Tarrawonga Coal Project

Environmental Assessment

APPENDIX I

AGRICULTURAL RESOURCES AND PRODUCTIVITY ASSESSMENT

Resource Strategies

Tarrawonga Coal Pty Ltd

TARRAWONGA COAL PROJECT

AGRICULTURAL RESOURCES AND PRODUCTIVITY ASSESSMENT

PREPARED BY
RESOURCE STRATEGIES PTY LTD

OCTOBER 2011

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Document No. 00414552.doc

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Attachment B	Agricultural Resource Assessment: "Tarrawonga Coal Project", Boggabri, NSW (McKenzie Soil Management, 2011)

1 INTRODUCTION

The Tarrawonga Coal Mine is an open cut mining operation located approximately 15 kilometres (km) north-east of Boggabri and 42 km north-northwest of Gunnedah in New South Wales (NSW) (Figure 1). Tarrawonga Coal Pty Ltd (TCPL) is the owner and operator of the Tarrawonga Coal Mine, which is a joint venture between Whitehaven Coal Mining Pty Ltd (Whitehaven) (70% interest) and Boggabri Coal Pty Ltd (a wholly owned subsidiary of Idemitsu Australia Resources Pty Ltd) (30% interest).

The Tarrawonga Coal Mine commenced operations in 2006 and currently produces up to 2 million tonnes per annum (Mtpa) run-of-mine (ROM) coal. The existing Tarrawonga Coal Mine has been approved to extract approximately 16.4 million tonnes (Mt) of coal at a maximum rate of 2 Mtpa. ROM coal is crushed and screened on-site and transported by road to Whitehaven's Coal Handling and Preparation Plant (CHPP), which is located approximately 35 km to the south near Gunnedah (Figure 1).

The Tarrawonga Coal Project (the Project) would involve the continuation and extension of open cut mining operations at the Tarrawonga Coal Mine and would facilitate a ROM coal production rate of up to 3 Mtpa. The proposed life of the Project is 17 years, commencing 1 January 2013.

The approximate extent of the existing and approved surface development (including open cut, mine waste rock emplacement, soil stockpiles and infrastructure areas) at the Tarrawonga Coal Mine is shown on Figure 2.

A detailed description of the Project is provided in Section 2 in the Main Report of the Environmental Assessment (EA).

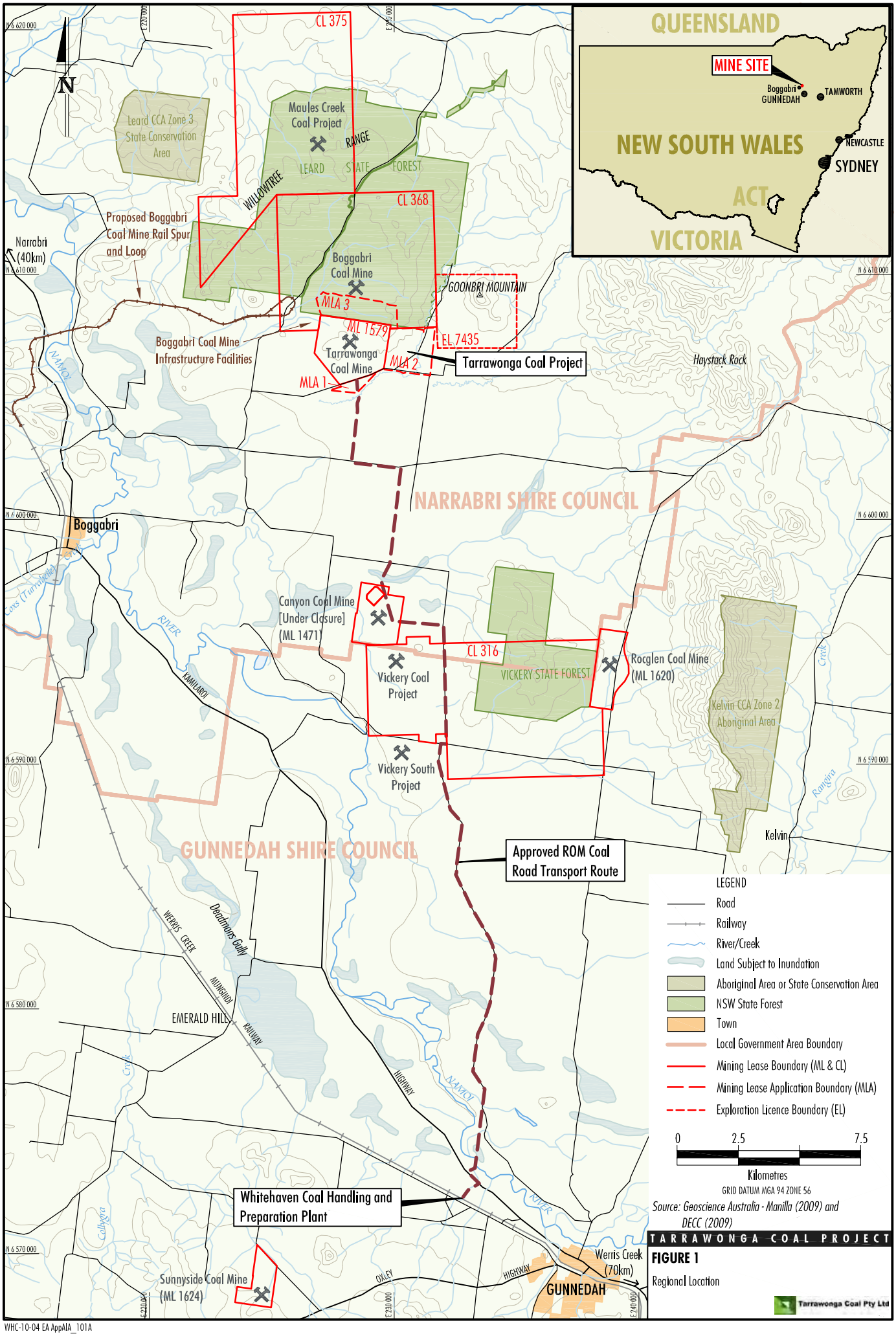
1.1 BACKGROUND AND SCOPE

This Agricultural Resources and Productivity Assessment has been prepared to address the following components of the Director General's Environmental Assessment Requirements for the Project:

> ***Agricultural Productivity*** *– including:*
>
> - *a description of the agricultural resources (especially soils and water resources used or capable of being used for agriculture) and agricultural enterprises of the locality;*
> - *a detailed assessment of the potential impacts of the project on agricultural resources and/or enterprises of the locality;*
> - *a detailed description of the measures that would be implemented to avoid and/or minimise the potential impacts of the project on agricultural resources and/or enterprises of the locality; and*
> - *justification for any significant long term changes to agricultural resources, particularly if highly productive agricultural resources (eg alluvial lands) are proposed to be affected by the project;*
>
> *…*

A Groundwater Assessment (Heritage Computing, 2011) (Appendix A of the EA) and a Surface Water Assessment (Gilbert & Associates, 2011) (Appendix B of the EA) have been prepared for the Project. These assessments have been referred to in this study where relevant.

Potential noise, blasting, air quality and road transport impacts associated with the Project are assessed separately in the Noise and Blasting Assessment (Wilkinson Murray, 2011) (Appendix C of the EA), the Air Quality Assessment (PAE Holmes, 2011) (Appendix D of the EA) and the Road Transport Assessment (Halcrow, 2011) (Appendix H of the EA).



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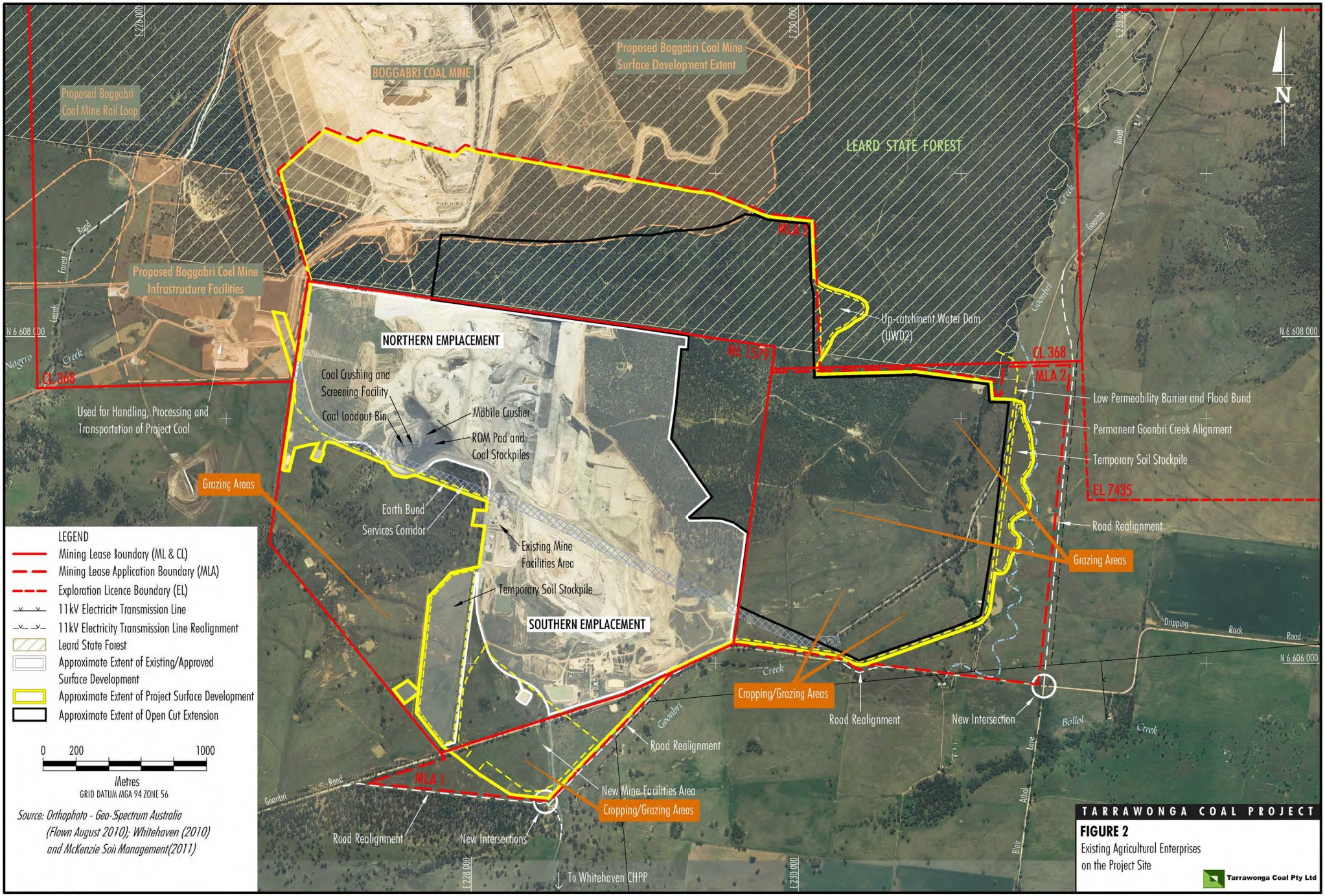

TARRAWONGA COAL PROJECT

FIGURE 2

Existing Agricultural Enterprises on the Project Site

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1.2 CONSULTATION

TCPL has undertaken consultation regarding the Project with federal and state government agencies, local governments, infrastructure owners/service providers and the local community prior to and during the preparation of the EA. Details of the consultation undertaken for the Project are provided in Section 3 of the Main Text of the EA.

1.3 STRUCTURE OF DOCUMENT

The remainder of this report is structured as follows:

Section 2: Provides an overview of the Project.

Section 3: Characterises the regional agricultural industry.

Section 4: Describes the existing agricultural resources at the Project site, buffer area and Project biodiversity offset area.

Section 5: Assesses the potential impacts of the Project on agricultural resources.

Section 6: Provides a detailed description of the proposed management measures.

Section 7: Provides a justification for proposed changes to agricultural resources.

Section 8: Lists the references cited in this report.

Attachments A and B contain supporting documentation relevant to this report:

Attachment A Economic Review of Potential Agricultural Impacts (Gillespie Economics, 2011a)

Attachment B Agricultural Resource Assessment: "Tarrawonga Coal Project", Boggabri, NSW (McKenzie Soil Management, 2011)

2 PROJECT OVERVIEW

2.1 PROJECT DESCRIPTION

The main activities associated with the development of the Project would include (Figure 2):

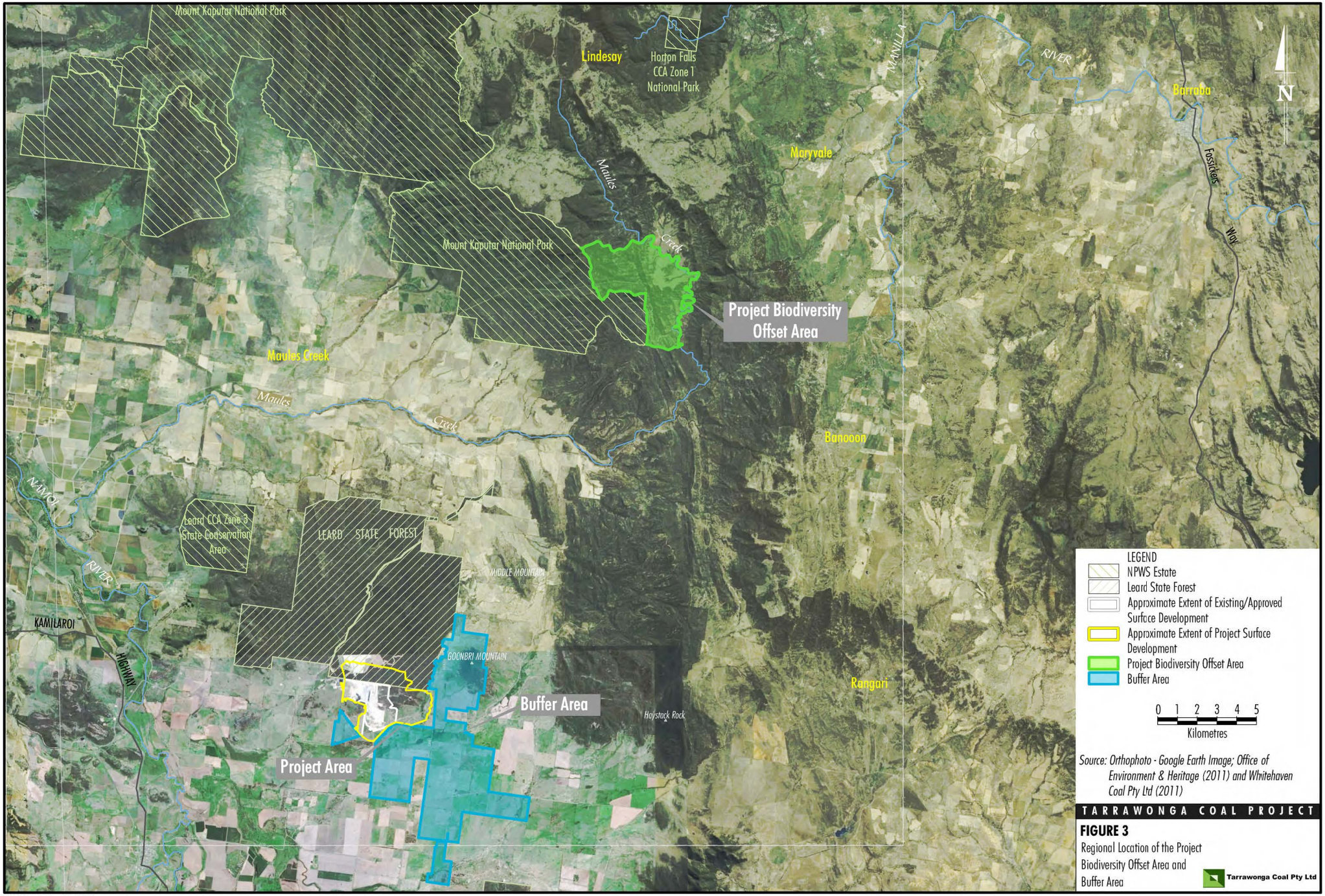
- continued development of mining operations in the Maules Creek Formation to facilitate a Project ROM coal production rate of up to 3 Mtpa, including open cut extensions:
  - to the east within Mining Lease (ML) 1579 and Mining Lease Application (MLA) 2; and
  - to the north within Coal Lease (CL) 368 (MLA 3) which adjoins ML 1579;
- ongoing exploration activities;
- construction and use of a services corridor (including haul road link) directly from the Project open cut mining operation to the upgraded Boggabri Coal Mine Infrastructure Facilities[1];
- use of upgraded Boggabri Coal Mine Infrastructure Facilities for the handling and processing of Project coal and the loading of Project product coal to trains for transport on the Boggabri Coal Mine private rail spur to the Werris Creek Mungindi Railway[1];
- construction and use of a new mine facilities area including relocation of existing mine facilities infrastructure and service facilities;
- use of an existing on-site mobile crusher for coal crushing and screening of up to 150,000 tonnes of domestic specification coal per annum for direct collection by customers at the mine site;
- use an existing on-site mobile crusher to produce up to approximately 90,000 cubic metres of gravel materials per annum for direct collection by customers at the mine site;
- progressive backfilling of the mine void behind the advancing open cut mining operation with waste rock and minor quantities of coarse reject material;
- continued and expanded placement of waste rock in the Northern Emplacement (including integration with the Boggabri Coal Mine emplacement) and Southern Emplacement, as mining develops;
- progressive development of new haul roads and internal roads, as mining develops;
- realignment of sections of Goonbri Road and construction of new intersections;
- construction of an engineered low permeability barrier to the east and south-east of the open cut to reduce the potential for local drainage of alluvial groundwater into the open cut;
- removal of a section of Goonbri Creek within the Project open cut and the establishment of a permanent Goonbri Creek alignment and associated flood bund to the east and south-east of the open cut;
- progressive development of sediment basins and storage dams, pumps, pipelines and other water management equipment and structures;
- continued development of soil stockpiles, laydown areas and gravel/borrow areas;
- ongoing monitoring and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

[1] Subject to approvals and upgrades being in place for the transfer of Project ROM coal to the Boggabri Coal Mine Infrastructure Facilities.

The Whitehaven-owned land in the vicinity of the Project, but outside of ML 1579, MLA 1 and MLA 2 (Figures 3 and 4) is referred to as the buffer area. The buffer area consists of approximately 4,000 hectares (ha) of land that is typically used for agriculture. The buffer area is shown on Figures 3 and 4.

The offset proposal for the Project involves conserving an area of land with existing fauna and flora conservation values and providing active management to maintain and enhance the values. The biodiversity offset area is approximately 1,660 ha in size and is located approximately 20 km north-east of the Project area on the Willeroi property (Figures 3 and 4).

Details of the existing and proposed agricultural activities on the buffer area and the biodiversity offset area are provided in Sections 4.1 and 5.1.



TARRAWONGA COAL PROJECT

FIGURE 3

Regional Location of the Project Biodiversity Offset Area and Buffer Area

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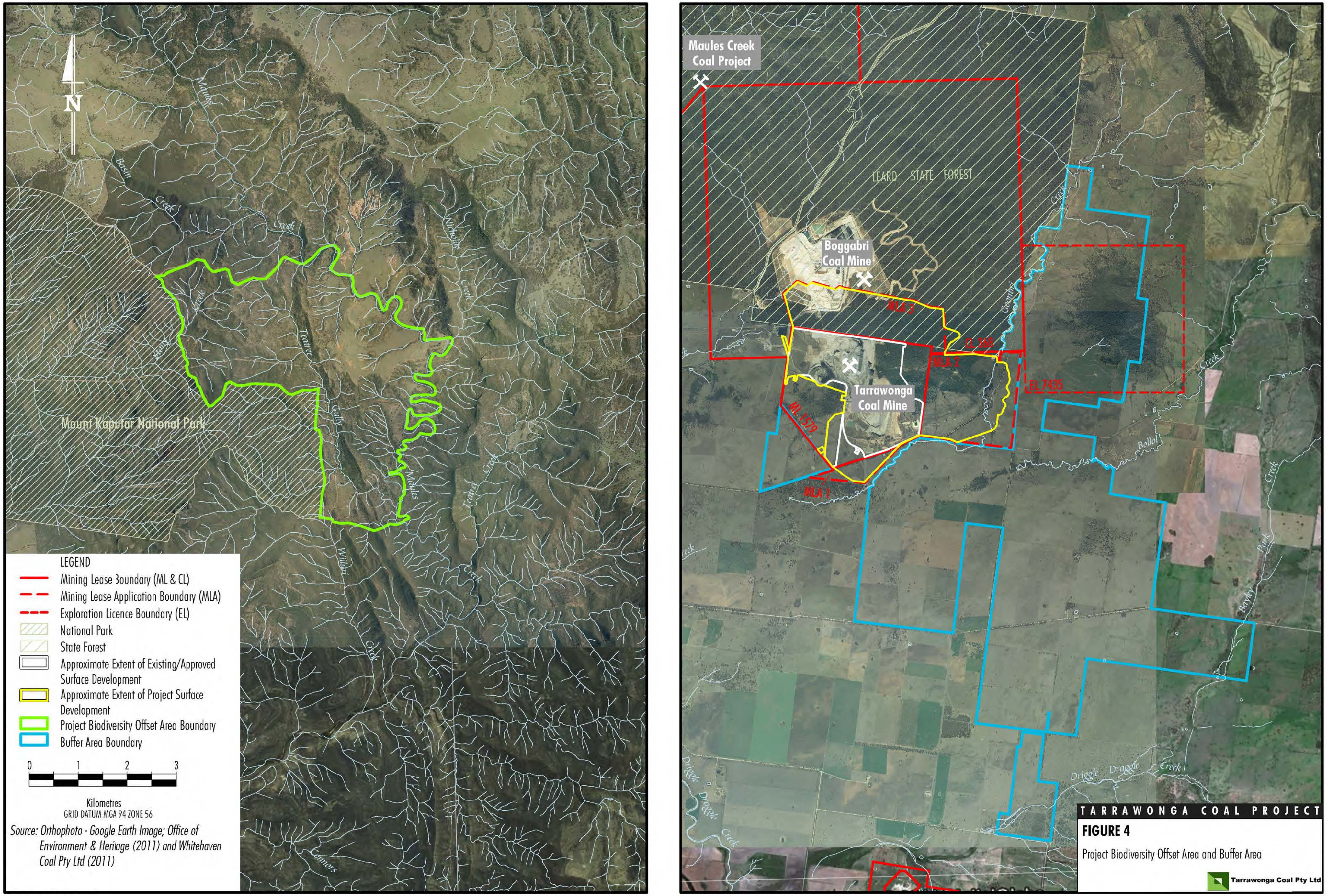


FIGURE 4

Project Biodiversity Offset Area and Buffer Area

3 REGIONAL AGRICULTURAL INDUSTRY OVERVIEW

This section provides an overview of the agricultural industry in the Narrabri and Gunnedah Local Government Areas (LGAs).

3.1 BACKGROUND

The Narrabri and Gunnedah LGAs are located in the Namoi Valley and host a diverse range of agricultural activities. The Narrabri and Gunnedah LGAs have a combined land area of approximately 1,200,000 ha of which approximately 68% is agricultural land (Attachment A). Agricultural land under irrigation makes up approximately 5.6% of the total agricultural land (Attachment A).

Agricultural activities in the Narrabri and Gunnedah LGAs are dominated by livestock and crop (summer and winter crops) production including (Australian Bureau of Agricultural and Resource Economics and Sciences [ABARE], 2006 and Gunnedah Shire Council, 2011):

- Beef.
- Lamb/Mutton.
- Poultry.
- Pork.
- Wool.
- Cotton.
- Wheat.
- Sorghum.
- Barley.
- Oats.
- Soybeans.
- Chickpeas.
- Mung Beans.
- Canola.
- Maize.
- Sunflowers.

Agricultural activities undertaken in the Narrabri and Gunnedah LGAs vary depending on location and seasonal conditions. Farms located on the floodplains tend to conduct cropping activities and farms located on the slopes tend to focus on livestock production (ABARE, 2006). Cotton production is concentrated in irrigable areas of the plains and other grains (e.g. wheat) are typically concentrated in the dryland farming areas of the plains.

3.2 KEY SUPPORT INFRASTRUCTURE, SUPPLIERS AND SERVICES

A broad range of support infrastructure, suppliers and services for the agricultural industry are located in the Narrabri and Gunnedah LGAs.

A variety of specialist agricultural suppliers and services (e.g. agricultural supplies, irrigation suppliers, harvest contractors and machinery service centres) are located in Gunnedah, Narrabri, Boggabri and other towns in the Narrabri and Gunnedah LGAs.

Infrastructure to allow for the transport, temporary storage and dispatch of crops (e.g. cotton and wheat) is located throughout the Narrabri and Gunnedah LGAs. This infrastructure includes silos, storage warehouses and rail and truck loading facilities. Cotton gins are operated in Boggabri and Narrabri. In addition, livestock sales yards are located in Narrabri and Gunnedah.

The Narrabri and Gunnedah LGAs are well located to utlise existing road and rail transport networks to access domestic and export markets. The key road transport routes servicing the area are the Kamilaroi and Newell Highways. The Newell Highway provides access to markets/ports in Brisbane and Melbourne and the Kamilaroi Highway provides access to markets/ports in Sydney. The Werris Creek Mungindi Railway provides access to markets/ports in Sydney and Brisbane.

The Australian Cotton Research Institute Facility (operated by the Commonwealth Scientific and Industrial Research Organisation) and the Wheat Research and Plant Breeding Centre (operated by the University of Sydney) are located in the Narrabri Shire.

3.3 CONTRIBUTION TO REGIONAL AND NSW ECONOMY

The total value of agricultural production in the Gunnedah and Narrabri LGAs in 2006 was estimated at $386 million (M) (Attachment A). The agriculture/forestry/fishing industry represents approximately 22% of the gross regional product in the Australian Bureau of Statistics Narrabri and Gunnedah Statistical Local Areas (SLAs) in 2004/2005 (Gillespie Economics, 2011b) (Appendix M of the EA). Grains, beef cattle and other agriculture were the dominant sectors within the agriculture/forestry/ fishing industry in terms of gross regional product (Attachment A).

3.4 EMPLOYMENT

The agricultural industry in the Gunnedah and Narrabri LGAs employs approximately 2,250 people (Attachment A). The agriculture/forestry/fishing industry in the Narrabri and Gunnedah SLA employed approximately 24% of the working population in 2004/2005 (Appendix M of the EA).

A more detailed employment by industry breakdown indicates that the main agricultural employment is in beef farming (specialised), grain-sheep or grain-beef cattle farming, other grain growing and cotton growing (Attachment A).

4 EXISTING AGRICULTURAL RESOURCES

This section provides a description of the existing agricultural resources at the Project site, buffer area and biodiversity offset area.

4.1 LAND RESOURCES

Project Site

The existing/approved Tarrawonga Coal Mine is located wholly within ML 1579 (Figure 2). The Project would be located within ML 1579 and would extend into new MLA areas (MLA 1, MLA 2 and MLA 3) (Figure 2). MLA 3 would be located within the existing CL 368.

The topography of the Project site comprises a series of rolling hills which vary in elevation from about 300 to 380 metres (m) Australian Height Datum (AHD). The floodplains of Bollol Creek to the south of the Project vary from approximately 260 to 280 m AHD.

McKenzie Soil Management (2011) (Attachment B) conducted a soil survey of the Project additional disturbance areas. The main soil types observed during the soil survey were (Attachment B):

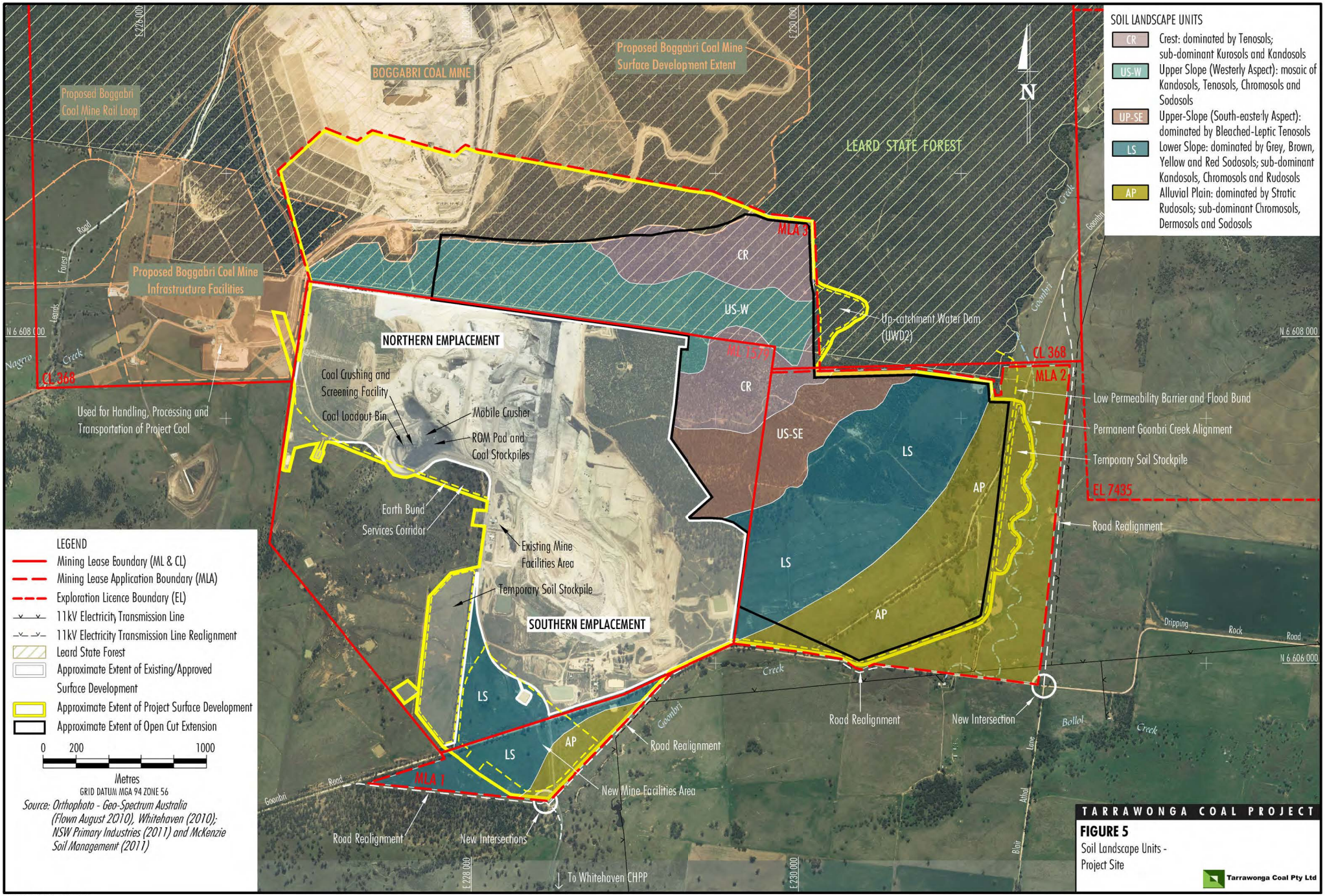
- Stratic Rudosols – characterised by a number of alluvial depositional layers that have been little altered by pedogenic processes except at or near the surface.
- Chromosols – characterised by a strong contrast in texture between topsoil and subsoil.
- Tenosols – shallow stony soils with only weak pedological development.
- Sodosols – strong texture contrast between topsoil and sodic subsoil, which is not strongly acidic.
- Kandosols – lack strong texture contrast and have poorly structured massive subsoils.
- Kurosols – duplex soils with strongly acidic subsoil.
- Dermosols – lack strong texture contrast, but had structured B horizons.

The soil landscapes associated with these soil types identified during the survey are shown on Figure 5 and include (Attachment B):

- Crest – dominated by Tenosols, sub-dominant Kurosols and Kandosols.
- Upper Slope (westerly aspect) – a mosaic of Kandosols, Tenosols, Chromosols and Sodosols.
- Upper Slope (south-easterly aspect) – dominated by Bleached-Leptic Tenosols.
- Lower Slope – dominated by Grey, Brown, Yellow and Red Sodosols, sub-dominant Kandosols, Chromosols, and Stratic Rudosols.
- Alluvial Plain – dominated by Stratic Rudosols, sub-dominant Chromosols, Dermosols and Sodosols.

Additional details of the soil survey are provided in Attachment B.

Agricultural areas are located in MLA 1 and the southern areas of ML 1579 and MLA 2 (Figure 2). No agricultural areas are currently located in MLA 3. Areas of the Project site that are not currently used for agriculture include the existing/approved Tarrawonga Coal Mine, the Boggabri Coal Mine, the Leard State Forest and remnant vegetated areas (Figure 2) (Attachment B).



TARRAWONGA COAL PROJECT

FIGURE 5

Soil Landscape Units - Project Site

Tarrawonga Coal Pty Ltd

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Agricultural enterprises known to have been conducted on the Project site include areas where a combination of pasture production for grazing and some rainfed crop production (Attachment B). Figure 2 shows the key areas of the Project site that are known to have been used for agricultural enterprises.

Crops (usually wheat) are rotated with lucerne-based pasture, all of which is non-irrigated. The main areas where rainfed crop production has occurred/could occur are located on the flatter areas of the Project site near Goonbri Creek (Figure 2). Remaining more elevated agricultural land has typically been used for grazing (Attachment B).

Approximately 335 ha of agricultural land is located in the Project disturbance area (Attachment B). This area consists of approximately 210 ha suitable for rainfed crop production in rotation with improved pasture and 125 ha only suitable for grazing on pasture dominated by native species (Attachment B).

Buffer Area

Whitehaven-owned lands to the south of the Project are located on alluvial flats associated with Goonbri Creek and Bollol Creek (Figure 4) and generally have an elevation of 260 to 280 m AHD. The topography of this component of the buffer area is generally flat with a gentle slope towards the south-west. The eastern component of the buffer area is also gently sloping to the south-west with the exception of Goonbri Mountain, which has an elevation of 540 m AHD (Figure 4).

Agricultural enterprises known to have been conducted in the buffer area include areas where a combination of pasture production for grazing and some rainfed crop production has occurred, and areas where pasture production for grazing only is undertaken.

Rainfed crop production in the buffer area is known to include lucerne, barley and wheat. The lucerne and barley are typically used as feed for cattle. Cattle and sheep grazing are conducted in the buffer area. A feedlot (200 head) was located in the buffer area, on the Templemore property.

Project Biodiversity Offset Area

The Project biodiversity offset area (Figures 3 and 4) includes approximately 305 ha of cleared agricultural land along with approximately 1,355 ha of existing forest/woodland (Resource Strategies and Cenwest Environmental Services, 2011) (Appendix E of the EA).

Agricultural activities historically conducted in the Project biodiversity offset area prior to Whitehaven purchasing it in 2010 included grazing livestock on native pastures.

4.2 WATER RESOURCES

4.2.1 Surface Water

Project Site

A Surface Water Assessment has been prepared for the Project (Appendix B of the EA) which provides a detailed description of surface water resources in the Project area.

The Project area and surrounds are drained by a series of ephemeral streams (principally the Nagero, Goonbri and Bollol Creeks) that descend onto the Namoi River floodplain and lagoons which fringe the Namoi River. These local streams are highly ephemeral, respond quickly to rainfall, flow for relatively short periods after rainfall events and exhibit little flow persistence (Appendix B of the EA).

The Tarrawonga and Jeralong properties are the closest privately-owned properties downstream of the Project. There are no records of water extraction or access licences having been issued on Nagero, Bollol or Goonbri Creeks. There are, however, extensive water access licences in force on the Namoi River under the *Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2003* (Appendix B of the EA).

Surface water resources used for agricultural purposes in the Project area to date have been taken through the landholders' harvestable rights (i.e. rainfall runoff collected in dams) and/or stock rights (i.e. stock watering from Goonbri Creek).

Buffer Area

Driggle Draggle Creek and its tributary Bayley Park Creek are located in the southern and eastern extents of the buffer area, respectively (Figure 4). Driggle Draggle Creek is an intermittent ill-defined watercourse which flows generally east-west to the Namoi River (Whitehaven, 2004). In addition, Nagero, Goonbri and Bollol Creeks (described above) are also present in the buffer area.

A review of existing surface water licences in the buffer area was conducted and there had been no records of water extraction or access licences having been issued on Driggle Draggle Creek or Bayley Park Creek. Surface water resources used for agricultural purposes in the buffer area would therefore be associated with the landholders' harvestable rights (i.e. rainfall runoff collected in dams) and/or stock rights (e.g. stock watering from Driggle Draggle Creek).

Project Biodiversity Offset Area

A number of ephemeral creek lines occur in the Project biodiversity offset area (Figure 4). The most prominent of these creek lines are Maules Creek and Teatree Gully (Appendix E of the EA). In the Project biodiversity offset area these ephemeral creek lines would not be suitable for surface water extraction as they would have limited flow duration as they are located at the head of the catchment.

Surface water previously used for agricultural purposes in the Project biodiversity offset area were limited to the landholders' harvestable rights (i.e. rainfall runoff collected in dams) and/or stock rights (i.e. stock watering from ephemeral creek lines).

4.2.2 Groundwater

Project Site

A Groundwater Assessment has been prepared for the Project (Appendix A of the EA) which provides a detailed description of groundwater resources in the Project area. Two groundwater systems identified in the relevant water sharing plans are (Appendix A of the EA):

- Porous rock groundwater system – including the coal measures of the Maules Creek Formation; and
- Alluvial groundwater system – associated with the low-lying flood plains of the Upper Namoi.

Based on the recorded electrical conductivity (EC) values, most groundwaters are at the limit of potable use, but are suitable for livestock, irrigation and other general uses (Appendix A of the EA).

A search of the NSW Office of Water (NOW) PINNEENA Groundwater Works Database, and a bore census conducted in consultation with local landholders in May 2011, was conducted to identify privately-owned bores/wells in the vicinity of the Project. This search identified that 121 bores are located within approximately 5 km of the Project, of which 11 are located on the Project site (Figure 6) (Appendix A of the EA). The closest bores to the Project site located on privately owned property are located on the Tarrawonga and Jeralong properties to the south and south-west of the Project, respectively (Figure 6).

Buffer Area

The buffer area includes alluvial groundwater systems associated with the Bollol Creek, Goonbri Creek, Nagero Creek and Driggle Draggle Creek surface drainages. The search of the NOW PINNEENA Groundwater Works Database and the bore census conducted in May 2011 (discussed above) identified 27 bores in the buffer area (Figure 6).

Project Biodiversity Offset Area

A search of the NOW Pinneena Groundwater Works Database was conducted for the Project biodiversity offset area in October 2011. The search identified no registered bores in the Project biodiversity offset area (Figure 6).

4.3 RURAL LAND CAPABILITY

4.3.1 Background

The Rural Land Capability classification system is used to delineate the various classes of rural land on the basis of the capability of the land to remain stable under particular uses (Attachment B). Land is allocated to one of the following eight classes:

Land Suitable for Regular Cultivation/Cropping

Class I: No special soil conservation works or practices necessary.

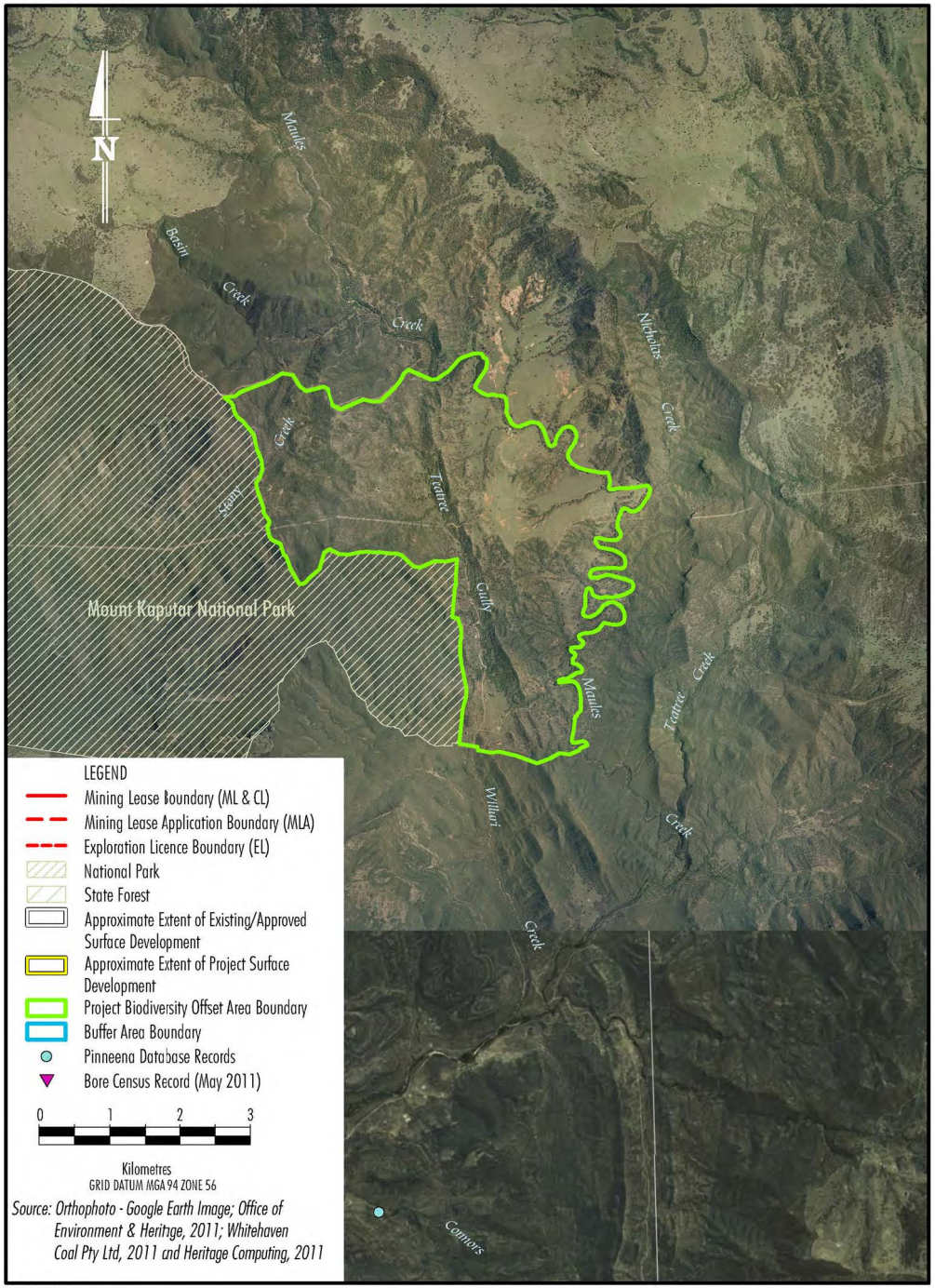
Class II: Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotations are necessary.

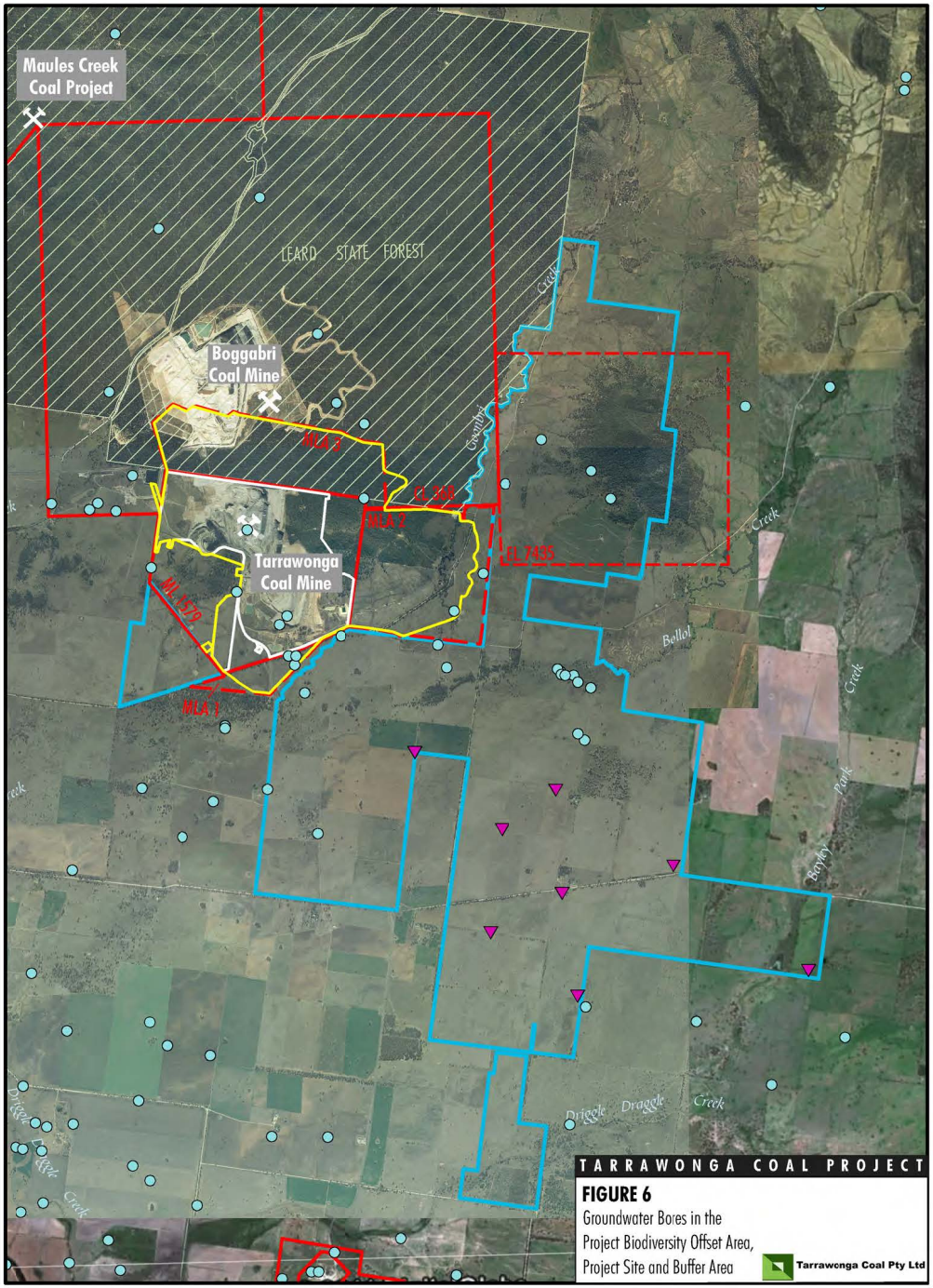
Class III: Soil conservation practices such as graded banks and waterways are necessary, together with all the soil conservation practices as in Class II.

Land Suitable Mainly for Grazing

Class IV: Soil conservation practices such as pasture improvement, stock control, application of fertiliser, and minimal cultivation for the establishment or re-establishment of permanent pasture, maintenance of good ground cover.

Class V: Soil conservation works such as diversion banks and contour ripping, in addition to the practices in Class IV.


N
Maules Creek
Basin Creek
Creek
Nicholas Creek
Stony Creek
Teatree Creek
Mount Kaputar National Park
Gully
Maules Creek
Teatree Creek
Willari Creek
Creek
Connors
LEGEND
Mining Lease Boundary (ML & CL)
Mining Lease Application Boundary (MLA)
Exploration Licence Boundary (EL)
National Park
State Forest
Approximate Extent of Existing/Approved Surface Development
Approximate Extent of Project Surface Development
Project Biodiversity Offset Area Boundary
Buffer Area Boundary
Pinneena Database Records
Bore Census Record (May 2011)
0 1 2 3
Kilometres
GRID DATUM MGA 94 ZONE 56
Source: Orthophoto - Google Earth Image; Office of Environment & Heritge, 2011; Whitehaven Coal Pty Ltd, 2011 and Heritage Computing, 2011


Maules Creek Coal Project
LEARD STATE FOREST
Boggabri Coal Mine
MLA 2
Greenbri Creek
CL 248
CL 7435
Tarrawonga Coal Mine
ML 678
MLA 1
Bellol Creek
Driggle Dragele Creek
TARRAWONGA COAL PROJECT
FIGURE 6
Groundwater Bores in the Project Biodiversity Offset Area, Project Site and Buffer Area
Tarrawonga Coal Pty Ltd

Land Suitable for Grazing

Class VI: Not capable of cultivation. Soil conservation practices include limitation of stock, broadcasting of seed and fertiliser, promotion of native pasture regeneration, prevention of fire, destruction of vermin, maintenance of good ground cover and possibly some structural works.

Land Suitable for Tree Cover

Class VII: Land best protected by trees.

Land Unsuitable for Agriculture

Class VIII: Cliffs, lakes or swamps where it is impractical to grow crops or graze pasture.

4.3.2 Rural Land Capability Mapping

Project Site

Rural Land Capability mapping for MLA 1, MLA 2, MLA 3 and the north-eastern section of ML 1579 has been completed by McKenzie Soil Management (2011) and is shown on Figure 7 and documented in Attachment B. Mapped Rural Land Capability ranged from Class II to Class VI (Figure 7). No Class V land was identified (Attachment B).

The major factor influencing the classification of the land was slope with the better classes (i.e. Classes II and III) located on the flatter areas and the poorer classes (i.e. Classes IV and VI) located on the steeper sections (Attachment B).

The presence of dispersive soil, acidic topsoil and major nutrient deficiencies prevented the allotment of higher Rural Land Capability classes (Attachment B).

More detail on the Rural Land Capability mapping is provided in Attachment B.

Buffer Area

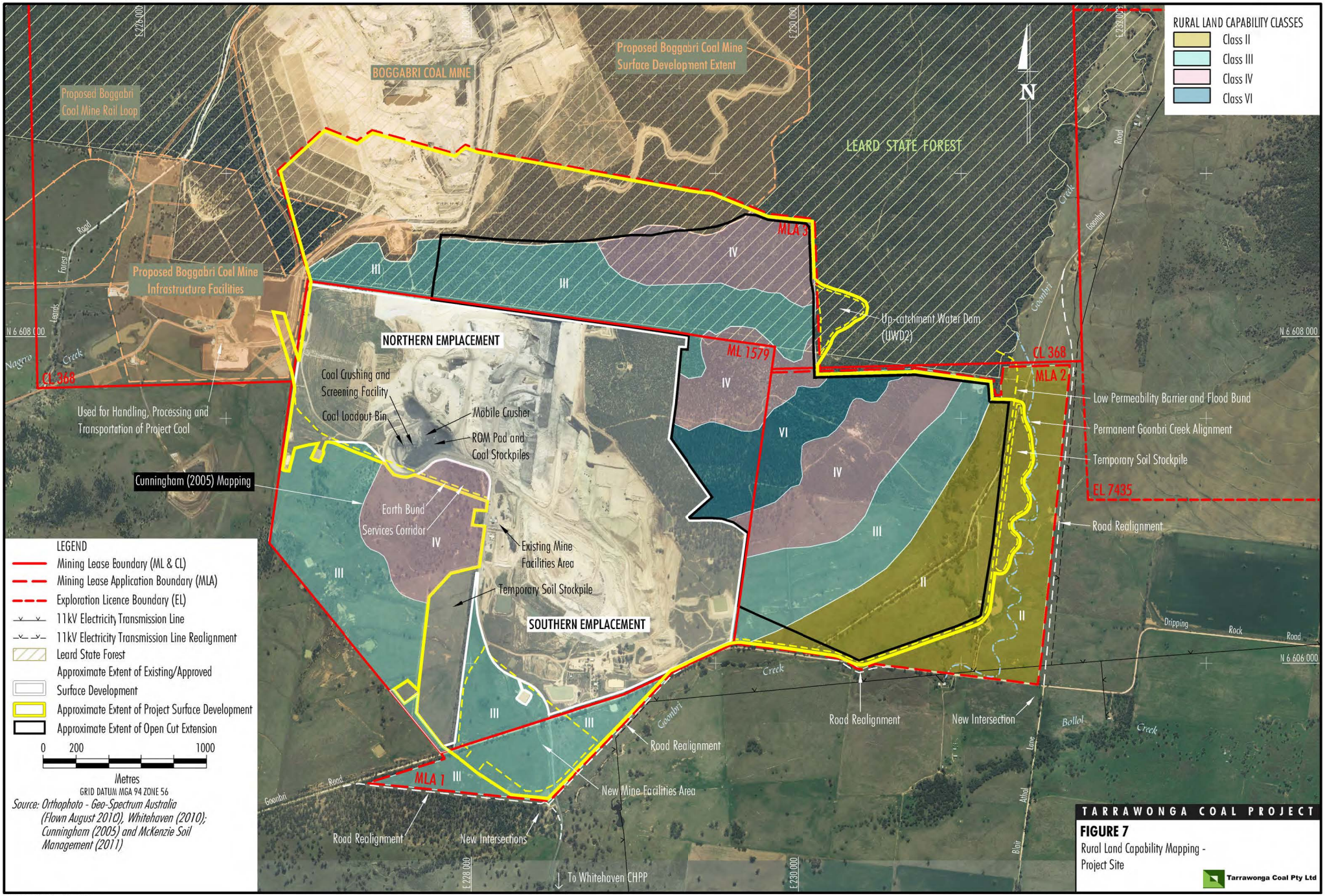
Rural Land Capability mapping prepared by the NSW Office of Environment and Heritage is available for the buffer area and is shown on Figure 8.

The buffer area includes Rural Land Capability Classes II, III, IV, VI and VII. The majority of the buffer area is Classes II and III with a small area of Class IV located in the north (Figure 8). Classes VI and VII are associated with the elevated areas of Goonbri Mountain.

Project Biodiversity Offset Area

Rural Land Capability mapping prepared by the NSW Office of Environment and Heritage is available for the Project biodiversity offset area and is shown on Figure 8.

The Project biodiversity offset area includes Rural Land Capability Classes IV, V, VI, VII and VIII. The Class IV area is associated with cleared agricultural areas in the central section of the Project biodiversity offset area (Figure 8). Class V areas are also associated with cleared agricultural areas located in the north-east and south. The majority of the Project biodiversity offset area consists of Classes VI, VII and VIII (Figure 8). Class VIII is not suitable for agriculture (Section 4.3.1).



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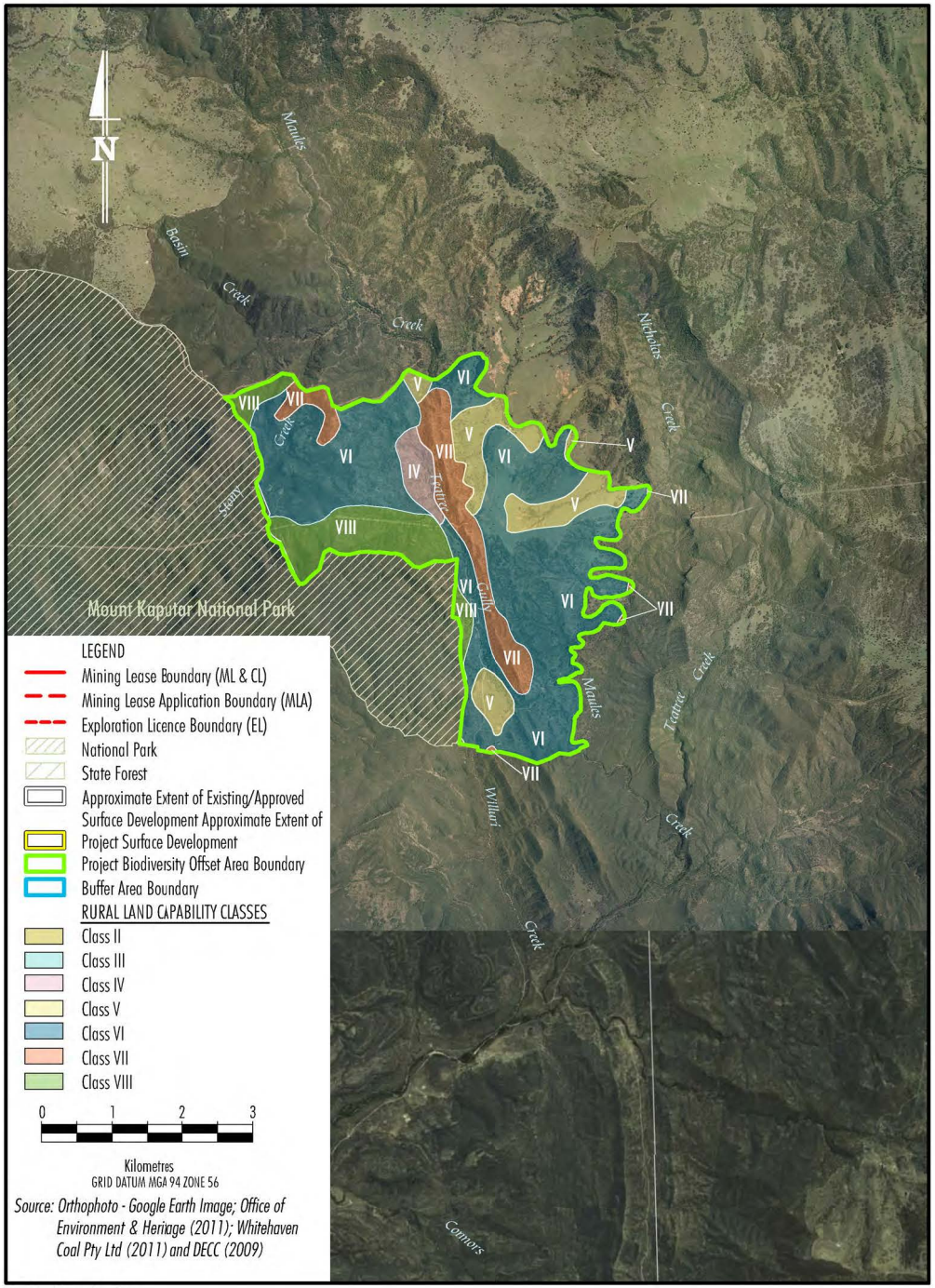
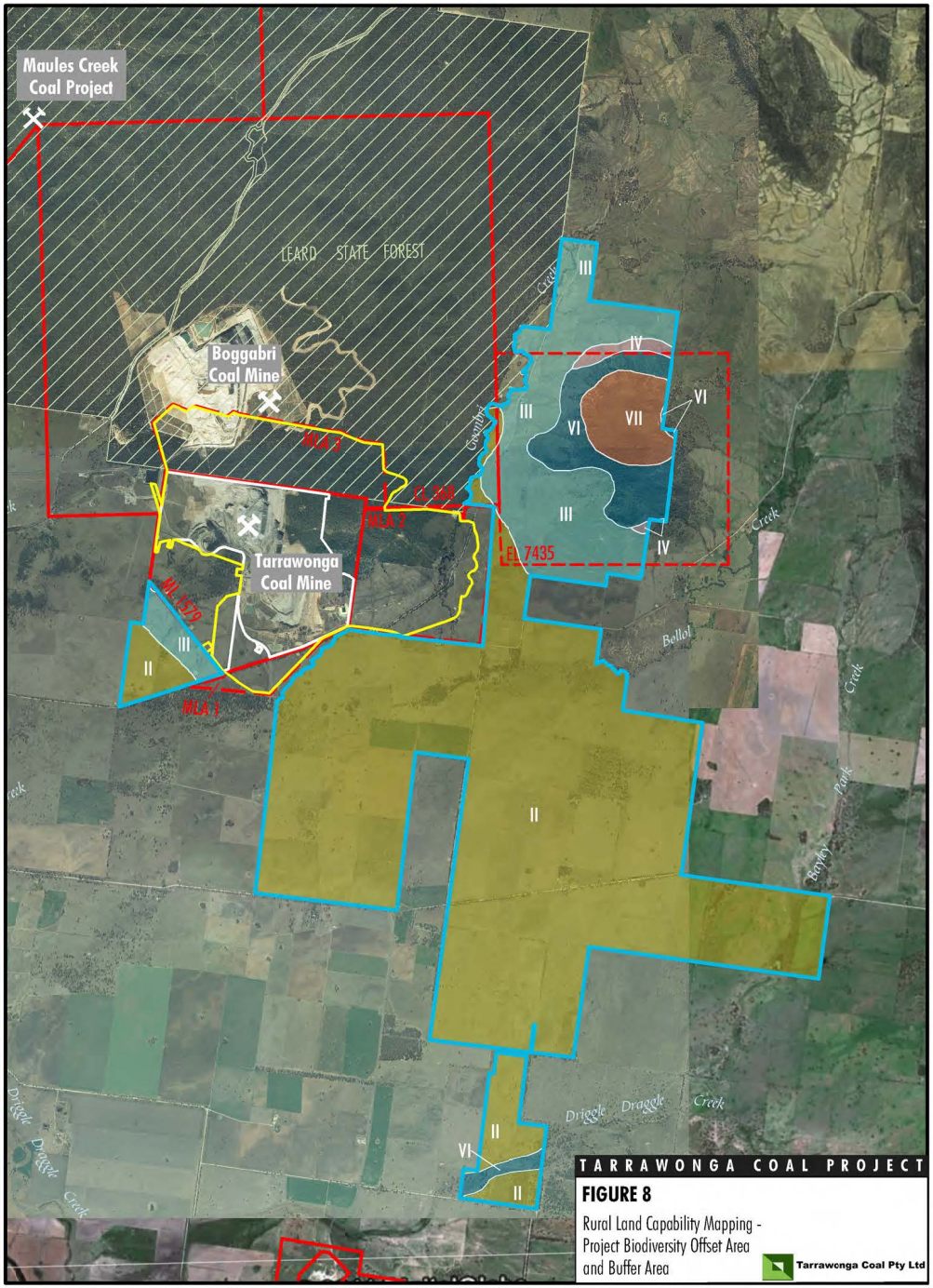

N
Maules Creek
Basin Creek
Creek
Nicholas Creek
Stony Creek
Rocky Creek
Mount Kaputar National Park
Maules Creek
Tractor Creek
Willari Creek
Cannors Creek
LEGEND
Mining Lease Boundary (ML & CL)
Mining Lease Application Boundary (MLA)
Exploration Licence Boundary (EL)
National Park
State Forest
Approximate Extent of Existing/Approved Surface Development
Approximate Extent of Project Surface Development
Project Biodiversity Offset Area Boundary
Buffer Area Boundary
RURAL LAND CAPABILITY CLASSES
Class II
Class III
Class IV
Class V
Class VI
Class VII
Class VIII
0 1 2 3
Kilometres
GRID DATUM MGA 94 ZONE 56
Source: Orthophoto - Google Earth Image; Office of Environment & Heritage (2011); Whitehaven Coal Pty Ltd (2011) and DECC (2009)


Maules Creek Coal Project
LEARD STATE FOREST
Boggabri Coal Mine
MLA 2
Tarrawonga Coal Mine
ML 1579
MLA 1
EL 7435
Greenbri Creek
Bellol Creek
Driggle Driggle Creek
TARRAWONGA COAL PROJECT
FIGURE 8
Rural Land Capability Mapping - Project Biodiversity Offset Area and Buffer Area
Tarrawonga Coal Pty Ltd

4.4 AGRICULTURAL SUITABILITY

4.4.1 Background

The Agricultural Suitability system is used to classify land in terms of its suitability for general agricultural use. Agricultural land is classified by evaluating biophysical, social and economic factors that may constrain the use of land for agriculture.

The essential characteristics of the five classes are as follows (Attachment B):

Class 1: Arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent.

Class 2: Arable land suitable for regular cultivation for crops, but not suited to continuous cultivation. It has a moderate to high suitability for agriculture but soil factors or environmental constraints reduce the overall level of production and may limit the cropping phase to a rotation with sown pastures.

Class 3: Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with sown pasture. The overall production level is moderate because of soil or environmental constraints. Erosion hazard, soil structural breakdown or other factors, including climate, may limit the capacity for cultivation and soil conservation or drainage works may be required.

Class 4: Land suitable for grazing but not for cultivation. Agriculture is based on native pastures and improved pastures established using minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.

Class 5: Land unsuitable for agriculture, or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors which prevent land improvement.

4.4.2 Agricultural Suitability Mapping

Project Site

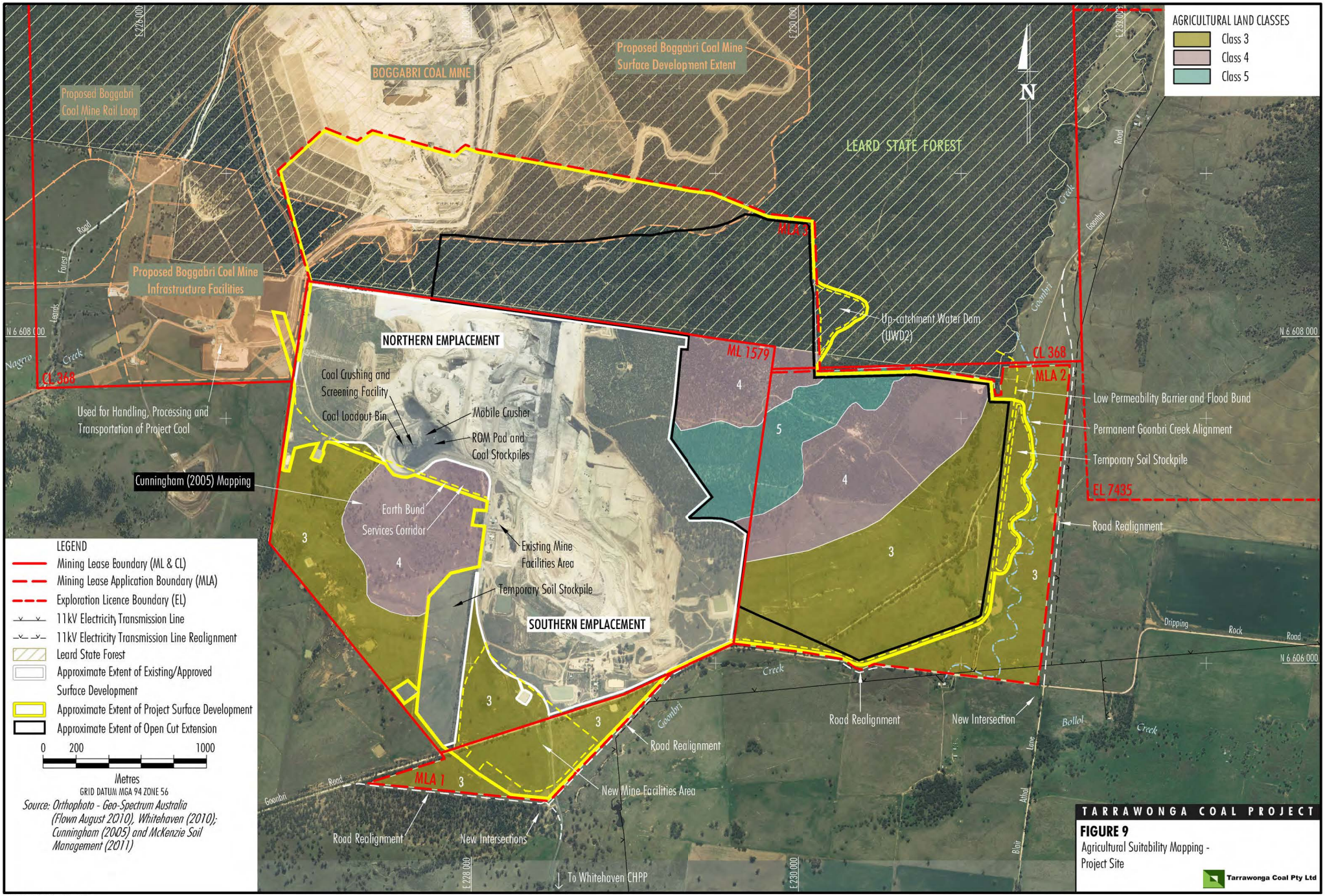
Agricultural Suitability mapping for MLA 1, MLA 2, the south-eastern corner of MLA 3 (i.e. outside of Leard State Forest) and the north-eastern section of ML 1579 has been completed by McKenzie Soil Management (2011) and is documented in Attachment B and Figure 9.

Agricultural Suitability classes identified across the Project site ranged from Class 3 to Class 5. Class 3 areas (i.e. grazing land or land well suited to pasture improvement) are associated with the flatter areas and the Alluvial Plain and Lower Slope soil landscape units. No Class 1 or Class 2 agricultural lands have been identified within the Project area (Attachment B).

More detail on the Agricultural Suitability mapping is provided in Attachment B.

Buffer Area

Agricultural Suitability mapping provided by the Department of Primary Industries (DPI) is available for the buffer area and is shown on Figure 10.



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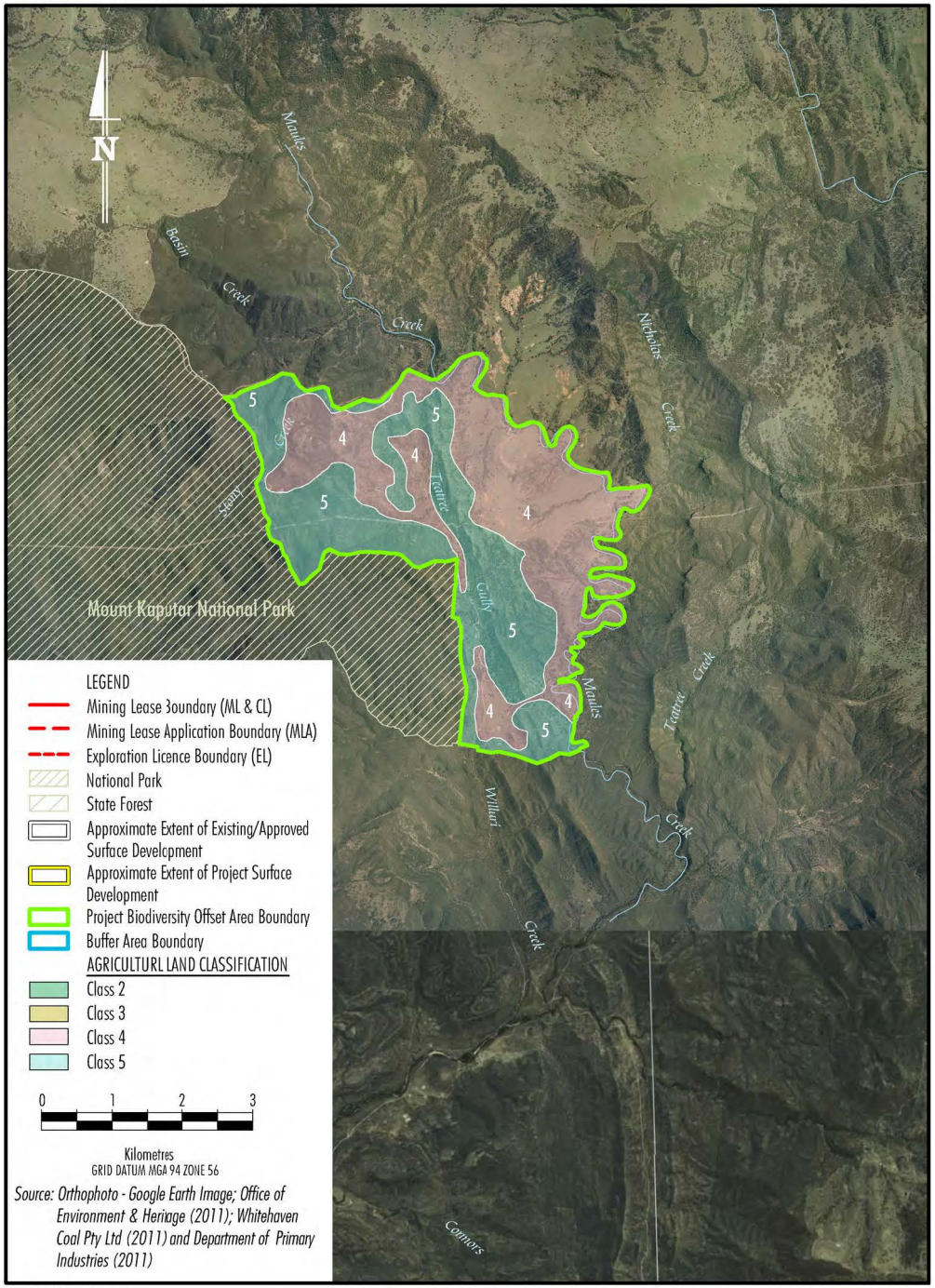
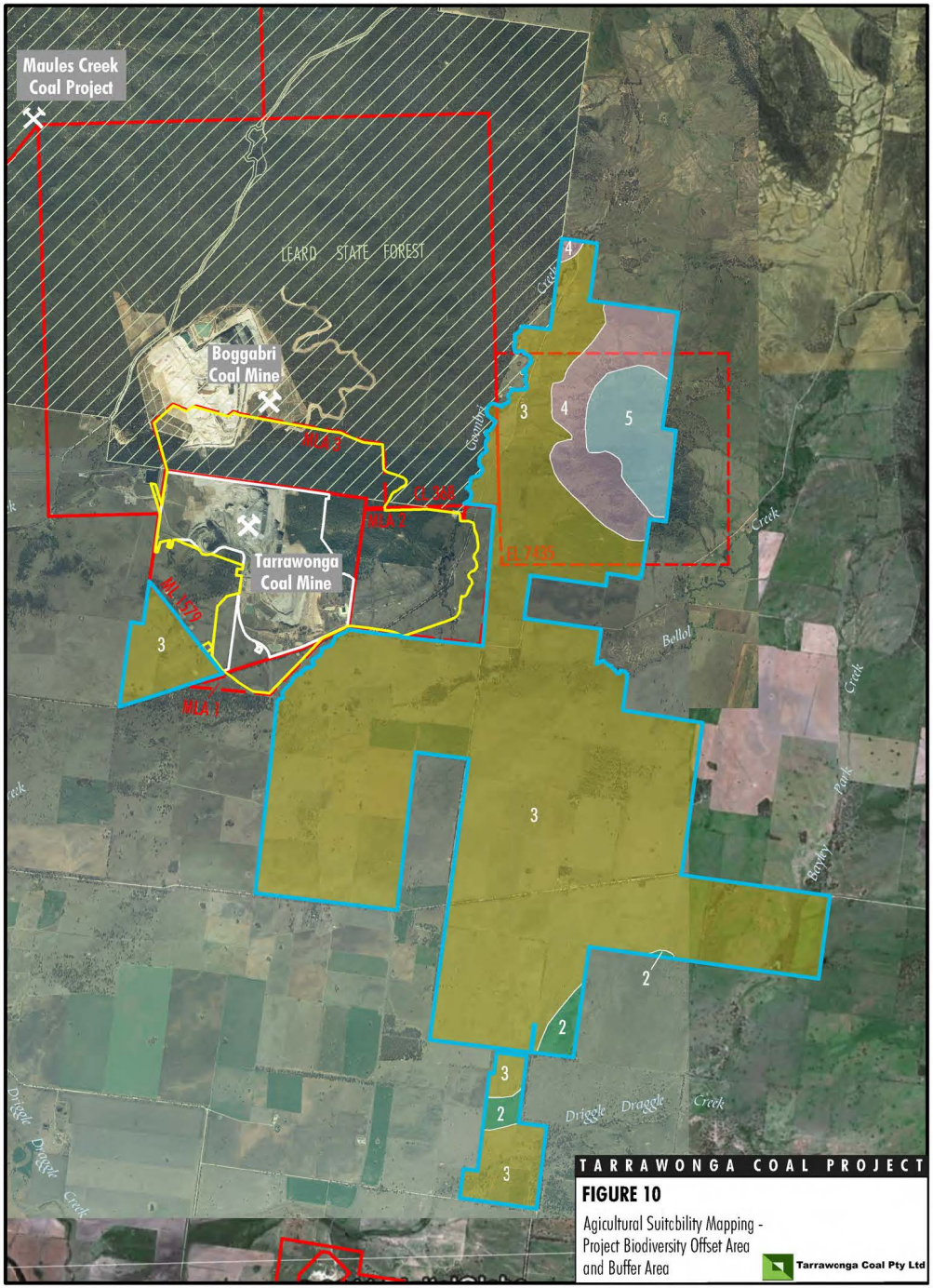


Source: Orthophoto - Google Earth Image; Office of Environment & Heritage (2011); Whitehaven Coal Pty Ltd (2011) and Department of Primary Industries (2011)



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The buffer area includes Agricultural Suitability Classes 2, 3, 4 and 5 (Figure 10). The majority of the buffer area is Class 3 land with smaller areas of Classes 2, 4 and 5 (Figure 10). The Class 2 land is associated with Driggle Draggle Creek in the south and the Classes 4 and 5 areas are located in elevated areas associated with Goonbri Mountain (Figure 10).

Project Biodiversity Offset Area

Agricultural Suitability mapping provided by the DPI is available for the Project biodiversity offset area and is shown on Figure 10.

The Project biodiversity offset area includes Agricultural Suitability Classes 4 and 5 (Figure 10). The Class 4 areas are associated with the generally cleared areas in the eastern and northern sections of the Project biodiversity offset area (Figure 10). Class 5 lands are not suitable for agriculture (Section 4.4.1).

4.5 AGRICULTURAL PRODUCTIVITY

Project Site

The productivity of the different agricultural enterprises conducted on the Project site have been estimated for average rainfall years (Attachment B) and are summarised in Table 1.

Table 1
Approximate Average Productivity of Agricultural Enterprises on the Project Site

Enterprise	Gross Margin
Rainfed Crop Production in Rotation with Improved Pasture	
• Wheat	$285/ha/year (70% of time)
• Lucerne	$203/ha/year (30% of time)
Grazing (Native Pasture)	
• Beef cattle	$95/ha/year

Source: After Attachment B

More detail on the agricultural productivity estimation for the Project site is provided in Attachment B.

Buffer Area

The agricultural productivity of the buffer area has not been estimated for this study as there would be no change to the current agricultural activities conducted in the buffer area (Section 5.1) and therefore there would be no change in agricultural productivity in the buffer area as a result of the Project.

Project Biodiversity Offset Area

Agricultural activities historically conducted in the Project biodiversity offset area include grazing livestock on native pastures. The Agricultural Suitability classification of the former agricultural areas in the Project biodiversity offset area is typically Class 4 (Figure 10).

Grazing on native pastures is also conducted on the Project area on Agricultural Suitability Class 4 areas and therefore the agricultural productivity estimate for the Project area (Table 1) would be relevant to the Project biodiversity offset area. The agricultural productivity (gross margin) of cattle grazing on native pasture estimate for the Project area was $95/ha/year (Table 1).

5 ASSESSMENT OF POTENTIAL IMPACTS

This section provides an assessment of the potential impacts of the Project (including the biodiversity offset) on agricultural resources and productivity.

5.1 PROPOSED WHITEHAVEN AGRICULTURAL ACTIVITIES

5.1.1 Project Life

Project Site

The Project would disturb approximately 335 ha of additional agricultural land. This additional agricultural land consists of approximately 210 ha suitable for rainfed crop production in rotation with improved pasture (based on the area of Agricultural Suitability Class 3 lands – Figure 9) and approximately 125 ha suitable for grazing on pasture dominated by native species (based on the area of Agricultural Suitability Class 4 lands – Figure 9) (Attachment B).

These existing agricultural areas on the Project site could continue to be used for agricultural activities until they are required for the Project. However, for the purposes of this assessment, it has conservatively been assumed that no agricultural activities would occur on the Project site during mining operations.

Project Biodiversity Offset Area

The Project biodiversity offset area consists of approximately 305 ha of cleared agricultural land that has not been used for agricultural purposes since the property was purchased by Whitehaven in 2010. Historically, grazing on native pasture has been conducted on the cleared agricultural land (Appendix E of the EA).

The offset proposal for the Project involves conserving an area of land (the Project biodiversity offset area) with existing fauna and flora conservation values and providing active management to maintain and enhance the values. Agricultural activities would therefore not be undertaken on the Project biodiversity offset area lands.

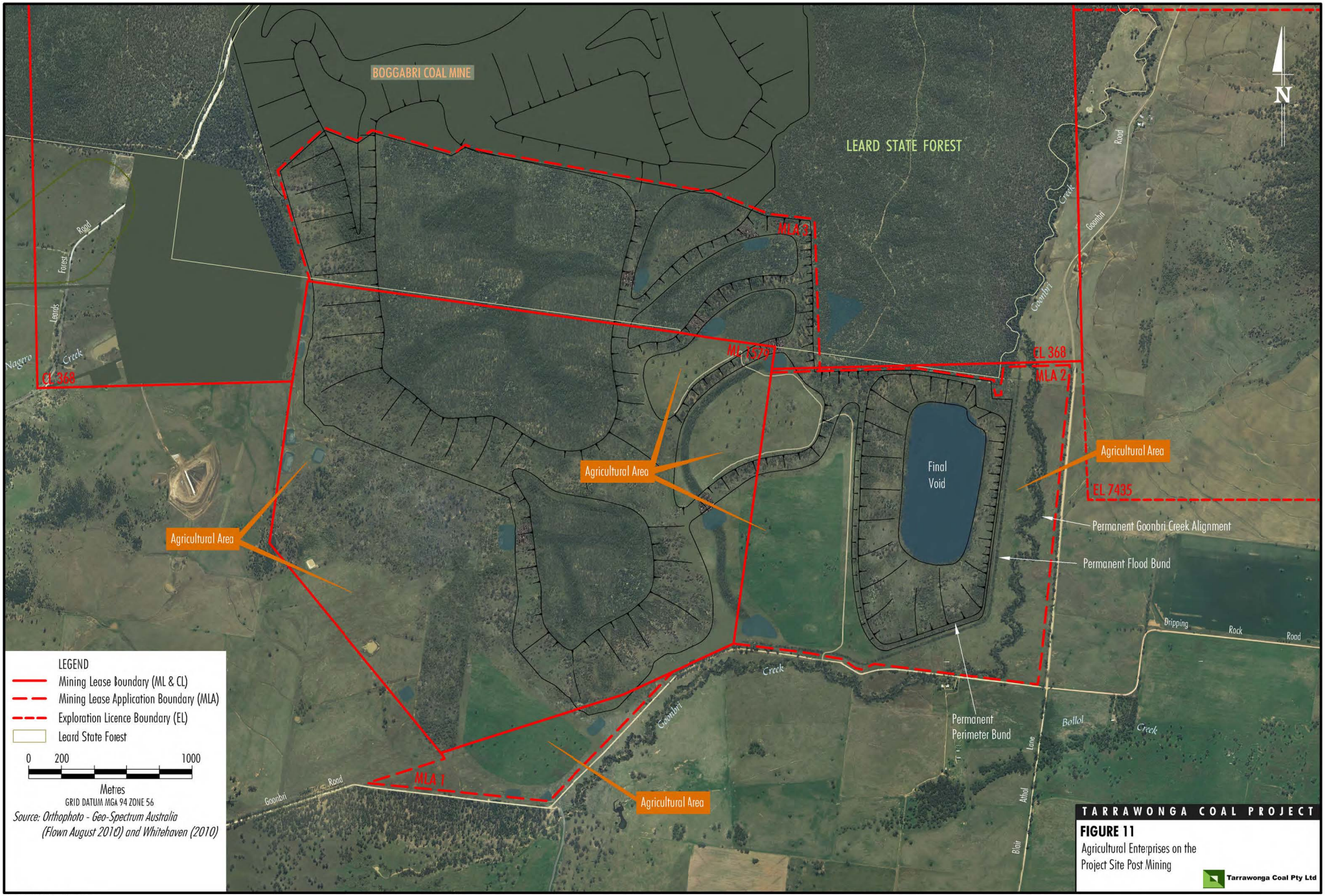
5.1.2 Post-Mining

Project Site

The Project would be progressively rehabilitated in a manner that provides a sustainable balance between the existing surrounding land uses (i.e. Leard State Forest and agricultural activities). The proposed post-mine land uses at the Project would therefore include woodland/forest regeneration areas and agricultural areas. The Project final landform and the proposed post-mine land uses are presented on Figure 11.

A review of the physical and chemical properties of the soil resource on the Project site has established that the soil resource includes soil that would be suitable as a rehabilitation medium for agricultural land uses (including cropping/grazing areas) on the Project site post-mining. These soils are considered suitable for the following reasons (Attachment B):

- Favourable pH values.
- Non-saline.
- Exchangeable sodium percentage values are low enough to be treated easily with coarse-grade gypsum.



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- Cation exchange capacity allows for natural decompaction through shrink-swell processes.
- These favourable properties would not be modified greatly during the stripping, stockpiling and spreading of the soils.

The areas rehabilitated for agricultural land uses post-mining would be prepared with a total soil profile depth of approximately 1.5 m, overlaid on mine waste rock. The underlying mine waste rock is expected to have high porosity/permeability and is therefore expected to allow for beneficial deep drainage and deep root growth beyond a depth of 1.5 m (Attachment B). This soil profile would provide rootzone chemical and physical conditions that are at least as favourable for cereal and pasture production as the existing agricultural areas (Attachment B).

Based on the available soil quantities and the soil profile described above, approximately 160 ha of agricultural land capable of cropping (i.e. Class 3 agricultural suitability land) could be re-established on the Project site post-mining (Attachment B).

In addition to the 160 ha of re-established agricultural land, approximately 50 ha of Agricultural Suitability Class 3 agricultural land used for the mine facilities area would be returned to agricultural use post-mining. Approximately 210 ha of agricultural land (suitable for cropping/grazing) would therefore be established on Project disturbance areas post-mining (Attachment B).

Buffer Area

At the completion of the Project, Whitehaven may no longer require the buffer area around the Project site. It is therefore expected that the properties associated with the buffer area would be sold and would continue to be used for agricultural purposes.

Project Biodiversity Offset Area

The Project biodiversity offset area would be permanently conserved and as a result, approximately 305 ha of grazing land would be sterilised in perpetuity.

5.2 AGRICULTURAL RESOURCES

5.2.1 Land Resources

The Project (including the biodiversity offset) would result in the long-term disturbance of agricultural lands (Section 5.1). A summary of the area of agricultural lands at the Project site and the Project biodiversity offset area before, during the Project life, and post-mining is provided in Table 2.

The Project would reduce the area of Class 4 agricultural suitability land at the Project area by approximately 125 ha in the long term. The proposed rehabilitation of Class 3 agricultural suitability lands (Section 5.1.2) would result in no long term change in the area of Class 3 agricultural suitability lands on the Project area (Table 2).

Agricultural activities would continue in the buffer area and therefore there would be no change to the area of agricultural lands in the buffer area as a result of the Project (Section 5.1.2).

The Project biodiversity offset area would result in the sterilisation of approximately 305 ha of agricultural lands (i.e. Class 4 and Class 5 agricultural suitability lands [Table 2]) by returning this area to native woodland/open woodland (Section 5.1.2).

Table 2
Summary of Agricultural Lands at the
Project Site, Buffer Area and Project Biodiversity Offset Area

Agricultural Suitability Classification	Area of Agricultural Land (ha)			
	Existing	Project Life	Post-Mining	Net Change
Project Site				
Class 3	210	0	210	0
Class 4	125	0	0	-125
Project Biodiversity Offset Area				
Existing Agricultural Lands (Classes 4 and 5)	305	0	0	-305

Source: After Attachment B and DPI (2011).

The Project would, therefore, result in the sterilisation of approximately 430 ha of Class 4 and 5 agricultural suitability lands in the long term. This represents approximately 0.05% of the total agricultural lands in the Narrabri and Gunnedah LGAs.

These sterilised agricultural lands are not considered to be highly productive agricultural resources based on their Agricultural Suitability classification (i.e. Classes 4 and 5). As described in Section 4.4.1, Classes 4 and 5 are defined as:

Class 4: Land suitable for grazing but not for cultivation. Agriculture is based on native pastures and improved pastures established using minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.

Class 5: Land unsuitable for agriculture, or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors which prevent land improvement.

5.2.2 Water Resources

Surface Water

A detailed assessment of potential surface water impacts is provided in Appendix B of the EA. The key potential surface water impacts in relation to agricultural activities include changes to surface water flow regimes and a reduction in surface water quality.

The maximum predicted reduction in contributing catchment over the life of the Project is 0.02% of the total catchment of the Namoi River (Appendix B of the EA). Following the completion of rehabilitation post-mining, only the catchment area of the final void would remain excised from the Namoi River catchment (approximately 155 ha, or 0.004% of the total catchment of the river).

With the implementation of the proposed surface water mitigation measures the Project would have a low risk of adversely affecting downstream waters (Appendix B of the EA).

Given the above, the Project would result in a very minor reduction in flows in the Namoi River catchment that may have otherwise been available for agricultural use, and would have a low risk of adverse water quality impacts on surface water resources currently used for agricultural purposes.

Groundwater

A detailed assessment of potential groundwater impacts is provided in Appendix A of the EA. The key potential groundwater impacts in relation to agricultural activities include changes to groundwater levels and a reduction in groundwater quality.

Numerical modelling indicates that the drawdown effects on groundwater users in the vicinity of the Project would not be significant (i.e. would be less than 1 m) and would, therefore, not materially affect the existing or potential future beneficial use of groundwater. The predicted impacts on individual bore/wells within 5 km of the Project are tabulated in Appendix A of the EA.

There are not expected to be any significant changes in the quality of the alluvial groundwater system as a consequence of the Project (Appendix A of the EA).

Given the above, it is considered that there would be no material affect on agricultural activities where groundwater is used as a result of the Project.

5.3 AGRICULTURAL PRODUCTION

The reduction in agricultural production associated with the Project can be estimated using the area of agricultural land that would be disturbed (Table 2) and the estimated agricultural productivity of this land (Section 4.5). In addition, the Project would result in the diversion of some surface and groundwater resources that may have otherwise been used for agricultural production (Section 5.2.2). The value of the agricultural production that may have been forgone as a result of the Project has been estimated based on the conservative assumption that all this water would be otherwise used to irrigate cotton (Attachment A). This is considered conservative given there is no cotton growing on the Project area or in the immediate vicinity of the Project, and given that cotton is the highest value agricultural commodity in the LGA.

Table 3 provides a summary of the estimated maximum foregone annual agricultural production (i.e. during the Project life before rehabilitation) as a result the Project. A full description of the calculation methodology is provided in Attachment A.

Table 3
Estimated Maximum Forgone Annual Agricultural Production

	Land Resources	Water Resources	Total
Production Type	Rainfed crop production in rotation with improved pasture and beef cattle grazing	Cotton	-
Direct Output Value	$100,000	$210,000	$310,000
Direct Income	$20,000	$40,000	$60,000
Direct Employment	1.0	0.5	1.5

Source: Attachment A.

The maximum annual output value of agricultural production forgone from the agricultural lands is estimated to be approximately $100,000 (Table 3). Once the agricultural lands are re-established on the Project site post-mining, the annual value of agricultural production foregone would reduce. The maximum annual output value of agricultural production forgone as a result of the diversion of water resources that may have otherwise been used for agriculture is estimated to be approximately $210,000 (Table 3).

The maximum annual value of total agricultural production forgone as a result of the Project is estimated to be approximately $310,000. The present value of the total foregone agriculture production (in perpetuity) as a result of the Project is approximately $1.5M (Attachment A).

5.4 AGRICULTURAL SUPPORT INDUSTRIES AND SERVICES

The reduction in agricultural production associated with the Project (Section 5.3) would potentially impact agricultural support industries and services in the region.

The reduction in the annual value of total agricultural production would be approximately $310,000 per year or 0.08% of the annual agricultural production in the Narrabri and Gunnedah LGAs (Attachment A).

It is expected that the reduction in agricultural production would result in the loss of approximately two direct and indirect jobs in the Gunnedah and Narrabri LGAs (Attachment A) or 0.09% of the agricultural-related employment in the Gunnedah and Narrabri LGAs.

Given the relative minor reduction in agricultural production and agricultural-related employment in the Narrabri and Gunnedah LGAs as a result of the Project, there is expected to be negligible impact on agricultural support industries and services in the region.

It is noted that the Project, may however, have some positive effects on some of these support industries and services, if they also service the mining industry (e.g. water management and irrigation equipment supplies, etc.).

6 MANAGEMENT MEASURES AND MONITORING

This section describes the management measures and monitoring proposed to be implemented for the Project to minimise potential impacts on land and water resources.

6.1 LAND RESOURCES

Agricultural land resource management at the Project would include the following key components:

- Minimisation of disturbance to agricultural lands where practicable.
- Continued use of adjoining Whitehaven-owned land for agricultural uses.
- Management of soil resources at the Project site so that they can be used for rehabilitation.
- Inclusion of agricultural lands in the Project rehabilitation strategy.

Minimisation of Disturbance to Agricultural Lands

The area of agricultural land disturbed on the Project site at any one time would be minimised so that agricultural uses can continue.

Refinements to the Project layout during the development of this EA include the proposed site of the relocated infrastructure area which reduced potential impacts on agricultural land located on the southern side of Goonbri Creek.

In addition, the biodiversity offset area is located in an area with low agricultural suitability, which means that its restoration to native woodland/open woodland would have a relatively low impact on agricultural lands in the region.

Continued Use of Existing Agricultural Areas

The buffer area would continue to be used for agricultural uses, where practicable.

A Farm Management Plan would be prepared by a suitably qualified person(s) to facilitate the management of agricultural land in the Project area and the buffer area. The Farm Management Plan would include property, grazing and cropping management measures, as well as erosion, weed and pest controls to be applied.

The Farm Management Plan would also include various measures to optimise biodiversity outcomes. Additional information on these biodiversity enhancement measures is provided in Appendix E of the EA.

At the completion of the Project, it is expected that Whitehaven would sell the adjoining properties it holds and thus they would continue to be used for agricultural purposes.

Management of Soil Resources

General soil resource management practices would include the stripping and stockpiling of soil resources prior to any mine-related disturbance for use in rehabilitation. The objectives of soil resource management for the Project site would be to:

- Identify and quantify potential soil resources for rehabilitation.
- Optimise the recovery of useable topsoil and subsoil during stripping operations.
- Manage topsoil and subsoil reserves so as not to degrade the resource when stockpiled.
- Establish effective soil amelioration procedures to maximise the availability of soil reserves for future rehabilitation works.

Soil resource management measures are outlined in detail in Attachment B.

A Rehabilitation Management Plan would be prepared by a suitability qualified expert to detail the soil resource management measures.

Re-establishment of Agricultural Lands

The rehabilitation and mine closure strategy for the Project includes restoration of approximately 210 ha of agricultural land suitable for cropping/grazing (Section 5.1.2). The rehabilitation of this land reduces the area of agricultural land that would be sterilised by the Project.

6.2 WATER RESOURCES

Surface Water

A number of management measures are proposed to manage potential impacts of the Project on surface water resources and these are described in Appendix B of the EA.

The Project water management system would control runoff generated from surface development areas, while minimising (where practicable) the mixing/capture of upslope surface water runoff by installation of upslope bunds and drains to divert water around such areas. This would minimise off-site water quality impacts and the volume of surface water runoff that is contained on-site and therefore unavailable for agricultural uses.

The existing Water Management Plan would be reviewed and revised to incorporate the Project. The Water Management Plan would describe the water management protocols and response procedures for the site water management system.

The existing Surface Water (and Groundwater) Response Plan would be reviewed and revised to describe any additional measures/procedures to be implemented over the life of the Project to respond to any potential exceedances of surface water related criteria and to provide contingent mitigation/compensation/offset options in the event that downstream surface water users or riparian vegetation is adversely affected by the Project.

Groundwater

A number of management measures are proposed to manage potential impacts of the Project on groundwater resources and these are described in Appendix A of the EA.

A low permeability barrier would be constructed to reduce local drainage from the alluvial groundwater system into the open cut during operational and post closure periods. The low permeability barrier would also reduce the potential for impacts on the beneficial use of the regional groundwater resource (through changes in water quality), resulting from flow (if any) from the final void waterbody into the alluvial groundwater system under post-closure conditions.

The existing Groundwater Monitoring Program, which is included in the Water Management Plan, would be updated to incorporate the Project. The extended groundwater monitoring program would be designed to detect changes in groundwater levels and quality as a result of mining.

In the event that a complaint is received during the life of the Project in relation to depressurisation of a privately-owned bore or well by local groundwater users, the results of the groundwater monitoring program would be reviewed by TCPL as part of a preliminary evaluation to determine if further investigation, notification, mitigation (e.g. bore re-conditioning), compensation (e.g. alternative water supply) or other contingency measures (refer below) are required.

The existing Groundwater Response Plan, which is included in the Water Management Plan, would be reviewed and revised to describe any additional measures/procedures that would be implemented over the life of the Project to respond to potential exceedances of groundwater-related criteria. It would also describe the contingent mitigation/compensation/offset options that would be enacted in the event that groundwater users are adversely affected by the Project, or the low permeability barrier does not perform to specification.

7 JUSTIFICATION OF CHANGES TO AGRICULTURAL RESOURCES

The Project would result in the sterilisation of approximately 430 ha of agricultural lands (Section 5.2.1). This represents approximately 0.05% of the total agricultural lands in the Narrabri and Gunnedah LGAs.

These agricultural lands are not considered to be highly productive agricultural resources based on their Agricultural Suitability classification (i.e. Classes 4 and 5). As described in Section 4.4.1, Classes 4 and 5 are defined as:

Class 4: **Land suitable for grazing but not for cultivation**. Agriculture is based on native pastures and improved pastures established using minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.

Class 5: **Land unsuitable for agriculture**, or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors which prevent land improvement.

Table 4 compares the annual regional production and economic impacts associated with the Project with the maximum level of annual agricultural production that would be forgone as a result of the Project.

Table 4
Maximum Annual Regional Production/Economic Impacts
of the Forgone Agricultural Production and the Project

	Forgone Agriculture Production	Project
Direct Output Value	$310,000	$424M
Direct Income	$60,000	$12M
Direct Employment	1.5	106
Direct and Indirect Output Value	$440,000	$490M
Direct and Indirect Income	$100,000	$27M
Direct and Indirect Employment	2.1	300

Source: After Attachment A.

The Project is estimated to provide considerable stimulus to the Gunnedah and Narrabri regional economy of that is far in excess of the regional economic impacts associated with the maximum level of annual agricultural production that would be forgone as a result of the Project (Table 4).

The direct annual output of the Project (at 3 Mtpa of ROM coal production) is estimated at $424M. This is greater than the annual value of all agriculture production in both the Gunnedah and Narrabri LGAs in 2006 (i.e. $386M) (Section 3.3). The annual agricultural production forgone from the land and water resources that would be impacted by the Project is $310,000 (Table 4).

The direct and indirect employment provided by the Project would be approximately 300 compared to approximately two agricultural-related jobs that would be forgone as a result of the Project (Table 4).

A benefit cost analysis has been prepared for the Project (Appendix M of the EA). The present value of net production benefits of the Project are estimated at $1,138M (Gillespie Economics, 2011b). In contrast the present value of forgone future agricultural resources is estimated at approximately $1.5M (Attachment A).

There are a number of potential negative and positive externalities associated with the Project. Including all externalities (including the opportunity cost of agricultural production) the Project is estimated to have net benefits to Australia of $790M (Gillespie Economics, 2011b) and therefore the Project is considered to be more efficient than the agricultural production that would be displaced.

Given that no highly productive agricultural lands would be sterilised by the Project and that the Project is more efficient than the continued agricultural production, it is considered that the reallocation of existing agricultural resources to the Project is justified.

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ATTACHMENT A

ECONOMIC REVIEW OF POTENTIAL AGRICULTURAL IMPACTS (GILLESPIE ECONOMICS, 2011)

Tarrawonga Coal Project
Economic Review of Potential Agricultural Impacts

Prepared for

Tarrawonga Coal Pty Ltd

By

Gillespie Economics
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Email: gillecon@bigpond.net.au

October 2011

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1 INTRODUCTION

The Tarrawonga Coal Mine is an open cut mining operation located approximately 15 kilometres (km) north-east of Boggabri and 42 km north-northwest of Gunnedah in New South Wales (NSW). Tarrawonga Coal Pty Ltd (TCPL) is the owner and operator of the Tarrawonga Coal Mine, which is a joint venture between Whitehaven Coal Mining Pty Ltd (Whitehaven) (70% interest) and Boggabri Coal Pty Ltd (a wholly owned subsidiary of Idemitsu Australia Resources Pty Ltd) (30% interest). The Tarrawonga Coal Mine commenced operations in 2006 and currently produces up to approximately 2 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal.

The Tarrawonga Coal Project (the Project) would involve the continuation and extension of open cut mining operations at the Tarrawonga Coal Mine and would facilitate a ROM coal production rate of up to 3 Mtpa. The proposed life of the Project is 17 years, commencing 1 January 2013. A detailed description of the Project is provided in Section 2 in the Main Report of the Environmental Assessment.

This report assesses the potential economic implications of the impacts of the Project on agricultural (including 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 1), the area of land under major food crop production (i.e. wheat and barley[1]) has actually increased (Figure 1).

Table 1
NSW Agricultural Land Area

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

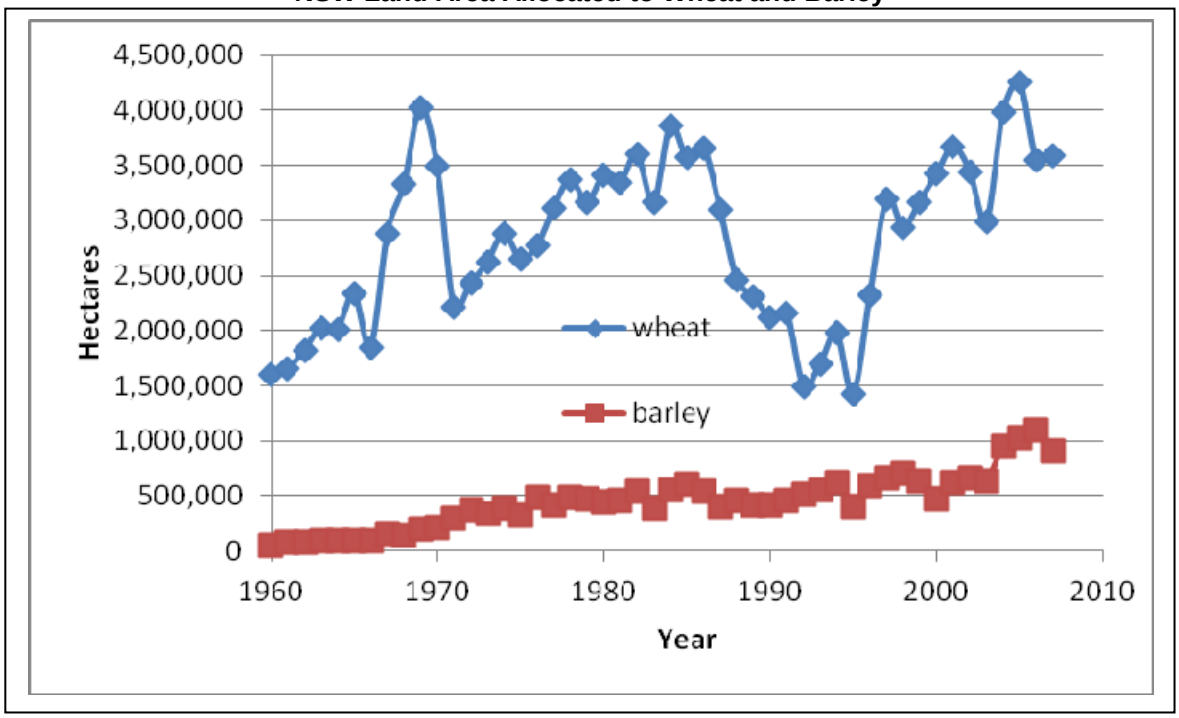
Source: ANRA (2009b).

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 2009-10 was $1,421M and value-added was $5,077M. Gross operating surplus and gross mixed income from agriculture, forestry and fishing was $2,441M (ABS, 20010a).

[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.

Figure 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. likely to be less than 0.1% of the total NSW land area) and directly employs 19,026 or 0.7% of total employment in NSW (ABS, 2006). Payment to mining employees in 2009-10 was $3,049M and value-added was $14,535M. Gross operating surplus and gross mixed income from mining was $9,519M (ABS, 2010a).

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 stimulus 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).

3 AGRICULTURAL AND MINING INDUSTRIES IN THE NARRABRI AND GUNNEDAH REGION

The Gunnedah and Narrabri region (i.e. the Gunnedah and Narrabri local government areas [LGAs]) have a combined land area of 1.2M ha, of which 68% is agricultural land (Table 2). Of this agricultural land, 5.6% is irrigated with annual irrigation volumes of approximately 323,000 million litres (ML) (Table 2). The total value of agricultural production in this region in 2006 is estimated at $386M (ABS, 2010b, 2010c) (Table 2).

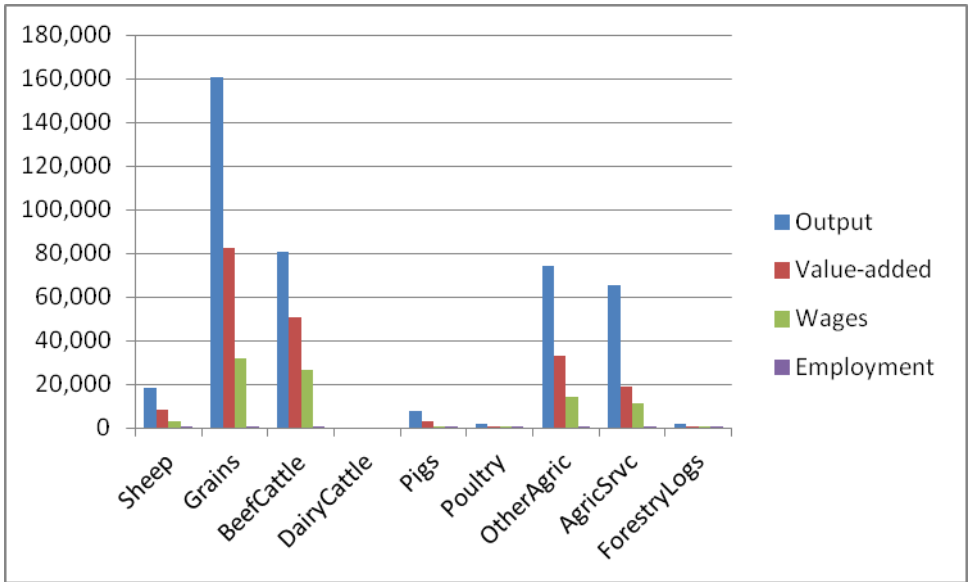
Table 2
Existing Agricultural Land Use and Value of Production
in Gunnedah and Narrabri – 2006

	Units	Gunnedah LGA	Narrabri LGA	Total
Area				
Land Area	ha '000	499	1,303	1,802
Area of Agricultural Land	ha '000	434	791	1,225
Irrigation				
Area Irrigated	ha '000	18	51	69
Irrigation Volume Applied	ML	62,907	260,266	323,173
Other Agricultural Uses	ML	2,068	4,355	6,423
Total Water Use	ML	64,974	264,621	329,595
Area Irrigated as Proportion of Agricultural Land	%	4.1	6.4	5.6
Value				
Gross Value of Crops	$M	95	215	310
Gross Value of Livestock Slaughterings	$M	29	41	71
Gross Value of Livestock Products	$M	1	4	5
Total Gross Value of Agricultural Production	***$M***	***126***	***261***	***386***

Source: ABS (2010b, 2010c).
Note: Totals may have minor discrepancies due to rounding.

The input-output table developed for the Narrabri and Gunnedah LGAs (Gillespie Economics, 2011) provides an indication of the direct relative significance of the different agricultural sectors, affirming grains, beef cattle and other agriculture (which includes cotton) as the main agricultural sectors (Figure 2).

Figure 2
Agricultural Sectors in Gunnedah and Narrabri LGAs



Source: Gillespie Economics (2011).

Total employment in the agricultural industry in the Gunnedah and Narrabri LGAs is 2,252 (ABS, 2010d). Table 3 provides a more detailed employment by industry breakdown which indicates that the main agricultural employment is in beef farming (specialised), grain-sheep or grain-beef cattle farming, other grain growing and cotton growing.

Extractive industries in Gunnedah and Narrabri are less than 1% of the land area (Edge Land Planning, 2007, 2009). Despite being a small fraction of the footprint of agriculture, the saleable coal output level in 2007/08 is estimated to have a value of around $400M[3] (Table 4) which is greater than the value of agricultural production in the Gunnedah and Narrabri LGAs (Table 2).

[3] Assuming a market price of $100 per tonne.

Table 3
Employment by Agricultural Sectors in Gunnedah and Narrabri LGAs

Industry	Employment
Agriculture, not further defined	72
Vegetable Growing (Outdoors)	5
Grape Growing	3
Citrus Fruit Growing	3
Olive Growing	8
Sheep, Beef Cattle and Grain Farming	14
Sheep Farming (Specialised)	74
Beef Cattle Farming (Specialised)	457
Beef Cattle Feedlots (Specialised)	4
Sheep-Beef Cattle Farming	101
Grain-Sheep or Grain-Beef Cattle Farming	381
Other Grain Growing	428
Cotton Growing	388
Other Crop Growing	8
Poultry Farming	3
Poultry Farming (Eggs)	4
Pig Farming	30
Beekeeping	7
Other Livestock Farming	4
Forestry and Logging	3
Forestry	3
Hunting and Trapping	3
Agriculture, Forestry and Fishing Support Services, not further defined	3
Forestry Support Services	5
Cotton Ginning	118
Shearing Services	3
Other Agriculture and Fishing Support Services	101
Agriculture, Forestry and Fishing, not further defined	19
Total	**2,252**

Source: ABS (2010d)

Table 4
Existing Coal Mining Production, Gross Value and Direct Employment in Gunnedah and Narrabri LGAs

Coal Mining	Units	Total
Coal Saleable Production (2007/2008)	Mt	4.03
Gross Value of Coal Production	$M	403
Direct Mining Employment	No.	375

Source: NSW Department of Primary Industries (DPI) (2009).
Note: Mt = million tonnes.

4 ASSESSING THE ECONOMIC EFFICIENCY OF PROPOSALS THAT IMPACT AGRICULTURAL LAND

4.1 ECONOMIC EFFICIENCY

From an economic perspective, the aim is 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 circumnstances 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 is more economically efficient than no intervention.

4.2 ECONOMIC EFFICIENCY OF MINING PROPOSALS THAT IMPACT AGRICULTURAL LAND

Mining proposals in NSW are subject to a requirement to obtain government approval through the NSW *Environmental Planning and Assessment Act, 1979*. This commonly includes a consideration of economic efficiency via the completion of a BCA. In a simple BCA framework, the potential costs and benefits of of a mining project that impacts agricultural land are outlined in Table 5.

Table 5
Potential Costs and Benefits of a Mining Proposal that Impacts Agricultural Land

	Costs	Benefits
Net Production Benefits	**Production**	
	Opportunity costs of land and capital	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[1]

[1] These benefits have been estimated using choice modelling in Gillespie Economics (2008, 2009a, 2009b).

Where the mining proposal impacts agricultural land there is an opportunity cost to society of using the land for mining instead of agriculture. The magnitude of this opportunity cost is reflected in the market value of the land, since the market value of the land reflects, among other things, the discounted future net revenue that can be earned from the property and revenue reflects how much the community values the outputs of agricultural production. Any increasing scarcity of agricultural commodities will be reflected in the market value of agricultural land.

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

5 PROJECT IMPACTS ON AGRICULTURAL RESOURCES

5.1 PRODUCTION

Land Resources

The Project (including the biodiveristy offset area) would result in the long-term disturbance of agricultural lands. A summary of the current area of agricultural lands at the Project site and in the biodiveristy offset area, the area during the Project life, and the area post-mining is provided in Table 6.

The Project would reduce the area of Class 4 agricultural land at the Project site by approximately 125 ha in the long-term. The proposed rehabilitation of Class 3 agricultural lands would result in no long-term change in the area of Class 3 agricultural lands on the Project site (Table 6).

The biodiveristy offset area would result in the sterilisation of approximately 305 ha of agricultural lands (Table 6).

The estimated agricultural productivity of the Project site and the biodiveristy offset area is also summarised in Table 6.

Table 6
Summary of Agricultural Land Impacts and Estimated Productivity

Agricultural Suitability Classification	Area of Agricultural Land (ha)				Productivity		
	Existing	Project Life	Post-Mining	Net Change	Enterprise	Yield (t/ha)	Gross Margin ($/ha/year)
Project Site							
Class 3	210	0	210	0	Wheat	1.7 grain	285 (70% of time)
					Lucerne	4.0 DM	203 (30% of time)
Class 4	125	0	0	-125	Beef Cattle	2.0 DM	95
Biodiversity Offset Area							
Existing Agricultural Areas (Classes 4 and 5)	305	0	0	-305	Beef Cattle	2.0 DM	95

Source: McKenzie Soil Management Pty Ltd (2011) adjusted for area of agricultural land affected by offsets.

Note: DM = Dry Matter.

t = tonne

Based on the change in the area of agricultural land and the estimated productivities in Table 6, the present value of forgone agricultural production (in perpetuity) as a result of the Project is estimated at $0.8M.

Water Resources

As well as using the agricultural lands identified in Table 6, the Project would divert surface and groundwater resources of up to 290 ML per year (peaking in Year 16 and 17 of the Project) that could potentially be used for agricultural production. For the purposes of this assessment, this water has been assumed to be otherwise used for irrigated cotton production.

The NSW DPI (2010) farm budget for irrigated cotton suggests a requirement of 7 ML per ha of irrigated cotton. The maximum level of surface and groundwater diverted by the Project could therefore otherwise contribute to an estimated 41 ha of irrigated cotton per year with an output value of $207,000 per annum and gross margin of $102,000 per annum. Having regard to the estimated time profile of water diverted from agriculture, the present value of foregone agriculture (in perpetuity) of allocating this water to mining is $0.7M.

5.2 FLOW-ON EFFECTS

The regional flow-on effects of the maximum level of annual agricultural production forgone as a result of the Project (Section 5.1) were estimated from the sectors in the Gunnedah/Narrabri regional input-output table (Gillespie Economics, 2011) within which production is located i.e. cotton growing is included in the *other agriculture sector*, wheat production is included in the *grains sector* and beef enterprises in the *beef sector.*

Table 7 compares the annual regional production and economic impacts associated with the Project with the maximum level of annual agricultural production that would be forgone as a result of the Project (Section 5.1).

Table 7
Maximum Annual Regional Production/Economic Impacts
of the Forgone Agriculture and the Project

	Water	Agriculture Land	Project
Annual Water Usage (ML)	290[1]	-	-
Area (ha)	41	640[2]	557[3]
Production Type	Cotton	Rainfed crop production in rotation with improved pasture and beef cattle grazing	Coal
Production (t) or Bales (b)	373 b	See Table 6	3 Mtpa ROM Coal
Direct Output Value	$0.21M	$0.10M	$424M
Direct Income	$0.04M	$0.02M	$12M
Direct Employment	1.0	0.5	106
Direct and Indirect Output Value	$0.3M	$0.14M	$490M
Direct and Indirect Income	$0.06M	$0.04M	$27M
Direct and Indirect Employment	1.4	0.7	300

[1] This is the maximum annual volume of water diverted to the Project and only occurs in Years 16 and 17 of the Project.

[2] This is the maximum area of additional agricultural land (Agricultural Suitability Classes 3 and 4) that would be impacted by the Project. This area would reduce to 430 ha post-mining.

[3] Additional disturbance area associated with the Project.

The Project is estimated to provide considerable stimulus to the Gunnedah and Narrabri regional economy that is far in excess of the regional economic impacts associated with the maximum level of annual agricultural production that would be forgone as a result of the Project (Table 7).

The direct annual output of the Project (at 3 Mtpa of ROM coal production) is estimated at $424M. This is greater than the annual value of agriculture production in both the Gunnedah and Narrabri LGAs in 2006 (i.e. $386M) (Table 2). Conservatively, the annual agricultural production from the land and water resources that would potentially be impacted by the Project is $0.31M (Table 7).

The direct and indirect regional employment provided by the Project would be approximately 300 compared to approximately two agricultural-related jobs that would be forgone as a result of the Project impacts on agricultural land and use of Project water (Table 7).

This stimulus provided by the Project would continue for approximately 17 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 17 year period. The present value of net production benefits of the Project are estimated at $1,138M (Table 8) (Gillespie Economics, 2011)[4]. In contrast, the present value of future use of agricultural lands that would be utilised by the Project is estimated at $0.8M 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 $0.7M (Table 8).

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

Table 8
Net Production Benefits of Agricultural Resources Compared to the Project

	Water Resource (Cotton)	Land Resources (Wheat and Beef)	Project
Annual Net Production Benefits[1]	$0.07M	$0.10M	$195M
Net Production Benefits[1]	$0.7M	$0.8M	$1,138M

Source: Gillespie Economics (2011).

[1] Discounting is at 7%.

Based on the comparative values provided in Table 8, excluding consideration of externalities 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. Including all externalities (including the opportunity cost of agricultural production) the Project is estimated to have net benefits to Australia of $790M (Gillespie Economics, 2011) and therefore the Project is considered more efficient than the agricultural production that would be displaced.

6 CONCLUSION

In the Narrabri and Gunnedah LGAs:

- Extractive industries comprise less than 1% of the land area in the Narrabri and Gunnedah region while agriculture comprise 68% of the land area.
- The regional output value of existing coal production is comparable to agricultural production in the Narrabri and Gunnedah region.
- The annual output value of the Project would be greater than the output value of agriculture production in the Narrabri and Gunnedah region in 2006.
- Direct employment provided by the Project would be significantly higher than that provided by continued agricultural use of the land/water.
- 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 externality impacts, the Project is estimated to have net benefits to Australia of $790M.

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

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