$ 164,700
Inland weaners	192	-	$ 135,428	$ 58,784
Total	**1,132**	**43,766**	**$ 500,828**	**$ 223,484**

** Includes culled breeding stock.*

Table 16 shows that the gross value of agriculture from the offsite biodiversity offset is $500,828 per annum and the net value is $223,484 per annum. The gross value of production is made up of:

- $284,074 from wool sales;
- $81,326 from sheep sales; and
- $135,428 from beef cattle sales.

Weaners from the offsite biodiversity offset enterprise are grown out in the Upper Hunter Valley and for this assessment are assumed to be sold through the Scone sale yards. The 192 head of beef cattle from the offsite biodiversity offset represents 0.25% of the annual through put and $1,570 (at $8.18 per head) of income to the Scone sale yards.

Newcastle is the closest auction facility for wool to the offsite biodiversity offset followed by Yennora, Sydney. Traditionally, Newcastle is the venue for the wool clip (especially the finer wools) from the Upper Hunter and New England regions, selling approximately 70,000 bales per annum (Elders Newcastle, 2012 *pers. com.*). Assuming an average bale weight of 176.8 kg (Australian Wool Exchange, 2012) the total wool clip from the offsite biodiversity offset would be 156 bales or 0.2% of the Newcastle sale facility's annual throughput.

Cull wethers would be sold direct off farm or through sale yards at Tamworth. In 2011, 173,555 sheep were sold through the Tamworth sale yards (MLA, 2011b). The 940 cull wethers from the offsite biodiversity offset represent 0.54% of the 2011 throughput.

5.4 Potential Agricultural Production

5.4.1 Drayton South

The potential agricultural production of Drayton South 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 to 15 DSE/hectare;
- Domain B: $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; carrying capacity improves to 10 DSE per hectare;
- Domain C: $250 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 $50 per hectare per annum; carrying capacity improves to 7 DSE per hectare; and
- Domain D: $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 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 17 shows that the gross value of agricultural production could be increased to $1,229,543 per annum and the net value to $615,006 per annum.

Table 17 Maximum Potential of Agricultural Production within Drayton South

Domain	Enterprise	Number Animals Sold*	Gross Value of Production	Net Value of Production
A	Vealers	277	$204,345	$114,228
B	Vealers	442	$311,484	$98,403
C	Inland weaners	1,086	$605,800	$340,799
D	Inland weaners	193	$107,914	$61,575
Total		**1,998**	**$1,229,543**	**$615,006**

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

5.4.2 Offsite Biodiversity Offset

From the observations made during the property inspection, the offsite biodiversity offset is currently managed to a very high level showing signs of previous pasture improvement and paddock subdivision.

The potential agricultural production of the offsite biodiversity offset was examined assuming further improvements in management and capital investment in upgrading the current pastures.

The following assumptions are made:

- Domain X: Additional pasture maintenance cost of $10 per hectare per annum and carrying capacity improves to 4.0 DSE/hectare;
- Domain Y: $150 per hectare invested in pasture improvement and repeated every seven years, additional $20 per hectare spent on pasture maintenance annually and carrying capacity improved to 8.5 DSE; and
- Domain Z: No change, carrying capacity remains at zero.

It is assumed that the enterprise balance is changed to carry all wethers as this represents the higher return per DSE and is less susceptible to adverse seasonal conditions. This is the only allowance made for increased risk as management moves further along the risk reward production curve. Another limitation to this scenario is the level of wild dog prevalence in the area. Grown Merino wethers would be less susceptible than lambs (and to a lesser extent calves) to wild dog predation.

Table 18 shows that the gross value of agricultural production could increase to $688,048 per annum and the net value to $287,009 per annum.

Table 18 Maximum Potential of Agricultural Production within the Offsite Biodiversity Offset

Enterprise	Number Animals Sold*	Wool sold (including Crutchings) (kg)	Gross Value of Production	Net Value of Production
Wethers	1,770	51,988	$ 688,048	$ 287,009
Inland weaners	-	-	-	-
Total	**1,770**	**51,988**	**$ 688,048**	**$ 287,009**

5.5 Alternate Agricultural Land Use Suitability

5.5.1 Thoroughbred Breeding

Drayton South has been assessed against the mapping and criteria outlined in the SRLUP for the equine CIC.

The southern portion of Drayton South, which fronts the Golden Highway and forms the northern boundary of both Coolmore Stud and Woodlands Stud, has been identified as part of the equine CIC as mapped in the SRLUP (see **Figure 1**). Drayton South has also been validated as part of the soil and land capability impact assessment (Appendix Q of the EA) (EES, 2012) to gain an appreciation of the extent and suitability of the land for alternative land practices, such as thoroughbred breeding.

The two horse studs are located on and utilise:

- Hunter Alluvial soil landscapes (the Hunter River flats);
- Ogilvie Shallow soil landscape;
- Dartbrook Brown Clays soil landscape; and
- Brays Hill Red Clays soil landscape.

The studs also rely heavily on irrigation water from the Hunter River.

Drayton South is not well suited to thoroughbred breeding as it lacks the productive alluvial soils of the Hunter River and has limited quantities of the better quality soils of the Dartbrook Brown Clays and Brays Hill Red Clays.

The soils of Drayton South are generally of poorer quality with limited water holding capacity and lack depth to make them suited to growing irrigated pasture and/or irrigate Lucerne. The quality of the soils and the reliability of pasture growth supplemented with irrigation water are cornerstones to the productivity of the thoroughbred breeding industry in the Hunter Valley and the horses they produce.

5.5.2 Viticulture

Drayton South has been assessed against the mapping and criteria outlined in the SRLUP for the viticulture CIC.

Areas of Drayton South have been identified as part of the viticulture CIC as mapped in the SRLUP (see **Figure 1**). Drayton South has also been validated as part of the soil and land capability impact assessment (Appendix Q of the EA) (EES, 2012) to gain an appreciation of the extent and suitability of the land for alternative land practices, such as viticulture.

Viticulture operations are best suited to land '*that falls under soil fertility classes high, moderately high, moderate, moderately low under the Draft Inherent General Fertility of NSW (OEH) and land capability classes I, II, III, IV or V under the Land and Soil Capability Mapping of NSW (OEH) and is within 2 km of a mapped alluvial water source*' as prescribed by the SRLUP.

Validation of Drayton South, confirms that much of the mapped viticulture CIC within the Project Boundary (2,425 ha) fails to meet the criteria of the SRLUP. Approximately 2,102 ha of mapped viticulture CIC corresponds with a land capability Class of VI and VII (EES, 2012) while the criteria for viticulture is a land capability of Class V or better. Furthermore, approximately 19 ha of mapped viticulture CIC is situated further than 2 km from a mapped alluvial, including the Hunter River, Saddlers Creek and Saltwater Creek alluviums.

Mapped viticulture CIC, as provided in the SRLUP, has been identified on Class V land and within the general vicinity of Saddlers Creek. However, the associated alluvial of Saddlers Creek is characterised as having a limited capacity to store and transmit water, offers low yields and poor water quality, and does not form a single, well-connected aquifer (AGE, 2012). The water quality of the alluvial is too saline for stock watering with Electrical Conductivity ranging between 8,000 and 9,000 µS/cm and Total Dissolved Solids ranging between 3,000 to 7,000 mg/L (AGE, 2012). Given the current condition of the alluvial, no licensed water allocations exist along Saddlers Creek (WRM, 2012). In this regard, it is unlikely that the land associated with this mapped viticulture CIC within the Project Boundary is suitable for viticulture operations.

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 EA. 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&I;
- DTIRIS (Primary Industries);
- Hunter Central Rivers – Catchment Management Authority; and
- Muswellbrook Shire Council.

Neighbouring Landowners and Industries

- Coolmore Australia;
- Darley Australia;
- Arrowfield Estate (managed by Hollydene Estate who purchased the property during the preparation of the EA for the Project);
- Gee family (neighbouring dairy);
- Murray Richards;
- Robyn Wolfgang;
- Mark, Robyn and Peter Wolfgang; and
- Jeff Wolfgang.

Various consultation methods were adopted to identify stakeholder issues, including Project briefings, Community Newsletters, presentations, and the establishment of working groups with neighbouring industries.

Table 19 outlines the regulatory stakeholder issues specific to this assessment and the section of the report which corresponds to each issue.

Table 19 Regulatory Stakeholder Issues

Ref.	Issue Raised	Section
1	Assess air quality impacts (including cumulative impacts)	8.3
2	Assess noise impacts (including cumulative impacts)	8.4
3	Assess impacts on local watercourses, including Saddlers Creek and the Hunter River	8.2
4	Assess groundwater impacts, including potential for contamination and draw down on the Saddlers Creek and Hunter River groundwater aquifers	8.2
5	Identify and assess impacts on existing groundwater users	8.2
6	Identify and assess potential agricultural land use conflicts	8.0
7	Assess impacts on agricultural resources and enterprises and proposed avoidance or mitigation strategies	8.0
8	Describe post-mining land uses	8.1.1
9	Assess traffic impacts (including cumulative impacts) on the local road network	8.6
10	Assess impacts on the local skills base	8.7

Table 20 outlines the community stakeholder issues specific to this assessment and the section of the report which corresponds to each issue.

Table 20 Community Stakeholder Issues

Ref.	Issue Raised	Section
1	Air quality impacts (including cumulative impacts) on residences and livestock	8.3
2	Noise impacts (including cumulative impacts) on residences and livestock	8.4
3	Impacts on surface water quality	8.2
4	Extraction of water from the Hunter River	8.2
5	Discharges into the Hunter River	8.2
6	Impacts on groundwater aquifers, including draw down and contamination	8.2
7	Impacts to the visual amenity of the surrounding landscape and sensitive receptors	8.5
8	Onsite screening to conceal construction and operation activities	8.5
9	Increases in traffic volumes	8.6
10	Impact on travel time associated with the Edderton Road realignment	8.6
11	Access during the construction phase of the Edderton Road realignment	8.6
12	Suitability of the land for agriculture	5.0

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 Anglo American Risk Assessment Tools. This risk assessment is presented in **Appendix 5**. Each of the potential environmental issues was ranked in accordance with the Anglo American Risk Matrix as either being of low, medium or significant risk (see **Table 21**).

Table 21 Risk Assessment

Category	Issues
High	N/A
Significant	Air Quality, Noise and Visual
Medium	Water Usage, Traffic and Transport, Availability and Productivity of Agricultural Land
Low	Labour Supply

Following the assessment of potential impacts issues ranked as significant, medium and low have been assessed in further detail as part of the EA 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 study area. As part of the agricultural impact statement, Gillespie Economics were engaged to undertake an economic review of the potential agricultural impacts of the project. A summary of the findings of this review are presented throughout this section and in full in **Appendix 6**.

8.1 Availability and Productivity of Agricultural Land

8.1.1 Drayton South

Any agricultural land that is situated within the Drayton South disturbance footprint will be removed from production indefinitely as a result of the Project. Sustainable farming practices will, however, continue during the life of the Project in available areas outside the Drayton South disturbance footprint on land owned by Anglo American (see **Section 9.4** for further details).

Post mining, agricultural land within the Drayton South disturbance footprint (1,928 ha) will no longer be available for agricultural purposes. Instead, the affected land will be rehabilitated to establish Narrabeen Footslopes Slaty Box Woodland and Central Hunter Box-Ironbark Woodland communities. This area will be reserved in perpetuity as an onsite offset for the Project. The onsite component of the biodiversity offset plan is discussed further in the EA ecology impact assessment (Cumberland Ecology, 2012) (see Appendix J of the EA).

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

- Domain A 21 ha;
- Domain B 286 ha;
- Domain C 1261 ha; and
- Domain D 360 ha.

Table 22 shows the total annual value of agricultural production impacted by the Project on the agricultural land within Drayton South.

Table 22 Quantum and Value of Agricultural Production Affected within Drayton South

Enterprise	Drayton South
Irrigation water used (ML/yr)	1*
Wool sold (kg)	-
Wethers sold	-
Beef cattle sold per annum	432
Gross value of production per annum	$ 257,110
Net value of production per annum	$ 170,625

**Water Access Licence currently held for irrigation purposes.*

Conservatively assuming that agricultural production from the entire Drayton South disturbance footprint ceases at the commencement of the Project for perpetuity, the present value of the gross value of production foregone is $3.7 M (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $2.4 M (using a 7% discount rate) (Gillespie Economics, 2012) (see **Appendix 6**).

8.1.2 Offsite Biodiversity Offset

Pending further land management arrangements, the property selected as an offsite offset for the Project, may:

- No longer be available for agricultural purposes and reserved in perpetuity for the conservation of ecological values; or
- Managed in part for agricultural purposes, where current land practices apply, in conjunction with the conservation of ecological values in perpetuity.

Table 23 shows the total annual value of agricultural production impacted by the Project on agricultural land within the offsite biodiversity offset should that land become unavailable for agricultural purposes.

Table 23 Quantum and Value of Agricultural Production Affected within the Offsite Biodiversity Offset

Enterprise	Offsite Biodiversity Offset
Irrigation water used (ML)*	-
Wool sold (kg) per annum	43,766
Wethers sold per annum	940
Beef cattle sold per annum	192
Gross value of production per annum	$ 500,828
Net value of production per annum	$ 223,484

Conservatively assuming that agricultural production from the offsite offset area ceases at the commencement of the Project for perpetuity, the present value of the gross value of production foregone is $7.2 M (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $3.2 M (using a 7% discount rate) (Gillespie Economics, 2012).

The quantum and value of agricultural production for the offsite biodiversity offset if it was managed in part for agricultural purpose cannot be assessed until further arrangements have been finalised.

8.1.3 Combined Value

The combined gross value of production from the impacted properties is $0.8 M per annum. As shown in **Table 24** this value is 0.26% of the total annual agricultural production of the Hunter Region, 0.01% of NSW and 0.002% of Australia.

Table 24 Value of Total Agricultural Production Impacted and Outputs

Enterprise	Drayton South and Offsite Biodiversity Offset	Hunter Region	NSW	Australia
Wool produced	$0.3 M	$ 3.1 M	$ 641.1 M	$ 1,927.5 M
Sheep slaughtering	$0.1 M	$ 2.8 M	$ 548.3 M	$ 2,328.6 M
Beef slaughtering	$0.4 M	$ 95.5 M	$ 1,487.6 M	$ 6,550.5 M
Total agricultural production	$ 0.8 M	$ 311.7M	$ 8,359.2 M	$ 39,645.1 M

Source: ABS, 2008; ABS 2011

In total, foregone net agricultural production from agricultural land resources required for the Project is estimated at $5.6 M present value (using 7% discount rate) (Gillespie Economics, 2012).

As the overall agricultural contribution of the land within the Drayton South disturbance footprint and the offsite biodiversity offset 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.

8.1.4 Regional Impacts of Agriculture Foregone as a Result of the Project

The regional impacts of the level of annual agricultural production foregone as a result of the Project (including the Drayton South disturbance and offsite biodiversity offset) were estimated from the sectors in the Upper Hunter regional input-output table by Gillespie Economics (see **Appendix 6**).

Table 25 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. Further details are provided within **Appendix 6**.

Table 25 Annual Regional Production and Economic Impacts

Aspect	Agriculture	Project
Area (ha)	4,007[1]	1,928[2]
Production Type	Beef and sheep	Coal
Direct Output Value	$0.8 M	$451 M
Direct Income	$0.2 M	$47 M
Direct Employment	7	326
Direct and Indirect Output Value	$1.0 M	$592 M
Direct and Indirect Income	$0.3 M	$90 M
Direct and Indirect Employment	8	819

[1] *This is the area of agricultural land (Drayton South disturbance footprint and offsite biodiversity offset) that would be impacted in perpetuity by the Project.*

[2] *Drayton South disturbance footprint.*

The direct annual output of the Project is estimated at $451 M per annum. In contrast, the direct annual output of future use of agricultural lands that would be utilised by the Project is estimated at $0.8 M per annum.

Gillespie Economics (2012) also undertook a benefit cost analysis which included an estimation of the present value of production costs and benefits of the Project over a 27 year period. The present value of net production benefits of the Project to Australia are estimated at $490 M (7% discount rate). In contrast, the present value of future use of agricultural lands that would be utilised by the Project is estimated at $5.6 M (7% discount rate). Gillespie Economics concluded that based on these comparative values, the Project is considered to be significantly more efficient than continued agricultural production.

8.1.5 Surrounding Locality

The Project will not reduce the availability of land for agricultural purposes or affect the productivity of existing agricultural land within the immediate locality, including land utilised by either equine or viticulture enterprises. As such, this has not been discussed further in the assessment.

8.2 Water

8.2.1 Surface water

As stated previously in **Section 3.4**, one of the significant agricultural resources of the local area is irrigation water from the Hunter Regulated River Water Source. This system is a highly reliable source of industrial, town and irrigation water for the regulated users who are licensed to extract water.

The surface water model for the Project predicts that there is less than a 1% chance that offsite supplies would be required for the Project. That is, runoff from within the Project Boundary and dewatered groundwater from the mining areas can supply all of Drayton South's water requirements over the life of the Project (unless conditions were drier than the 99th percentile conditions). This is consistent with the existing operations at Drayton Mine, which has not needed to source water from offsite over the life of its operations to date (WRM, 2012) (Appendix M of the EA). The EA surface water impact assessment provides further details regarding the Project's water balance (see Appendix M of the EA).

Based on the findings of the surface water model, this indicates that the Project will not require water from the Hunter Regulated River Water Source and as such will not impact on significant agricultural resource or divert water from irrigated agriculture, including the thoroughbred breeding industry, to mining. As the Project is not envisaged to participate in the open water market it will not influence the market value of water traded within the regulated system. As such, this has not been discussed further in the assessment.

In the event that 99th percentile conditions are forecast and water is required from the Hunter River to support Project operations, Anglo American will need to seek the necessary licences prior to extraction.

The surface water model for the Project has also determined that over the life of the Project there will be an accumulation of water on site, and that under certain circumstances, the Project will need to discharge excess water into the Hunter River in accordance with the Hunter River Salinity Trading Scheme (HRSTS). The HRSTS was implemented by the NSW government to reduce salinity levels in the Hunter River and allows controlled water discharges into the Hunter River during periods of high flow.

Overall the surface water impact assessment for the Project has determined that the Project will not impact on receiving waters (WRM, 2012) (Appendix M of the EA).

8.2.2 Groundwater

In order to assess the potential impacts of the Project on the existing groundwater regime, a groundwater impact assessment was completed by Australasian Groundwater & Environment Consultants (AGE, 2012) (Appendix N of the EA). As part of this assessment a predictive numerical model was developed to assess the potential impacts of the Project on the groundwater regime. This model was used to estimate the inflows of groundwater into the open cut void over the life of the Project, predict the zone of influence of dewatering and the potential for impacts on other registered users and predict the magnitude of any drainage from the alluvial aquifers associated with the Hunter River and Saddlers Creek.

The predicted mining area inflow rates vary throughout the mining period. This variability in inflow is directly related to the proposed mine plan, the depth/thickness of saturated coal being mined and hydraulic gradients induced by the depressurisation of the coal seam. Over the

27 year mine life, inflow rates for all mining areas will average approximately 2.4 ML/day. Predicted inflow rates peak at about 4.6 ML/day in Year 10.

From the results of the groundwater model, only two registered bores/wells are encompassed within the zone of influence as defined by the 1 m drawdown contour at the end of mining for the Project. These are both owned by Anglo American. No private bores are predicted to be impacted as a result of the Project.

The groundwater model predicts that the zone of influence is predicted to be restricted to the immediate vicinity surrounding the mining areas. This is a maximum distance of approximately 600 m to the west and south of the mining areas in Year 27. The zone of influence within the shallow regolith / alluvium is not predicted to extend into the Hunter River alluvial aquifer; however, it is predicted to extend marginally into the Saddlers Creek alluvium.

Predicted seepage fluxes at the cessation of mining indicate that the Hunter River alluvium will continue to receive seepage at a rate comparable to pre-mining conditions. However, as the zone of influence expands over time, the seepage flux to the Hunter River alluvium may be reduced by approximately 0.01 ML/day at Year 400. This reduced seepage flux is not likely to impact groundwater levels within the alluvial aquifer by a measurable amount.

Previous groundwater assessments on the potential for drawdown impacts on Saddlers Creek as a result of mining at Mt Arthur Coal Mine have predicted that the pre-mining flux of water into the Saddlers Creek alluvium (~0.31 ML/day) will be reduced to about 0.12 ML/day by the Mt Arthur Mine operations. The remaining influx to the Saddlers Creek alluvium (~0.12 ML/day) may therefore be reduced to zero as a result of the Project. Groundwater seepage from the coal seams is anticipated to continue recharging the lower portion of Saddlers Creek as it approaches the Hunter River, even during peak mining activities associated with the Project and Mt Arthur Coal Mine. Water associated with the Saddlers Creek alluvium does not currently support any agricultural enterprises.

As explained above the Project could reduce upward seepage in the Saddlers Creek alluvium to nil. Water in the Saddlers Creek alluvial aquifer typically possesses a TDS content of 3,000 to 7,000 mg/L. This is considered too saline for agricultural purposes. Although the term 'highly productive groundwater' is not defined in the SRLUP, it is reasonable to conclude that the Saddlers Creek alluvial aquifer is not 'highly productive groundwater'.

The Hunter River alluvial aquifer is more likely to constitute 'highly productive groundwater'. However, the Project will not have any measurable impact on the Hunter River alluvial aquifer. Therefore, the Project will not reduce the agricultural productivity of BSAL through impacts to highly productive groundwater.

There are not anticipated to be any impacts on groundwater availability for any agricultural enterprises within the locality.

The EA groundwater impact assessment provides further details regarding the Project's potential impacts on the existing groundwater regime (see Appendix N of the EA).

8.3 Dust

In most cases the 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.

Modelling by PAEHolmes (2012) (Appendix F of the EA) predicts that the cumulative annual average dust deposition concentration predicted for properties south of the Golden Highway is below 2g/m^2/month in all modelled years. This is well below the cumulative criteria of 4g/m^2/month. When considering the Project's emissions alone the contributions to properties south of the Golden highway are in all cases less than 0.7g/m^2/month. Again well within the criteria of 2g/m^2/month.

Doley and Rossato (2010) report that "*Deposition of mining, quarry and road dust on vegetation canopies has been observed to inhibit plant growth when dust burdens exceed 7 g/m^2*". They also reported that there is a linear relationship of increase plant dry matter (production) and net dust deposition up to 1g/m^2/day while in cotton (which matures in hot sunny weather) estimated net rates of dust deposition of 0.5g/m^2/day reduced canopy photosynthesis by 11% and cotton yield by 3%. A dust deposition rate on a leaf of 0.5g/m^2/day is equivalent to a monthly deposition rate of 15g/m^2/month, greatly above the levels predicted for the properties to the south of the Golden Highway which include Coolmore Australia, Arrowfield Estate and Darley Australia.

As well as dust deposition rates other factors affect the net amount of dust deposited on a leaf. Dooley and Rossato (2010) report the following factors.

- Leaf characteristics with smooth leaves and pendant leaves accumulating less dust;
- Period leaf has been exposed to dust including factors of leaf appearance rate, leaf life span and age of leaf; and
- Environmental events that remove dust such as rainfall and wind.

Based on the findings of PAEHolmes (2012) (Appendix F of the EA) and work conducted by Dooley and Rossato (2010), the predicted dust deposition rates will have nil to minimal impact on the productivity of vegetation south of the Golden Highway, including Arrowfield Estate, due to the Project individually or as part of a cumulative effect with other dust sources.

The potential impacts of dust on equine health have also been assessed as part of the EA. A summary of this is provided in **Section 8.5** below and Appendix H of the EA.

The EA air quality and greenhouse gas impact assessment addresses the extent of dust emissions in further detail (see Appendix F of the EA).

8.4 Noise

The impacts of noise on agricultural resources and enterprises in the locality are assessed as minimal as the Project will satisfy the legislative criteria governing industrial noise. The implementation of real time monitoring systems within the vicinity of the Project will also ensure that noise targets are not exceeded.

The potential impacts of noise on equine health have also been assessed as part of the EA. A summary of this is provided in **Section 8.5** below and Appendix H of the EA.

The EA acoustic impact assessment addresses the extent of noise in further detail (see Appendix G of the EA).

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

8.5 Equine Health

An equine health impact assessment was undertaken by Dr. Nicholas Kannegieter, Specialist Equine Surgeon, and is provided in Appendix H of the EA. The purpose of the assessment was to determine whether the dust, noise and blasting impacts of the Project will have any adverse impacts on the health of thoroughbred horses, including adult horses and foals that are either permanently or temporarily residing within the vicinity.

In order to determine whether thoroughbred horses will be adversely affected by air quality, noise and blasting impacts, it was necessary to ascertain the thresholds at which equine health would be impacted. As such a detailed literature review with regard to the effects of dust, noise and vibration on horses was undertaken by Dr. Nicholas Kannegieter. A summary of the findings from the equine health impact assessment are provided below.

Dust

The published studies indicate that thoroughbred horses are exposed to high levels of dust, with the dominant sources of dust being bedding, hay and feed. Cargill (1999) recommends a maximum inspirable dust concentration of 2,500 to 3,000 µg/m^3 and a maximum respirable dust concentration of 230 µg/m^3 in stables while levels of 80 to170 µg/m^3 are considered normal for a paddock.

Modelling by PAEHolmes (2012) (Appendix F of the EA) predicts the annual average cumulative PM_{10} concentrations resulting from the Project will meet the regulatory criteria of 30 µg/m^3 at all locations on the Darley and Coolmore properties. Even under a worst case scenario when considering the maximum predicted 24 hr average PM_{10} concentrations from the Project, alone the predicted levels will not exceed 52 µg/m^3 and the cumulative 24 hr average PM_{10} will not exceed the criteria of 150 µg/m^3. The PM_{10} levels generated by the Project are well below the limit of 230 µg/m^3 recommended by Cargill (1999) and within the range considered normal for a paddock. As a result, Dr. Nicholas Kannegieter found that the dust produced by the Project will not pose a risk to equine health.

The literature review revealed that health issues associated with dust are caused by endotoxins attached to the particulate matter, rather than the inorganic particles themselves. Endotoxins are bacterial structural components that cause a pyrogenic response (rise in body temperature). If inhaled, endotoxins can induce an inflammatory response, which can lead to diseases of the lower respiratory tracts (LRT) such as Rattles.

Horses possess a highly refined respiratory tract that provides good protection against contamination of the LRT, and mucocilliary clearance mechanisms that can easily expel particulate matter from their bodies. As a result, particulate matter in the absence of endotoxins is merely an irritant.

McGoram et al (1998) found that endotoxins are unlikely to cause diseases of the LRT unless the airborne endotoxin concentration exceeds 20 ng/m^3 (0.02 µg/m^3). A typical pasture environment was found to possess endotoxin levels of 0.00129 µg/m^3, which is well below the amount likely to cause diseases of the LRT (McGoram et al, 1998).

Endotoxin testing undertaken for the Project found that using the worst case 24hr PM_{10} level of 52 µg/m^3 at receiver 227F (on Coolmore) in year 10 and assuming there is the highest level of endotoxin in the dust (403 EU/g), this would equate to endotoxin levels of approximately 0.0021 ng/m^3 of dust in the PM_{10} fracture of dust. Assuming the highest annual average PM_{10}

level predicted at 227F on Coolmore Stud (28 μg/m^3 in year 10) the annual average endotoxin levels would be approximately 0.00078 ng/m^3.

At site D3B (D11) there was considerably more endotoxin in the dust samples than at other sites. The reasons for this are unclear and repeat sampling over a period of time would be required to provide greater accuracy. However even at this higher level, the endotoxin levels of dust would still only be approximately 0.076 ng/m^3 in a worst case scenario at site 227F on Coolmore in Year 10.

Dr Nicholas Kannegieter concluded that the small increase in dust levels predicted to be generated by the Project is well below levels experienced by horses, including adults and foals, in a stabled environment (both at the studs and while in race training). Foals and yearlings are routinely stabled either as a result of illness, for management purposes or for training and are therefore exposed to high dust levels on a regular basis. There will be no increase in risk to foals or yearlings from the physical impact of dust inhalation as a result of the Project.

Given the minimal total airborne endotoxin concentration likely to cause LRT disease typically exceeds 20 ng/m^3 (McGorum et al, 1998) and the worst case scenario as a result of the Project is predicted to be approximately 0.076 ng/m^3, it is highly unlikely that there will be any effect on equine health in both adults and foals.

Noise and Vibration

From the literature review it was determined that horses exposed to noise levels in the range of 54 to 70 dBA would be unlikely to exhibit signs of distress particularly in the absence of a visual stimuli or threat. Further it was found that horses are known to demonstrate habituation. This is the ability to become accustomed to certain stimuli. If a noise becomes familiar to the horse and it is not associated with danger it will not be startled by the noise.

Modelling by Bridges Acoustics (2012) (Appendix G of the EA) predicts noise levels will not exceed 40 dBA on any part of the Coolmore Stud or Woodlands Stud. For the majority of these properties noise levels of 30 to 33 dBA are predicted, which is comparable to the measured background noise level. Given the noise exposures experienced by thoroughbred horses, including foals, in stables and habituation, the operational noise of the Project is unlikely to have any adverse impacts on equine health. Mares and foals visiting studs temporarily will be exposed in transit to noise levels much higher than that predicted to arise from the Project and therefore should not be affected by any slight increase in noise.

Bridges Acoustics also predicts that overpressure levels from blasting (when closest to the receiver) are predicted in the range of 93 to 109 dBL for indicative locations on Coolmore and Woodlands Studs. However, the mining at Drayton South will occur in a north to south direction. As a result, the distance from blasting to the horse studs will be greatest at the beginning of the Project and overpressure levels will be significantly lower. This provides the horses will an opportunity to become accustomed to the overpressure. As mining progresses southwards it is likely that horses will have developed an increased tolerance to blasting due to habituation.

Dr Nicholas Kannegieter also concluded that it is unlikely that the vibrations associated with blasting would have any negative impacts on equine health. The vibration levels produced by blasting would appear to be lower than the levels experienced by horses during road and air transportation.

Although there is little scientific research into the impacts of transportation on animal health, anecdotal evidence shows that horses do not suffer any ill effects from the vibrations

experienced during transportation. There is also anecdotal evidence indicating that horses at the Muswellbrook racecourse and stables are not startled by blasting at the neighbouring Bengalla Mine. Therefore, the ground vibration and overpressure caused by blasting is not expected to have any negative impacts on equine health.

8.6 Visual

A visual impact assessment was undertaken by JVP Visual Planning and Design (JVP) and is provided in Appendix I of the EA. 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.

Agricultural enterprises, in particular the thoroughbred breeding and viticulture industry, are sensitive to changes in the visual aesthetics of the surrounding environment, as the property's image is a component in attracting clientele. With this in mind, it has always been one of the key objectives of the Project to develop a mine plan that reduces as far as practical the visual impacts of the mine on sensitive receptors located to the immediate south including Coolmore Stud, Woodlands Stud, the existing Arrowfield Estate and the village of Jerrys Plains. This was largely achieved through careful mine planning and design to ensure that the existing ridgeline to the south of the Project was maintained and that overburden emplacement areas remained shielded behind it in order to protect views from the sensitive receptors. The existing ridgeline is able to shield the majority of views from the Project particularly from the Redbank and Blakefield mining areas, however, there is a valley located immediately to the south of the Houston mining area where views would be possible. As such, to alleviate potential long term views of the Project, a visual bund will be constructed within this valley to shield views of operations in the Houston and Whynot mining areas (see **Figure 2**).

The Houston visual bund will undergo an eight stage construction program from Year 3 for a period of approximately 16 months. Throughout stages 1, 3, 6 and 8, a dozer and trucks will be supporting construction activities, which will be visible on the face of the visual bund. All other stages of the construction of the visual bund have been designed to remain shielded behind the previous lifts (see **Table 26**).

Table 26 Visual Bund Construction Program

Stage	Construction Activity	Time (Months)	Visibility (Months)
1	Lift to 175 RL	2.1	2.1
2	Backfill to 170 RL	1.5	-
3	Lift to 200RL and 4% grade to 225 RL (East End)	4.3	4.3
4	Backfill to 195 RL	1.5	-
5	Backfill to 4% grade (East End)	1.0	-
6	Lift to 225 RL and crest line (West End)	2.1	2.1
7	Backfill to 220 RL	0.6	-
8	Lift to crest line and final shaping	2.7	2.7
Total		**16**	**11.3**

The Houston visual bund will be progressively covered with available topsoil and rehabilitated with a crop of pasture grass to minimise the risk of dust generation and erosion posed by exposed areas. Tree screens, composed of native species, will be established on the visual bund to restore visual amenity.

Tree screens have also been established on the Golden Highway and will be planted along the ridgeline adjoining the Houston visual bund and the Edderton Road realignment to minimise views of the Project from various vantage points. These tree screens will be planted prior to the construction phase to allow for substantial growth and to maximise survival rates.

JVP found that the construction of the bund will create a high visual impact for limited periods of time until the bund is constructed over a 16 month period. In order to limit potential high impact periods the construction of the bund has been designed in a series of lifts with progressive rehabilitation being undertaken as part of this process (see **Table 26**). This limits the visible exposure of the bund to approximately 11 months. These impacts would be further reduced as rehabilitation is completed. This is likely to be no more than three to five months following completion of the final stage lift of construction. After this the visual impact will reduce to moderate and then low reflecting decreasing visual effect levels.

Once constructed, JVP concludes that the Houston visual bund adds to the effect of the existing ridgeline in shielding views from all of the sensitive viewing locations from the south.

As part of the visual impact assessment due consideration was given to the Gateway criteria as prescribed under the SRLUP (as outlined in **Section 2.2**). It is recognised that scenic and landscape diversity is a key resource base for tourism and associated agricultural pursuits such as viticulture and thoroughbred horse breeding.

As described above, sensitive receptors located to the south of the Project, including Coolmore Stud, Arrowfield Estate and to a degree Woodlands Stud, will experience visual impacts for a relatively short period (approximately 16 months) with all other major Project components, such as mining areas and overburden emplacement areas, being designed to remain behind the existing southern ridgeline and out of view. Following the construction of the visual bund and establishment of the tree screens, visual aesthetics will be restored, and the impact of the Project from this aspect will be minimal. In this regard JVP concludes that the Project will not lead to significant impacts on the equine and viticulture CICs through a loss of scenic and landscape values of the tourist and agricultural businesses around the Project.

The EA visual impact assessment describes the Project's impact on the visual aesthetics of the surrounding environment at sensitive receptors in further detail (see Appendix I of the EA).

8.7 Traffic and Support Infrastructure and Services

Traffic impacts on support infrastructure utilised by agricultural enterprises in the locality of the Project are minimal as all access to the Project will be via the existing Drayton Mine Access Road off Thomas Mitchell Drive with the exception of the work undertaken on the Edderton Road realignment. Despite the minimal disruption during the construction phase, the Edderton Road realignment will result in an improved support infrastructure route to services in the north. At no stage will Edderton Road be closed during the construction phase.

As all traffic has been reduced, as far as practical, along support infrastructure routes utilised by agricultural enterprises, including those by the equine and viticulture CICs, the impact of the Project from this aspect is minimal and is therefore not discussed any further in this assessment. The EA traffic and transport impact assessment discusses the traffic regime in further detail (see Appendix S of the EA).

Support services directly employed by agricultural enterprises, including those by the equine and viticulture CICs, will not be shared by the Project and therefore will not be impacted.

8.8 Labour Supply

The Project is not anticipated to have significant impacts to local labour supply as the existing Drayton Mine operation workforce will continue to be utilised. As such the labour supply available for the operation of agricultural enterprises, including equine and viticulture enterprises, is not expected to be impacted as a result of the Project and is therefore not discussed any further in this assessment.

The EA social impact assessment describes the Project's impact on the broader community in further detail (see Appendix T of the EA).

9 Mitigation and Management Measures

Based on the findings outlined in **Section 8.0**, the Project is not anticipated to have impacts on:

- Availability of land for agricultural purposes or the productivity of existing agricultural land outside the Project Boundary within the immediate locality, including land utilised by the equine and viticulture enterprises ;
- Water supply (the Hunter Regulated River Water Source) by means of water extraction for mining purposes or depressurisation;
- Traffic regimes along support infrastructure routes;
- Labour supply; and
- Support services directly employed by agricultural enterprises.

As such, no mitigation measures regarding these issues have been proposed in this assessment.

9.1 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.

9.2 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 southern ridgeline is maintained and that all OEAs are developed and shaped so that they remain shielded behind this ridgeline from receivers in the southern sector;
- Development of the Houston visual bund to alleviate potential long term views of the Project. The Houston visual bund has been designed to be constructed as quickly as possible in a staged lift configuration so that each main stage lift is able to be progressively covered with available topsoil and rehabilitated with a crop of pasture grass to minimise exposed areas. Tree plantings, composed of native species, will be established on the visual bund to restore visual amenity and compatibility with surrounding woodland landscapes;
- Tree screens have been established along the Golden Highway and will be planted along the ridgeline adjoining the Houston visual bund and the Edderton Road realignment to minimise views of the Project from various vantage points. These tree screens will be planted prior to the construction phase to allow for substantial growth and to maximise survival rates;
- Detail planting plans will be prepared to clearly illustrate areas and character of planting on all rehabilitation areas including the visual bunds and tree screens; and
- Progressive rehabilitation of OEAs and disturbed areas.

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.

Anglo American will also conduct ongoing consultation with stakeholders surrounding the site over 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.

9.3 Weed and Pest Management

Anglo American should develop and implement a weed and pest management plan to control the distribution of invasive species and feral animals at Drayton South and the offsite biodiversity offset. This plan will see the commitment of appropriate resources (physical, financial and labour) to ensure it is implemented in an effective manner.

Anglo American should consult with the Hunter Livestock Health and Pest Authority as to the appropriateness of the plan. A monitoring and reporting system will be an integral part of the management plan.

9.4 Sustainable Farming Practices

9.4.1 Drayton South

Sustainable farming practices, including rotational grazing techniques, is considered a final land use goal in available areas outside of the Drayton South disturbance footprint on land owned by Anglo American (approximately 2,669 ha). This includes land to the west near Saddlers Creek, to the east towards Plashett Dam and to the south beyond the existing ridgeline. A description of the land and its capability in each area is provided below.

The land to the west near Saddlers Creek primarily coincides with the following:

- Agricultural domains A, B and C;
- Land capability classes IV, V and VI. Land capability decreases further away from Saddlers Creek; and
- Agricultural land suitability classes 3 and 4.

The land to the east towards Plashett Dam primarily coincides with the following:

- Agricultural domain C;
- Land capability classes VI and VII; and
- Agricultural land suitability class 4.

The land to the south beyond the ridgeline primarily coincides with the following:

- Agricultural domains B, C and D;
- Land capability classes VI and VII; and
- Agricultural land suitability classes 3, 4 and 5.

Given that the Project will not reduce the availability or agricultural productivity of the land outside of the Drayton South disturbance footprint, the land proposed for sustainable farming practices will retain its current condition, which is best suited for grazing.

Sustainable farming practices should be undertaken in conjunction with measures proposed by the Central-Hunter Rivers Catchment Management Authority (CMA) for the restoration of Saddlers Creek and any proposed biodiversity offsets.

Anglo American should ensure that as part of the Licences to Occupy, land managers will be required to commit to the implementation of the program as outlined in the collaboration agreement between Anglo American and the CMA.

9.4.2 Offsite Biodiversity Offset

In the event that the offsite biodiversity offset is managed in part for agricultural purposes, sustainable farming practices should be implemented to encourage the establishment of native grassland communities.

10 Conclusion

The land associated with Drayton South is owned by Anglo American and licensed to two landholders who use the land for beef production. One licensee also operates an opportune horse agistment (on land located outside of the proposed mining area) during the thoroughbred breeding season when demand dictates.

The current gross value of beef production from Drayton South is estimated to be $701,208 per annum turning off 1,140 head of cattle per annum. With further development of the property this could rise to $1,229,543 per annum turning off 1,998 head of cattle per annum. Not all of Drayton South will be removed from agriculture. The area that will be removed (Drayton South disturbance footprint) is approximately 1,928 ha and is predominantly the least productive land within Drayton South. The gross value of production from the beef enterprises within this area totals $257,110 per annum.

The offsite biodiversity offset (2,079 ha), located in the Liverpool Plains LGA (just north of Murrurundi), currently runs merino wethers and beef breeders. Gross value of production from wool and livestock sales is $500,828 per annum. Further development of the property could see this increase to $688,048 per annum through the production of wethers alone.

The value of agricultural production from the combined area lost to agriculture (the Drayton South disturbance footprint and offsite biodiversity offset) is predicted to be $0.8 M per annum. This represents 0.26% of the gross annual value of agricultural production in the Hunter region, 0.01% of NSW's agricultural production and 0.002% of the national production.

As the overall agricultural contribution of the Drayton South disturbance footprint and the offsite biodiversity offset 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. 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 immediate locality.

The direct annual output of the Project is estimated at $451 M per annum. In contrast, the direct annual output of future use of agricultural lands that would be utilised by the Project is estimated at $0.8 M per annum.

Gillespie Economics (2012) also undertook a benefit cost analysis which included an estimation of the present value of production costs and benefits of the Project over a 27 year period. The present value of net production benefits of the Project to Australia are estimated at $490 M (7% discount rate). In contrast, the present value of future use of agricultural lands that would be utilised by the Project is estimated at $5.6 M (7% discount rate). Gillespie Economics concluded that based on these comparative values, the Project is considered to be significantly more efficient than continued agricultural production.

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APPENDIX 1

Assumptions for Carrying Capacity of Drayton South (Existing Production)

Appendix 1

Drayton South Ag Domain		A	B	C	D	Total
Area	Ha	376	749	2,780	692	4,597
CURRENT	DSE/ha	8	6	4	2	
	TDM/ha	2.92	2.19	1.46	0.73	
Total DSE		3,008	4,494	11,120	1,384	20,006
Total pasture		1,098	1,640	4,059	505	7,302
Enterprise		Vealer	Vealer	Inland weaner	Inland weaner	
DSE Rating	DSE/breding cow	16.27	16.27	14.88	14.88	
Total cows		185	276	747	93	1,301
Stocking rate	ha/breeder	2.0	2.7	3.7	7.4	
Gross Income	$/h	$ 333.17	$ 249.52	$ 124.45	$ 62.24	
Costs	$/ha	$ 188.55	$ 141.21	$ 29.45	$ 14.73	
Gross Margin	$/ha	$ 144.61	$ 108.31	$ 95.00	$ 47.51	
Animals sold per ha		0.5	0.4	0.2	0.1	
Gross Income	$/breeder	$ 677.14	$ 677.14	$ 463.15	$ 463.15	
Costs	$/breeder	$ 383.22	$ 383.22	$ 109.60	$ 109.60	
Gross Margin	$/breeder	$ 293.92	$ 293.92	$ 353.55	$ 353.55	
Animals sold per 100 breeeders		96	96	83	83	
Gross Income	$	$ 125,271	$ 186,891	$ 345,973	$ 43,073	$ 701,208
Costs	$	$ 70,896	$ 105,769	$ 81,871	$ 10,193	$ 268,728
Gross Margin	$	$ 54,375	$ 81,122	$ 264,102	$ 32,880	$ 432,479
Total Animal Sold		178	265	620	77	1,140

Horse enterprise per dry mare

Days on farm	100	
$/day	$24	
Full Feed costs per day		
Supplement	$/kg	$0.70
Hay	$/tonne	$350
Hay wastage	15%	
Supp fed	Kg	4
Hay fed	kg	4
Costs fed per day		$4.45
Margin over feed costs		$19.55

APPENDIX 2

Assumptions for Carrying Capacity of Offsite Biodiversity Offset (Existing Production)

Appendix 2

Biodiversity Offset Property

Ag Domain		X	Y	Z	Total
Area	Ha	1,646	333	100	2,079
	%	79.2	16.0	4.8	
CURRENT	DSE/ha	3.5	6.5	0	
	TDM/ha	1.3	2.4	0	
Total DSE		5,761	2,165	0	7,926
Total pasture		2,103	790	0	2,893
Enterprise		Wethers	Inland weaner		
DSE Rating	DSE/wether	1.00	14.88		
Total wethers		5,000	200	7976	
Gross Income	$/hd	$ 73.08	$ 677.14		
Costs	$/hd	$ 40.14	$ 383.22		
Gross Margin	$/hd	$ 32.94	$ 293.92		
Animals sold per 100 hd		18.8	96		
Wool sold kg/hd		5.5	-		
Gross Income	$/DSE	$ 73.08	$ 45.51		
Costs	$/DSE	$ 40.14	$ 25.75		
Gross Margin	$/DSE	$ 32.94	$ 19.75		
Gross Income		$ 365,400	$ 135,428	$ 500,828	
Costs		$ 200,700	$ 76,644	$ 277,344	
Gross Margin		$ 164,700	$ 58,784	$ 223,484	
Total sold		940	192		
Wool sold Kg		43,766			

Ag Domain	Area	As is DSE/ha	Potential DSE/ha
X	1,646	3.5	4.0
Y	333	6.5	8.5
Z	101	-	-
	2,080		
Total DSE		7,926	9,415
Current DSE		7,976	

APPENDIX 3

Assumptions for Carrying Capacity of Drayton South (Maximum Production)

Appendix 3

Drayton South Ag Domain		A	B	C	D	Total
Area	Ha	376	749	2,780	692	4,597
Max Potential	DSE/ha	15	10	7	5	
	TDM/ha	5.475	3.65	2.555	1.825	
Total DSE		5,640	7,490	19,460	3,460	36,050
Total pasture		2,059	2,734	7,103	1,263	13,158
Enterprise		Vealer	Vealer	Inland weaner	Inland weaner	
DSE Rating	DSE/breding cow	16.89	16.27	14.88	14.88	
Total cows		334	460	1,308	233	2,335
Stocking rate	ha/breeder	1.1	1.6	2.1	3.0	
Gross Income	$/ha	$ 543.47	$ 415.87	$ 217.91	$ 155.95	
Costs	$/ha	$ 239.67	$ 284.49	$ 95.32	$ 66.96	
Gross Margin	$/ha	$ 303.80	$ 131.38	$ 122.59	$ 88.98	
Animals sold per ha		0.7	0.6	0.4	0.3	
Gross Income	$/breeder	$ 611.81	$ 677.14	$ 463.15	$ 463.15	
Costs	$/breeder	$ 269.81	$ 463.22	$ 202.60	$ 198.88	
Gross Margin	$/breeder	$ 342.00	$ 213.92	$ 260.55	$ 264.27	
Animals sold per 100 breeeders		83	96	83	83	
Gross Income	$	$ 204,345	$ 311,484	$ 605,800	$ 107,914	$1,229,543
Costs	$	$ 90,117	$ 213,081	$ 265,001	$ 46,339	$ 614,538
Gross Margin	$	$ 114,228	$ 98,403	$ 340,799	$ 61,575	$ 615,006
Total Animal Sold		277	442	1,086	193	1,998

APPENDIX 4

Assumptions for Carrying Capacity of Offsite Biodiversity Offset (Maximum Production)

Appendix 4

Biodiversity Offset Property

Ag Domain		X	Y	Z	Total
Area	Ha	1,646	333	100	2,079
POTENTIAL	DSE/ha	4.0	8.5	-	
	TDM/ha	1.5	3.1	0.0	
Total DSE		6,584	2,831	0	9,415
Total pasture		2,403	1,033	0	3,436
Enterprise		Wethers	Inland weaner		
DSE Rating	DSE/wether	1.00	14.88		
Total wethers		9,415	0	9415	
Gross Income	$/hd	$ 73.08	$ 677.14		
Costs	$/hd	$ 42.60	$ 419.76		
Gross Margin	$/hd	$ 30.48	$ 257.38		
Animals sold per 100 hd		18.8	96		
Wool sold kg/hd		5.5	-		
Gross Income	$/DSE	$ 73.08	$ 45.51		
Costs	$/DSE	$ 42.60	$ 28.21		
Gross Margin	$/DSE	$ 30.48	$ 17.30		
Gross Income		$ 688,048	$ -	$ 688,048	
Costs		$ 401,039	$ -	$ 401,039	
Gross Margin		$ 287,009	$ -	$ 287,009	
Total sold		1,770	0		
Wool sold Kg		51,988			

APPENDIX 5

Anglo American Risk Matrix

DRAYTON SOUTH COAL PROJECT

Risk Assessment Tools: Matrix for Determining Level of Risk

Loss Type	Consequence (C)				
	1 Insignificant	2 Minor	3 Moderate	4 High	5 Major
(S/H) Harm to People (Safety/Health)	First aid case. Exposure to minor health risk.	Medical treatment case. Exposure to major health risk.	Lost time injury. Reversible impact on health.	Single fatality or loss of quality of life. Irreversible impact on health.	Multiple fatalities. Impact on health ultimately fatal.
(EI) Environmental Impact	Minimal environmental harm (L1 incident).	Material environmental harm (L2 incident, remediable short term).	Serious environmental harm (L2 incident remediable with LOM).	Major environmental harm (L2 incident remediable post LOM).	Extreme environmental harm (L3 incident irreversible).
(BI/MD) Business Interruption/Material Damage and Other Consequential Losses	No disruption to operation. Five percent loss of budgeted operating profit.	Brief disruption of operation. Ten percent loss of budgeted operating profit/listed assets.	Partial shutdown. Fifteen percent loss of budgeted operating profit/listed assets.	Partial loss of operation. Twenty percent loss of budgeted operating profit/listed assets.	Substantial or total loss of operation. Twenty-five percent of loss budgeted operating profit/listed assets.
(L&R) Legal and Regulatory	Low level legal issue.	Minor legal issue. Non compliance and breaches of the law.	Serious breach of the law. Investigation/report to authority, prosecution and/or moderate penalty.	Major breach of the law. Considerable prosecution and penalties.	Very considerable penalties and prosecutions. Multiple law suits and jail terms
(R/S/C) Impact on Reputation/Social/Community	Slight impact. Public awareness may exist but no public concern.	Limited impact. Local public concern.	Considerable impact. Regional public concern.	National impact. National public concern.	International impact. International public attention.
Likelihood (L)	Risk Rating				
5 Almost Certain	11 (M)	16 (S)	20 (S)	23 (H)	25 (H)
4 Likely	7 (M)	12 (M)	17 (S)	21 (H)	24 (H)
3 Possible	4 (L)	8 (M)	13 (S)	18 (S)	22 (H)
2 Unlikely	2 (L)	5 (L)	9 (M)	14 (S)	19 (S)
1 Rare	1 (L)	3 (L)	6 (M)	10 (M)	15 (S)

Likelihood Rating

Likelihood	Examples
5 Almost Certain	The unwanted event has occurred frequently; occurs in order of one or more times per year and is likely to reoccur within one year.
4 Likely	The unwanted event has occurred infrequently; occurs in order of less than once per year and is likely to reoccur within five years.
3 Possible	The unwanted event has happened in the business at sometime or could happen within 10 years.
2 Unlikely	The unwanted event has happened in the business at sometime or could happen within 20 years.
1 Rare	The unwanted event has never been known to occur in the business or it is highly unlikely that it will occur within 20 years.

Risk Rating

Risk Rating	Risk Level	Guidelines
21 to 25	(H) High	A high risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised immediately.
13 to 20	(S) Significant	A significant risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as soon as possible.
6 to 12	(M) Medium	A moderate risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as part of the normal management process.
1 to 5	(L) Low	A low risk exists that management's objectives may not be achieved. Monitor risk, no further mitigation required.

APPENDIX 6

Economic Review of Potential Agricultural Impacts

Drayton South Coal Project

Economic Review of Potential Agricultural Impacts

Prepared for

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July 2012

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Drayton Mine is managed by Anglo Coal (Drayton Management) Pty Ltd, which is owned by Anglo American. Drayton Mine commenced production in 1983 and currently holds Project Approval 06_0202 (dated 1 February 2008) that expires in 2017 at which time the operation will have to close. The Project will allow for the continuation of mining at Drayton Mine by the development of open cut and highwall mining operations within the Drayton South mining area while continuing to utilise the existing infrastructure and equipment from Drayton Mine.

The Project is located approximately 10 km north-west of the village of Jerrys Plains and approximately 13 km south of the township of Muswellbrook in the Upper Hunter Valley of New South Wales (NSW). The Project is predominately situated within the Muswellbrook Shire Local Government Area (LGA), with the south-east portion falling within the Singleton Shire LGA. The Project is located adjacent to two thoroughbred horse studs, two power stations and several existing coal mines.

The Project will extend the life of Drayton Mine by a further 27 years ensuring the continuity of employment for its workforce, the ongoing utilisation of its infrastructure and the orderly rehabilitation of Drayton Mine's completed mining areas.

Anglo American is seeking Project Approval under Part 3A of the EP&A Act 1979 to facilitate the extraction of coal by both open cut and highwall mining methods within Exploration Licence (EL) 5460 for a period of 27 years. The Project generally comprises:

- The development of an open cut and highwall mining operation extracting up to 7 Mtpa of Run of Mine (ROM) coal over a period of 27 years;
- The utilisation of the existing Drayton Mine workforce and equipment fleet (with an addition of a highwall miner and coal haulage fleet);
    - The Drayton Mine fleet consists of at least a dragline, excavators, fleet of haul trucks, dozers, graders, water carts and associated supporting equipment;
- The use of Drayton Mine's existing voids for rejects and tailings disposal and water storage to allow for the optimisation of the Drayton Mine final landform;
- The utilisation of the existing Drayton Mine infrastructure including the Coal Handling and Preparation Plant (CHPP), rail loop and associated loadout infrastructure, workshops, bath houses and administration offices;
- The construction of a transport corridor between Drayton South and Drayton Mine;
- The utilisation of the Antiene Rail Spur off the Main Northern Railway to transport product coal to the Port of Newcastle for export;
- The realignment of a section of Edderton Road; and
- The installation of water management and power reticulation infrastructure at Drayton South.

Drayton Mine will continue to operate under and in accordance with the existing Project Approval 06_0202 and there will be a period when Drayton Mine and Drayton South operate concurrently.

Scott Barnett & Associates Pty Ltd (2012) undertook an Agricultural Land Use Impact Assessment for the Drayton South Coal Project (the Project). This report utilises the information provided by Scott Barnett & Associates Pty Ltd to assess the potential economic implications of the impacts of the Project on agricultural (including land and water) resources. In Section 2 some of the underlying issues that have been raised in relation to the perceived conflict between coal mining and the use of agricultural land and water are considered. Section 3 examines agricultural and mining industries in

the Upper Hunter region. The economic efficiency and regional economic impact assessment frameworks for consideration of the economic impacts of Projects that impact land and water resources, are identified in Section 4. Section 5 examines the economic efficiency and regional economic impacts of the Project's use of land and water resources.

2 AGRICULTURAL AND MINING INDUSTRIES IN NEW SOUTH WALES

2.1 Land Use

Agricultural lands are important to NSW and cover approximately 81% of NSW (i.e. 65 million [M] hectares [ha]) (Australian Natural Resources Atlas [ANRA], 2009a). While the total agricultural land area in NSW has declined marginally since 1960 (Table 2.1), the area of land under major food crop production (i.e. wheat and barley[1]) has actually increased (Figure 2.1).

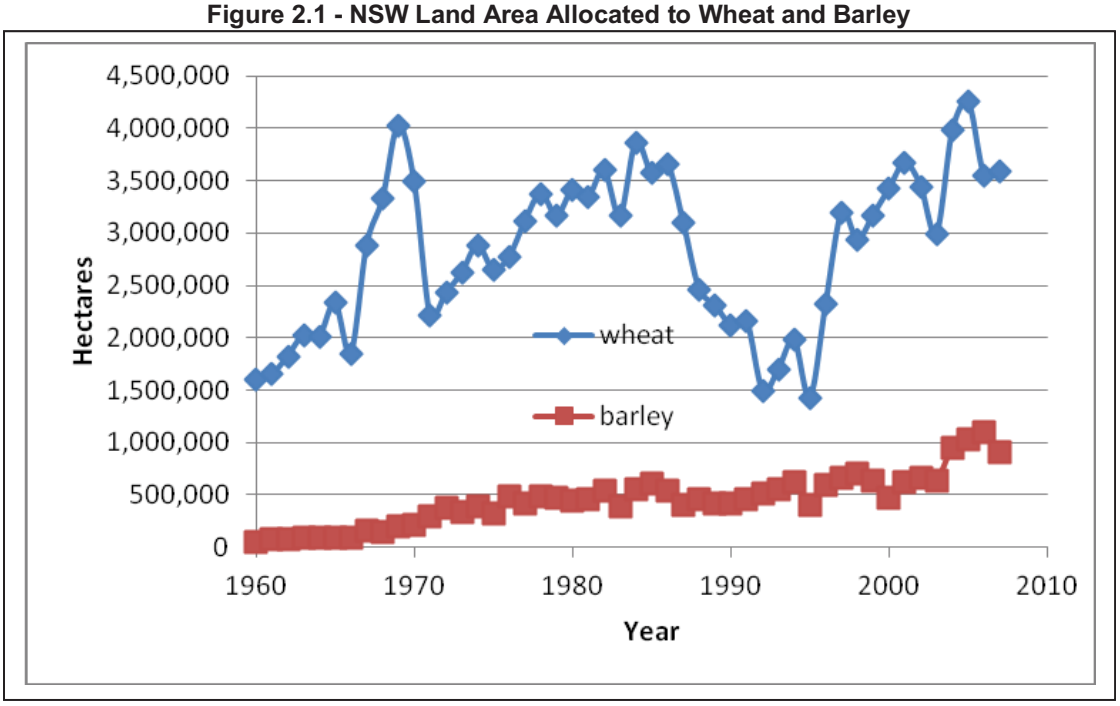
Table 2.1 - NSW Agricultural Land Area

Area of Agricultural Land (M ha)	1960	1980	1997
	69.95	65.01	60.90

Source: ANRA (2009b).

The NSW agricultural industry directly provides employment for 76,261 people or 2.7% of total employment in NSW (Australian Bureau of Statistics [ABS], 2006)[2]. Payment to agriculture, forestry and fishing employees in 20010-11 was $1,539M and value-added was $7,062M. Gross operating surplus and gross mixed income from agriculture, forestry and fishing was $6,908M (ABS, 2011a).

Figure 2.1 - NSW Land Area Allocated to Wheat and Barley



Source: ABS (2009).

Mining land use is a small fraction of the area of NSW (i.e. less than 0.1% of the total NSW land area) (Bureau of Regional Science 2009) and directly employs 19,026 or 0.7% of total employment in NSW (ABS, 2006). Payment to mining employees in 2010-11 was $2,466M and value-added was $10,633M. Gross operating surplus and gross mixed income from mining was $10,035M (ABS, 2011a).

[1] Wheat and barley are the two largest food crops produced in Australia
[2] This is based on the ABS sector of Agriculture, forestry and fishing.

In this comparison, mining is a more significant sector than agriculture in terms of payments to employees, value-added and gross operating surplus and gross mixed income. However, agriculture does employ more people, albeit while using a much larger area of NSW to achieve this employment.

Nevertheless, no policy implication should be drawn from the relative magnitudes of existing sectors. What is relevant in a policy context is whether moving from one land use to another is more economically efficient or not. That is, do the benefits to the community from changing land uses exceed the costs to the community. This is discussed in more detail in Section 4.

2.2 Economic Growth in Regional Areas

Agricultural lands have historically supported the economies of regional areas. However, regional economies are facing a number of trends including:

- loss of significant industries such as abattoirs and timber mills from many rural areas;
- increased mechanisation of agriculture and aggregation of properties, resulting in loss of employment opportunities in this industry;
- preference of Australians for coastal living, particularly for retirement; and
- preference of many of today's fastest growing industries for locating in large cities (Collits, 2001).

The result is that there has been declining population growth in 47 out of 96 rural statistical local areas (SLAs) that are located in non-coastal statistical subdivisions in NSW (excluding Hunter Statistical Division) (ABS, 2011). There has also been a decline in the population of smaller towns even in regions that have been growing.

Trends in agriculture are leading to improved productivity, but reduced economic stimulus in regional areas, as demand for inputs such as labour decline. In general, the prosperity of rural areas that are reliant on agriculture has also been in decline.

It is increased or new spending in regions that contributes to economic stimulus and growth. One potential source of new spending is mining projects that utilise the resource endowments of a region. Studies (Gillespie Economics, 2003, 2007) have shown that mining projects provide significant new economic activity to regional and rural economies through direct expenditures on inputs to production as well as the expenditure of employees. This latter stimulus is enhanced by the high wages paid in the mining sector.

Mining projects can also broaden the economic base of regions, thereby insulating the economy from external shocks such as droughts and downturns in agricultural commodity prices (Collits, 2001).

2.3 Prime Agricultural Land and Other Land Uses

In NSW, dryland and irrigated cropping land covers an area of 84,878 square km. Mining (and waste disposal) covers an area of 630 square km, 0.74% of the area of cropping lands (Table 2.2).

Table 2.2 - NSW Land Uses

Land use	Area (sqkm)	Area (%)
Nature conservation	61,058	7.6%
Other protected areas	2,478	0.3%
Minimal use	59,178	7.4%
Grazing native vegetation	309,428	38.6%
Production forestry	25,242	3.2%
Plantation forestry	4,200	0.5%
Grazing modified pastures	222,164	27.7%
Dryland cropping	74,692	9.3%
Dryland horticulture	390	0.0%
Irrigated pastures	3,160	0.4%
Irrigated cropping	10,186	1.3%
Irrigated horticulture	1,073	0.1%
Land in transition	951	0.1%
Intensive animal and plant production	243	0.0%
Intensive uses (mainly urban)	10,218	1.3%
Rural residential	4,387	0.5%
Mining and waste	630	0.1%
Water	11,352	1.4%
Total	**801,030**	**100.0%**

Source: Bureau of Rural Sciences (2009)

The threat to cropping land from mining would therefore appear to be minimal at a macro level. Nevertheless, the desirability of proposals that impact this land should be addressed at a micro level through a consideration of costs and benefits, including the costs to society of impacting high value, agricultural land.

2.4 Food Security

"Food security refers to the ability of individuals, households and communities to acquire appropriate and nutritious food on a regular and reliable basis, and using socially acceptable means. Food security is determined by the food supply in a community, and whether people have adequate resources and skills to acquire and use (access) that food" (NSW Centre for Public Health and Nutrition 2003).

With respect to food supply in NSW, the output of key food products such as wheat and barley from prime agricultural land has increased over time, as has the area of land allocated to these crops (ABS 2012).

Australia's agricultural industries have become more heavily export oriented over the last twenty years. Around two-thirds of agricultural production is now either directly or indirectly exported. The wool industry currently exports around 95 per cent of its production. The beef, sugar and wheat industries export around 65-75 per cent of their production, while the sheep meat, wine and dairy industries export around 50-60 per cent. With the exception of the wool industry — which has always been highly export oriented — these shares have all risen steadily in recent decades (Productivity Commissions 2005).

As identified by ABARES (2011, p. 2), "There is no foreseeable risk to Australia's food security. Australia produces twice as much food as it consumes, produces almost all its fresh food, and can easily afford the food it imports". Furthermore, "the global food security challenge is not about the capability of world agricultural producers to produce enough food to feed the world, but rather is about

ensuring that the poorest people in the world have the economic and physical access to the food they require to meet their nutritional needs" (ABARES 2011, p. 16).

2.5 Water Supplies and Mining

In NSW, the agriculture sector consumes the largest volume of water with 2,127 GL, or 49% of NSW water consumption in 2009-2010. Mining is a relatively small consumer of water, using 62 GL or 1% of NSW water consumption in 2009-2010 (Table 2.3).

Table 2.3 – NSW Water Consumption 2009-2010

Sector	GL	%
Agriculture	2,127	49%
Forestry and fishing	1	0%
Mining	62	1%
Manufacturing	142	3%
Electricity and gas	68	2%
Water supply(a)(b)	1,001	23%
Other industries(c)	357	8%
Household	565	13%
Total	**4,323**	**100%**

(a) Includes sewerage and drainage services
(b) Includes water losses
(c) Includes aquaculture and services to agriculture
Source: ABS (2011)

Like land, water can also be considered a scarce resource that faces competing demands. Consequently, the government has established a framework to facilitate its allocation between competing uses.

The *NSW Water Management Act 2000* (WM Act) vests ownership of water in the Crown. Water access and use is now only permissible with possession of a water access licence (except in the case of harvestable rights, native title rights and some stock and domestic rights). Water Sharing Plans that are prepared under the WM Act set the rules by which water is shared between all users, including the environment, in each water management area in NSW. These plans also set rules for water trading, that is, the buying and selling of water licences and also annual water allocations (Montoya 2010).

The aim of water trading is to facilitate the re-allocation of water from sectors with low added value to sectors with a higher added value (Savenije and van der Zaag 2001). Like the situation with land, the price of water performs the function of rationing the scarce supply of water among competing uses. Users that value water the most will be willing to pay the most for water entitlements.

Water productivity is one measure of water efficiency and can be expressed as the amount of output produced from one unit of water. Table 2.4 provides data on water consumption and industry gross value added for 2009–10, from which water intensity by industry can be calculated. Mining in Australia recorded (on average) $196 million in gross valued added per gigalitre (GL) of water consumed in 2009–10 with the equivalent figure for coal mining being $298 million per GL. This compares to the agriculture sector which generated, on average, $3 million in gross value added for every GL of water consumed in 2009–10 (Table 2.3).

Table 2.4 - Industry Gross Value Added For Water Using Industries—2009–10 (Australia)

		Industry gross value added (a)	Water consumption	Industry gross value added per GL of water consumed
		$m	GL	$m/GL
Agriculture, forestry and fishing	Agriculture	24 265	6 987	3
	Aquaculture, forestry, fishing	4 499	200	22
	Total Agriculture, forestry and fishing	28 764	7,187	4
Mining	Coal mining	22 576	76	298
	Oil and gas extraction	26 340	34	785
	Other mining(b)	38 880	336	116
	Exploration and mining support services	8 309	44	187
	Total mining	96 105	489	196
Manufacturing	Food, beverages and tobacco	23 953	301	80
	Wood and paper products	7 736	81	96
	Printing, publishing and record media	4 088	4	941
	Petroleum, coal, chemical and associated products	17 807	77	230
	Non-metallic, mineral products	5 783	33	176
	Metal products	21 310	139	153
	Machinery and equipment	19 881	9	2 134
	Other manufacturing (includes furniture)	3 047	1	2 998
	Total manufacturing	107 707	658	164
Electricity and gas		18 837	297	64
Water supply, sewerage and drainage		7 191	1 893	4
All other industries		944 442	1 084	871
Total		**1 203 046**	**11 609**	**104**

(a) At 2009–10 current prices
(b) Includes services to mining
Source: ABS (2011)

3 AGRICULTURAL AND MINING INDUSTRIES IN THE UPPER HUNTER REGION

3.1 Agriculture

The Upper Hunter region (i.e. the Singleton, Muswellbrook and Upper Hunter Shire local government areas [LGAs]) have a combined land area of 1.6M ha, of which 56% is agricultural land (Table 2). Of this agricultural land, 2.8% is irrigated with annual irrigation volumes of approximately 89,513 million litres (ML) (Table 3.1). The total value of agricultural production in this region in 2006 is estimated at $143M (Table 3.1).

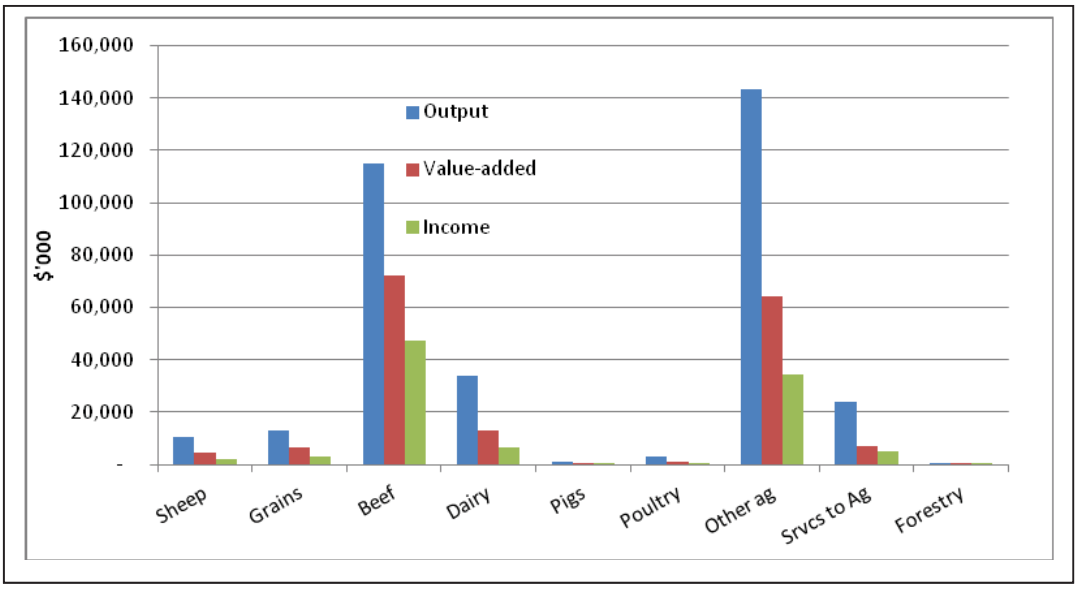
Table 3.1 - Existing Agricultural Land Use and Value of Production in Upper Hunter Region 2006

	Units	Singleton LGA	Muswellbrook LGA	Upper Hunter Shire LGA	Total
Area					
Land Area	ha '000	490	341	810	1,640
Area of Agricultural Land	ha '000	156	122	647	925
Irrigation					
Area Irrigated	ha '000	7	9	10	26
Irrigation Volume Applied	ML	27,394	30,894	31,225	89,513
Other Agricultural Uses	ML	2,015	1,728	4,792	8,535
Total Water Use	ML	29,409	32,621	36,017	98,047
Area Irrigated as Proportion of Agricultural Land	%	4.5	7.4	1.5	2.8
Value					
Gross Value of Crops	$M	8.2	9.6	8.5	26.3
Gross Value of Livestock Slaughterings	$M	17.4	11.3	49.6	78.3
Gross Value of Livestock Products	$M	11.5	13.1	13.5	38.1
Total Gross Value of Agricultural Production	**$M**	**37.1**	**34.0**	**71.6**	**142.7**

Source: ABS (2011b, 2011c, 2011d).
Note: Totals may have minor discrepancies due to rounding.

The input-output table developed for the Upper Hunter region (Gillespie Economics, 2012) provides an indication of the direct relative significance of the different agricultural sectors, affirming beef cattle and other agriculture (which includes grapes and horse breeding) as the main agricultural sectors (Figure 3.1).

Figure 3.1
Agricultural Sectors in Upper Hunter Region



Source: Gillespie Economics (2012).

Total employment in the agricultural industry in the Upper Hunter region in 2006 was 2,288 (ABS, 2010e). Table 3.2 provides a more detailed employment by industry breakdown which indicates that the main agricultural employment is in beef cattle farming, horse breeding, dairy cattle farming and grape growing.

Table 3.2 - Employment by Agricultural Sectors in the Upper Hunter Region

Sector	No.
0100 Agriculture, not further defined (nfd)	57
0112 Nursery Production (Outdoors)	4
0113 Turf Growing	3
0115 Floriculture Production (Outdoors)	3
0121 Mushroom Growing	37
0123 Vegetable Growing (Outdoors)	22
0130 Fruit and Tree Nut Growing, nfd	6
0131 Grape Growing	122
0136 Citrus Fruit Growing	4
0137 Olive Growing	8
0139 Other Fruit and Tree Nut Growing	3
0141 Sheep Farming (Specialised)	38
0142 Beef Cattle Farming (Specialised)	791
0143 Beef Cattle Feedlots (Specialised)	3
0144 Sheep-Beef Cattle Farming	154
0145 Grain-Sheep or Grain-Beef Cattle Farming	51
0149 Other Grain Growing	25
0159 Other Crop Growing, not elsewhere classified (nec)	40
0160 Dairy Cattle Farming	217
0170 Poultry Farming, nfd	4
0171 Poultry Farming (Meat)	4
0172 Poultry Farming (Eggs)	4
0191 Horse Farming	580
0192 Pig Farming	4
0199 Other Livestock Farming, nec	3
0301 Forestry	3
0420 Hunting and Trapping	3
0520 Agriculture and Fishing Support Services, nfd	7
0522 Shearing Services	8
0529 Other Agriculture and Fishing Support Services	67
A000 Agriculture, Forestry and Fishing, nfd	13
Total	**2,288**

Source: ABS (2010e)

3.2 Coal Mining

NSW DPI (2009) identifies 18 coal mines in the Hunter Coalfield producing 80.44 Mt of saleable coal in 2007/08. Conservatively assuming all of this production is steaming coal with a value of AUD$63.47 per tonne, this level of saleable coal production is estimated to have a value of around $8 billion (B) (Table 3.3) which is significantly greater than the value of all agricultural production in the Upper Hunter region (reported as $143M in Table 3.1). Direct employment in mining in the Hunter Coalfield as reported by NSW DPI (2009) is 8,384 which is also significantly greater than total employment in the agricultural industry in the Upper Hunter region in 2006 which was 2,288 (Table 3.2).

Table 3.3 - Existing Coal Mining Production, Gross Value and Direct Employment in the Hunter Coalfield

Coal Mining	Units	Total
Coal Saleable Production (2007/2008)	Mt	80.44*
Gross Value of Coal Production (2007/8)	$M	5,106**
Direct Mining Employment (2008)	No.	8,384*

Source: * NSW Department of Primary Industries (DPI) (2009)
** Conservatively assuming only steaming coal production and a value of AUD$63.47/t which was the median price for NSW Steaming coal exports Free on Board (FOB) in December 2007 (DPI, 2009)

Note: Mt = million tonnes.

3.3 Agriculture, Mining, Manufacturing And Accommodation, Cafes And Restaurants

Table 3.4 provides ABS data on direct employment in the major agriculture activities in the region, coal mining, the main manufacturing activities associated with agriculture and mining in the region and accommodation, cafes and restaurants in the region.

From this data it is evident that coal mining is by far the most significant provider of employment in the region and has strong backward linkages to, among other sectors, the mining and construction machinery manufacturing sector and explosives manufacturing sector. The mining sector provides 44 times the direct employment of the grape growing sector, nine times the direct employment of the horse farming sector and four times the direct employment of the entire accommodation, cafes and restaurants sectors. The most significant agriculture sector in terms of direct employment is beef grazing. Beef grazing also has strong linkages to the meat processing sector, which combined provide greater levels of direct employment than the grape growing and wine manufacturing sectors.

Table 3.4 - Employment in Agriculture, Mining, Manufacturing and Accommodation (Upper Hunter Region)

Agriculture		Mining		Manufacturing		Accommodation	
0131 Grape Growing	122	0600 Coal Mining	4,643	1111 Meat Processing	153	4400 Accommodation	276
0142 Beef Cattle Farming (Specialised)	791	1090 Other Mining Support Services	319	1214 Wine and Other Alcoholic Beverage Manufacturing	235	4500 Food and Beverage Services, nfd	24
0191 Horse Farming	580			1892 Explosive Manufacturing	118	4510 Cafes, Restaurants and Takeaway Food Services, nfd	3
0144 Sheep-Beef Cattle Farming	154		-	2462 Mining and Construction Machinery Manufacturing	178	4511 Cafes and Restaurants	275
0145 Grain-Sheep or Grain-Beef Cattle Farming	51			2461Agricultural Machinery and Equipment Manufacturing	11	4512 Takeaway Food Services	370
0160 Dairy Cattle Farming	217					4513 Catering Services	58
						4520 Pubs, Taverns and Bars	235
						4530 Clubs (Hospitality)	160
						H000 Accommodation and Food Services, nfd	3
Total Agriculture	**2,288**	**Total Mining**	**5,368**	**Total Manufacturing**	**1,819**	**Total Accommodation, Cafes and Restaurants**	**1,404**

Source: ABS 2006 Census of Population and Housing, Customised Data Report, Place of Work by Industry ANZSIC 4 digit.

Figures 3.2 to 3.4 are generated from a 2006 input-output table of the regional economy (Muswellbrook LGA, Singleton LGA and Upper Hunter Shire LGA) and provide a sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the economic structure of the economy.

What is clear from these figures is that in terms of gross regional output, value-added, income, employment, imports and exports, coal mining is the most significant sector of the regional economy. For comparison, the horse breeding and grape growing sectors are located in the other agriculture sector in Figures 3.2 to 3.4, while wine manufacturing is located in the food manufacturing sector. Accommodation, cafes and restaurants are located in the Accom/restaurants sector.

Figure 3.2 Sectoral Distribution of Gross Regional Output and Value-Added ($'000)

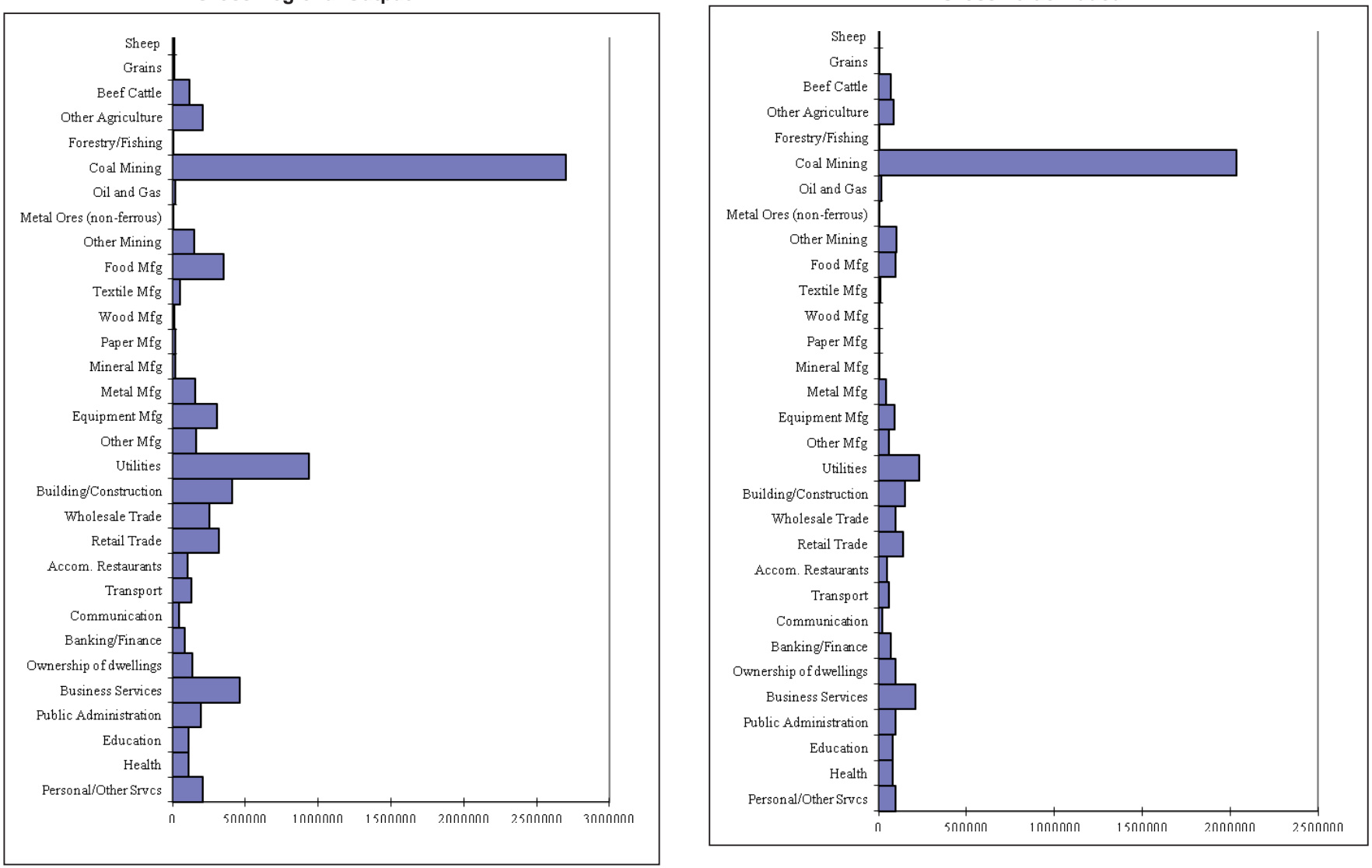


Figure 3.3 Sectoral Distribution of Regional Income ($'000) and Employment (No.)

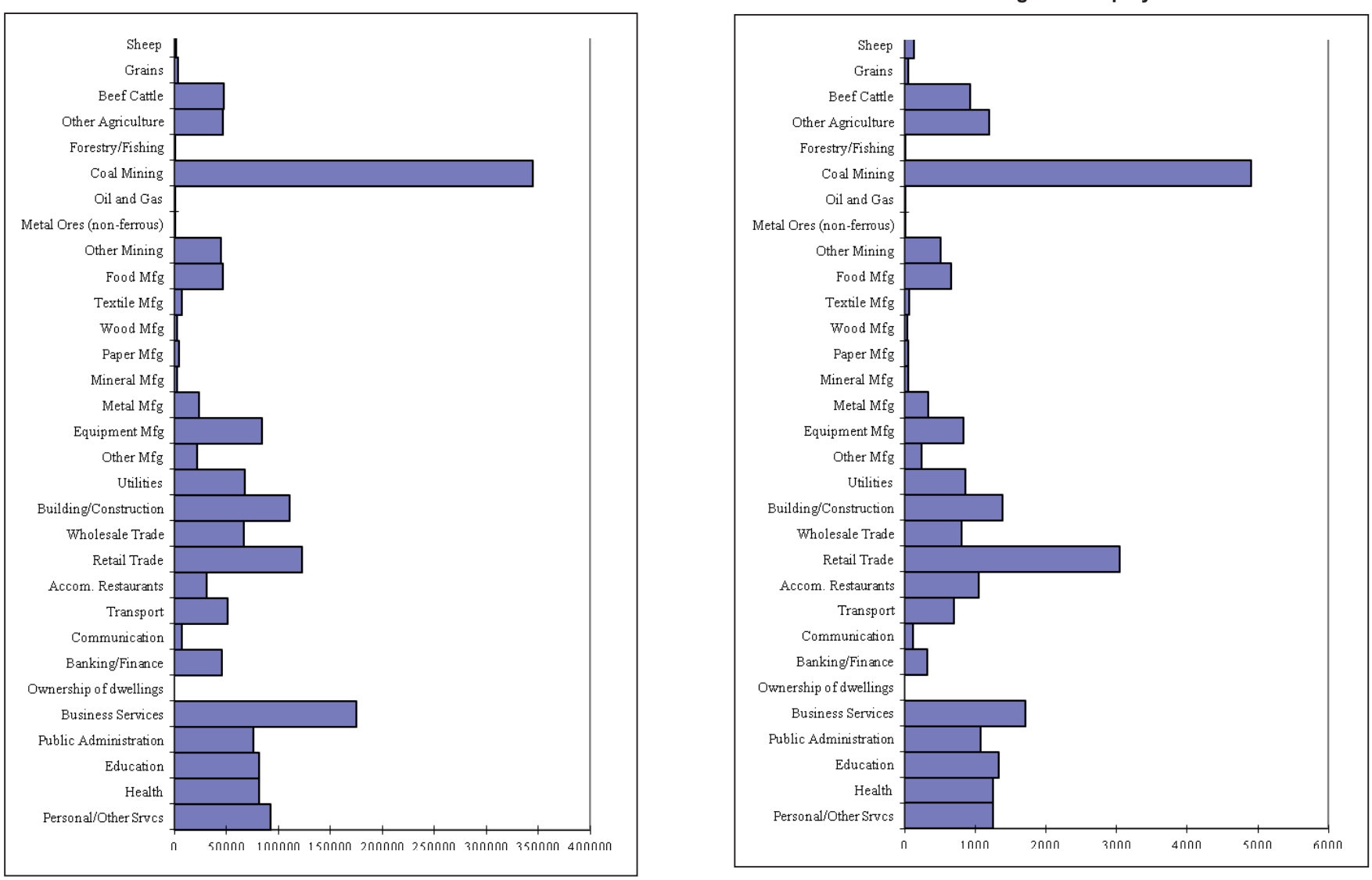
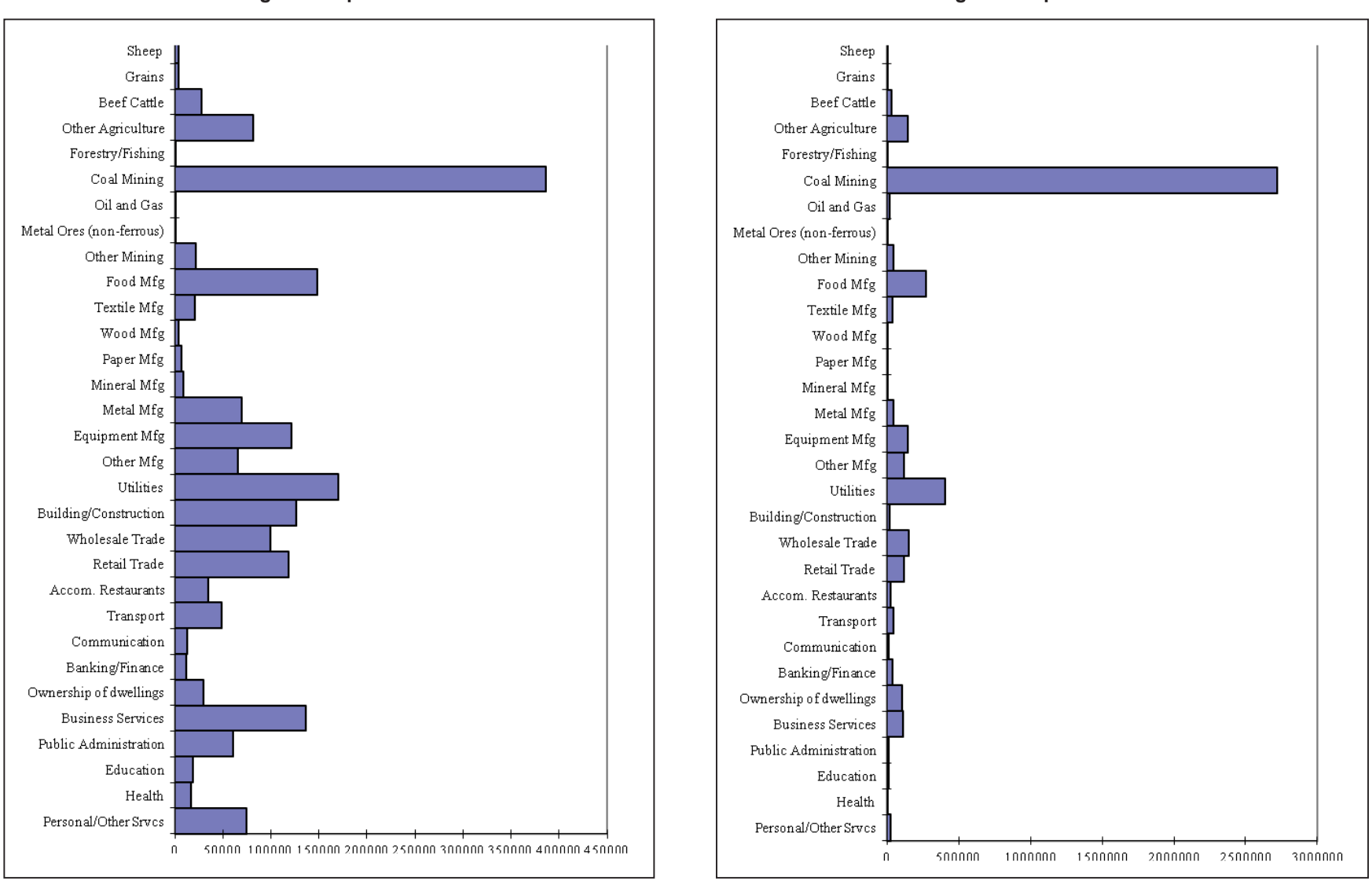


Figure 3.4 Sectoral Distribution of Imports and Exports ($'000)



4 ECONOMIC FRAMEWORKS FOR THE ASSESSMENT OF PROPOSALS THAT IMPACT AGRICULTURAL LAND AND WATER

4.1 Economic Efficiency

From an economic perspective, it is desirable to use scarce resources, such as capital, labour, land and water, to maximise economic welfare or community fulfilment. This is referred to as economic efficiency and refers to a situation where production costs are as low as possible (technical or productive efficiency), and consumers want the combination of goods and services that is being produced (allocative efficiency).

Economic efficiency can be achieved for market goods, where there are no externalities, through competitive markets. In this situation, the price mechanism (interaction of supply and demand) functions to allocate resources in a manner that maximises the net benefits to society as a whole.

Agricultural land and water (where property rights have been established) are market goods. The market will allocate these resources to their most productive use for society. The exception is where a change in land use or water use may result in market failure through the occurence of externalities. In these circumstances, markets will not allocate resources to maximise economic welfare. Government intervention may therefore be required to determine how resources should be allocated.

In these situations, any Government intervention should be guided by a consideration of the costs and benefits of the intervention. The method that economists use to do this is benefit cost analysis (BCA). The essence of BCA is:

- the estimation of the extent to which a community is made better off by a resource reallocation;
- the estimation of the extent to which the community is made worse off by a resource reallocation; and
- a comparison of these two figures.

If the benefits of the intervention are greater than the costs of the intervention then it provides net benefits to the community and results in an improvement in economically efficiency.

In a simple BCA framework, the potential costs and benefits of a mining project that impacts agricultural land and water may be as follows:

Table 4.1 – Potential Costs and Benefits of a Mining Proposal that Impacts Agricultural Land

	COSTS	BENEFITS
Net Production Benefits	**Production**	
	Opportunity costs of land, water and capital equipment	Value of mineral resource
	Capital and operating costs (including impact mitigation and rehabilitation)	Residual value of land and capital
Net Externalities	**Externalities**	
	Residual environmental impacts after impact mitigitation	Non use employment benefits of mining *

*these benefits have been estimated using choice modelling in Gillespie Economics 2008, Gillespie Economics 2009a and Gillespie Economics 2009b.

Where the proposal uses agricultural land and water there is an opportunity cost to society of using these resources for mining instead of agriculture. The magnitude of this opportunity cost is reflected in the market value of land and water.

The market value of the land reflects, among other things, the discounted future net income that can be earned from the property and income reflects how much the community values the outputs from the land. Where agriculture production becomes increasingly scarce, this will be reflected in the value of

agricultural products and the value of agricultural land. However, the long term trend for agricultural commodity prices has been a decline in real value rather than an increase in value, reflecting that with growth in productivity, supply has strengthened more rapidly than demand (ABARES 2011). Between 1961 and 2008, world population grew by 117 per cent while food production grew by 179 per cent (ABARES 2011). While commodity price increases have risen over the last few years this is partly a response to government subsidies and mandates regarding the production of biofuels (ABARES 2011). In the future, growth in global food consumption is expected to slow. Strong productivity growth and the utilisation of hitherto unused cropping should ensure the continuing adequacy of food supplies (ABARES 2011). Consequently, substantial real increases in food prices are not anticipated.

Similiarly, the market value of agricultural water entitlements reflects, among other things, its value as an input to production (i.e. its marginal value product). Where water becomes increasingly scarce or the value of output that is produced from water becomes increasingly valuable, the value of water as an input to production increases.

The utlimate outcome of any BCA of a project is an empirical issue. But estimating the value of the opportunity cost of agricultural land and water is an integral component of the analysis.

4.2 Regional Economic Impact Assessment

Regional economic impact assessment (using input-output analysis) may provide additional information as an adjunct to economic efficiency analysis. Input-output analysis can be used to estimate the change in economic activity in a region from land and water resources being used for mining instead of agriculture. These changes in economic activity are defined in terms of a number of specific indicators of economic activity, such as:

- Gross regional output – the gross value of business turnover;
- Value-added – the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output;
- Household income – the wages paid to employees including imputed wages for self employed and business owners; and
- Employment – the number of people employed (including full-time and part-time).

It is important not to confuse the results of regional economic impact assessment, which focuses on indicators of economic activity in a specific region, with the results of BCA which is concerned with the net benefits to Australia from a project.

5 PROJECT IMPACTS ON AGRICULTURAL RESOURCES

5.1 Opportunity Cost of Agriculture and Water Resources

5.1.1 Land Resources

The Drayton South Project will impact agricultural land resources through the mine disturbance footprint at Drayton South and the provision of ecological offsets in the region.

Drayton South

Scott Barnett & Associates Pty Ltd (2012) identify the following domains and agricultural production from Drayton South.

Table 5.1 - Current Enterprises per Agricultural Domain within Drayton South

Agricultural Domain	Carrying Capacity (DSE/ha)*	Area (ha)	Description of Agricultural Enterprise	Stocking Rate (ha/Breeding Cow)
A	8	376	Cattle breeding enterprise producing vealers for domestic trade	2.0
B	6	749	Cattle breeding enterprise producing vealers for domestic trade	2.7
C	4	2,780	Cattle breeding enterprise producing inland store weaners	3.7
D	2	692	Cattle breeding enterprise producing inland store weaners	7.4

Source: Scott Barnett & Associates Pty Ltd (2012)

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

Based on the current land use the gross value of production (beef cattle) from this land is estimated at $701,208 per annum ($10.0M present value at 7% discount rate) and the net value of agricultural production is $432,479 ($6.2M present value at 7% discount rate).

The Drayton South Project will impact agricultural land resources through the mine disturbance footprint and the provision of ecological offsets in the region. Areas outside the Drayton South disturbance boundary will continue to be sustainably farmed during the life of the Project as available

Any agricultural land that is situation within the Drayton South disturbance footprint will be removed from production indefinitely as this area will be rehabilitated to Narrabeen Footslope Slaty Box Woodland and Central Hunter Box-Ironbark Woodland communities and reserved inperpetuity as an onsite offset for the Project.

Scott Barnett & Associates Pty Ltd (2012) estimates that the following areas of the identified agricultural domains at Drayton South will be affected:

- Domain A 21ha;
- Domain B 286 ha;
- Domain C 1261 ha; and
- Domain D 360 ha.

Table 5.2 shows the total value of agricultural production impacted by the Project disturbance footprint.

Table 5.2 - Quantum and Value of Agricultural Production Affected within Drayton South

Enterprise	Drayton South
Irrigation water used (ML/yr)	1
Wool sold (kg)	-
Wethers sold	-
Beef cattle sold per annum	432
Gross value of production per annum	$ 257,110
Net value of production per annum	$ 170,625

Source: Scott Barnett & Associates Pty Ltd (2012)

Conservatively assuming that agricultural production from the entire disturbance footprint ceases at the commencement of the Project (i.e. 2012) for perpetuity the present value of the gross value of production foregone is $3.7M (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $2.4M (using a 7% discount rate).

Offsite Offset Area

Scott Barnet & Associates Pty Ltd (2012) identify the following agricultural activities from the offsite offset property

Table 5.3 - Current Enterprises per Agricultural Domain within the Offsite Offset Property

Domain	Carrying capacity (DSE/ha)*	Area (ha)	Description of Agricultural Enterprise	Stocking Rate (ha/Wether)	Stocking rate (ha/Breeding Cow)
X	3.5	1,646	Merino wethers (18 micron) and beef cattle breeding enterprise producing weaners	0.3	4.3
Y	6.5	333	Merino wethers (18 micron) and beef cattle breeding enterprise producing weaners	0.2	3.3
Z	0	100	Shelter country only	-	-

Source: Scott Barnett & Associates Pty Ltd (2012)

The gross value of agriculture from the offsite offset property is estimated at $500,828 and the net value is estimated at $223,484 (Table 5.4).

Table 5.4 - Value of Current Agricultural Production within the Offsite Offset Property

Enterprise	Number Animals Sold*	Wool Sold (including Crutchings) (kg)	Gross Value of Production	Net Value of Production
Wethers	940	43,766	$ 365,400	$ 164,700
Inland weaners	192	-	$ 135,428	$ 58,784
Total	**1,132**	**43,766**	**$ 500,828**	**$ 223,484**

Source: Scott Barnett & Associates Pty Ltd (2012)

** Includes culled breeding stock.*

Conservatively assuming that agricultural production from the offsite offset area ceases at the commencement of the Project (i.e. 2012) for perpetuity the present value of the gross value of production foregone is $7.2M (using a 7% discount rate) and the present value of the net value of agricultural production foregone is $3.2M (using a 7% discount rate).

Total Land Resources

In total, foregone net agricultural production from agricultural land resources required for the Project is estimated at $5.6M present value (using a 7% discount rate).

5.1.2 Water Resources

If the Project diverts water resources that could otherwise potentially be used for agricultural purposes there may also be an additional impact on agriculture.

However, consistent with the existing operations at Drayton Mine, the surface water model for the Project predicts that there is less than a 1% chance that offsite supplies would be required for the Project. Consequently, the Project will not require water from the Hunter Regulated River Water Source and as such will not impact on significant agricultural resource or divert water from irrigated agriculture, including the thoroughbred breeding industry, to mining. As the Project is not envisaged to participate in the open water market it will not influence the market value of water traded within the regulated system.

5.2 Regional Impacts

The regional impacts of the level of annual agricultural production forgone as a result of the Project (Section 5.1) were estimated from the sectors in the Upper Hunter regional input-output table (Gillespie Economics, 2012) within which production is located i.e. beef cattle farming is in the *beef sector*, farming of merino whethers is in the *sheep sector.* Table 5.5 summarises and the estimated direct and indirect regional impacts of the agricultural land resources (mine disturbance area and offsite offsets) required for the Project.

Table 5.5 - Regional Economic Impacts of Agricultural Land Resources Required for the Project

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	758	149	137	286	1,044
Type 11A Ratio	*1.00*	*0.20*	*0.18*	*0.38*	*1.38*
VALUE ADDED ($'000)	414	62	64	125	540
Type 11A Ratio	*1.00*	*0.15*	*0.15*	*0.30*	*1.30*
INCOME ($'000)	238	45	53	98	336
Type 11A Ratio	*1.00*	*0.19*	*0.22*	*0.41*	*1.41*
EMPL. (No.)	6.8	0.6	0.8	1.4	8.3
Type 11A Ratio	*1.00*	*0.09*	*0.12*	*0.21*	*1.21*

Table 5.6 compares the annual regional production and economic impacts associated with the Project with the level of annual agricultural production that would be forgone as a result of the Project (Section 5.1).

Table 5.6 - Annual Regional Production/Economic Impacts of the Foregone Agriculture and the Project

	Agriculture Land	Project
Area (ha)	4,007[1]	1,928[2]
Production Type	Beef and sheep	Coal
Production (t) or Bales (b)	See Table 5.2 and 5.3	7 Mtpa ROM Coal
Direct Output Value	$0.8M	$451M
Direct Income	$0.2M	$47M
Direct Employment	7	326
Direct and Indirect Output Value	$1.0M	$592M
Direct and Indirect Income	$0.3M	$90M
Direct and Indirect Employment	8	819

[1] This is the area of agricultural land (mine disturbance area and offsite offsets) that would be impacted in perpetuity by the Project.

[2] Mine disturbance area.

The Project is estimated to provide considerable activity to the Upper Hunter regional economy that is far in excess of the regional economic impacts associated with the level of annual agricultural production that would be forgone as a result of the Project (Table 5.6).

The direct annual output of the Project (at 7 Mtpa of ROM coal production) is estimated at $451M. This is greater than the annual value of agriculture production in the Upper Hunter region in 2006 (i.e. $143M) (Table 3.1). The annual agricultural production from the land and water resources that would potentially be impacted by the Project is $0.8M (Table 5.6).

The direct and indirect regional employment provided by the Project would be approximately 819 compared to approximately eight agricultural-related jobs that would be forgone as a result of the Project impacts on agricultural land and use of Project water (Table 5.6).

This stimulus provided by the Project would continue for approximately 27 years.

5.3 Economic Efficiency of Reallocation of Agricultural Resources to the Project

The BCA included estimation of the present value of production costs and benefits of the Project over a 27 year period. The present value of net production benefits of the Project to Australia are estimated at $490M (Table 5.7) (Gillespie Economics, 2012)[3]. In contrast, the present value of future use of agricultural lands that would be utilised by the Project is estimated at $5.6M and the present value of future use of the water resources that would be potentially diverted from agricultural uses by the Project is estimated at $0.0M (Table 5.7).

Table 5.7 - Net Production Benefits of Agricultural Resources Compared to the Project

	Water Resource	Land Resources (Beef and Sheep)	Project
Net Production Benefits[1]	$0.0M	$5.6M	$490M

Source: Gillespie Economics (2012).

[1] Discounting is at 7%.

Based on the comparative values provided in Table 5.7, excluding consideration of externalities of the Project and of agricultural production, the Project is considered to be significantly more efficient than continued agricultural production.

There are a number of potential negative and positive externalities associated with the Project (and with agricultural production). Including all externalities (including the opportunity cost of agricultural production) the Project is estimated to have net benefits to Australia of between $443M and $742M (Gillespie Economics, 2012) and therefore the Project is considered more efficient than the agricultural production that would be displaced.

[3] This includes an allowance for the opportunity costs of the agricultural land and water resources.

6 CONCLUSION

In the Upper Hunter region:

- The regional output value of existing coal production is considerably greater than agricultural production.
- The annual output value of the Project would be greater than the output value of agriculture production in the Upper Hunter region in 2006.
- Direct employment provided by the Project would be significantly higher than that provided by continued agricultural use of the land/water resources required for the Project.
- The net production benefits of the Project would be significantly higher than the continued agricultural production and use of water in the Project area.
- Incorporating the value of environmental, cultural and social impacts, the Project is estimated to have net benefits to Australia of between $443M and $742M.

The Project is considered on this basis to be more economically efficient than the agricultural production that would be displaced.

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