Appendix 11 – Agricultural Impact Statement (SLR, 2017c)

Centennial Coal Company Limited
P O Box 1000
Toronto NSW 2283
www.centennialcoal.com.au

global environmental solutions

Agricultural Impact Statement

Mandalong Mine

LW24 – LW24A Modification

Report Number 630.11810

April 2017

Centennial Mandalong Pty Limited

Version: Final

Agricultural Impact Statement

Mandalong Mine

LW24 – LW24A Modification

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road New Lambton NSW 2305 Australia

(PO Box 447 New Lambton NSW 2305 Australia)
T: 61 2 4037 3200 F: 61 2 4037 3201
E: newcastleau@slrconsulting.com www.slrconsulting.com

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1 INTRODUCTION

Centennial Mandalong Pty Limited (Centennial Mandalong) is proposing to modify the Mandalong Mine development consent SSD-5144 to facilitate an extension to the approved first workings and secondary extraction area for Longwall Panel 24 and the development and extraction of Longwall Panel 24A (LW24 – LW24A) (the Project). Centennial Mandalong engaged SLR Consulting (SLR) to prepare an Agricultural Impact Statement (AIS) for the Project.

1.1 Project Overview

Mandalong Mine is an existing underground longwall coal mining operation producing thermal coal that is supplied to domestic and export markets. It is located approximately 35 kilometres south-west of Newcastle near Morisset in New South Wales. Mandalong Mine is 100 percent owned and operated by Centennial Mandalong Pty. Ltd (Centennial Mandalong), a subsidiary of Centennial Coal Company Ltd. Centennial Coal Company Limited is a wholly owned subsidiary of Banpu Public Company Ltd.

Mandalong Mine operates under development consent SSD-5144 which was granted on 12 October 2015 by the NSW Planning Assessment Commission under Part 4, Division 4.1 of the EP&A Act, and provided for extension of the mining area with a production limit of 6 million tonnes per annum of thermal coal from the West Wallarah and Wallarah-Great Northern Seams.

The currently approved Mandalong Mine comprises the underground workings and surface infrastructure of the following:

- The Mandalong Mine Access Site, encompassing underground workings and associated surface infrastructure near Morisset.

- Delivery of run-of-mine coal from the underground workings to the Cooranbong Entry Site. The Cooranbong Entry Site coal handling and processing facilities are approved under the Northern Coal Logistic Project (SSD-5145).

- Delivery of run-of-mine coal from the underground workings to the Delta Entry Site, located near Wyee at the Vales Point Rail Unloader Facility. The coal handling facility is approved under DA35-2-2004.

- Mandalong South Surface Site (MSSS), which is yet to be constructed, encompassing ventilation shafts, ventilation fans and underground delivery boreholes located approximately 6 kilometres south-west of the Mandalong Mine Access Site.

An igneous sill exists to the west of approved longwall panels 22 to 24 (LW22 – LW24). Due to historical uncertainty associated with the extent of the igneous sill, longwall panels 22 to 24 were shortened as a conservative measure to mitigate the sill's impact on the mine's production. In recent times through ongoing geological exploration and the successful extraction of adjacent longwall panels below the igneous sill, its extent and condition has become better understood. This has resulted in the proposed extension of LW24 and the addition of LW24A within the development consent boundary of SSD-5144.

Centennial Mandalong has prepared a Statement of Environmental Effects (SEE) to support an application seeking to modify development consent SSD-5144 under Part 4 of the EP&A Act (Mod 5). The modification is seeking to undertake the extended development of maingate 24 and extended secondary extraction of LW24, in addition to the development of maingate 24A and extraction of LW24A within the development consent boundary of SSD-5144.

The primary components of the Project are:

- Extension of LW24 from 1,631 metres to 2,570 metres. This yields 1,030,813 additional tonnes beyond 1,766,912 tonnes already approved.

- Addition of LW24A, which is proposed to be 2,470 metres in length which yields an additional 2,679,560 tonnes.

1.2 Legislative Framework

State Significant Development (SSD) consent SSD-5144 was granted on 12 October 2015 by the NSW Planning Assessment Commission under Part 4 Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Centennial Mandalong is now proposing to modify SSD 5144 for the Mandalong LW24 – LW24A Modification. SSD consents may be modified under Section 96 of the EP&A Act provided that the development as modified will be substantially the same development as the development for which consent was originally granted.

It is considered the proposed modifications to SSD-5144 development consent are substantially the same development as the development for which consent was originally granted, being an underground longwall coal mine. The proposed modification will provide additional coal resources given the improved understanding regarding the extent and condition associated with the igneous sill. As such, it is considered the development consent can be modified pursuant to Section 96(2) of the EP&A Act.

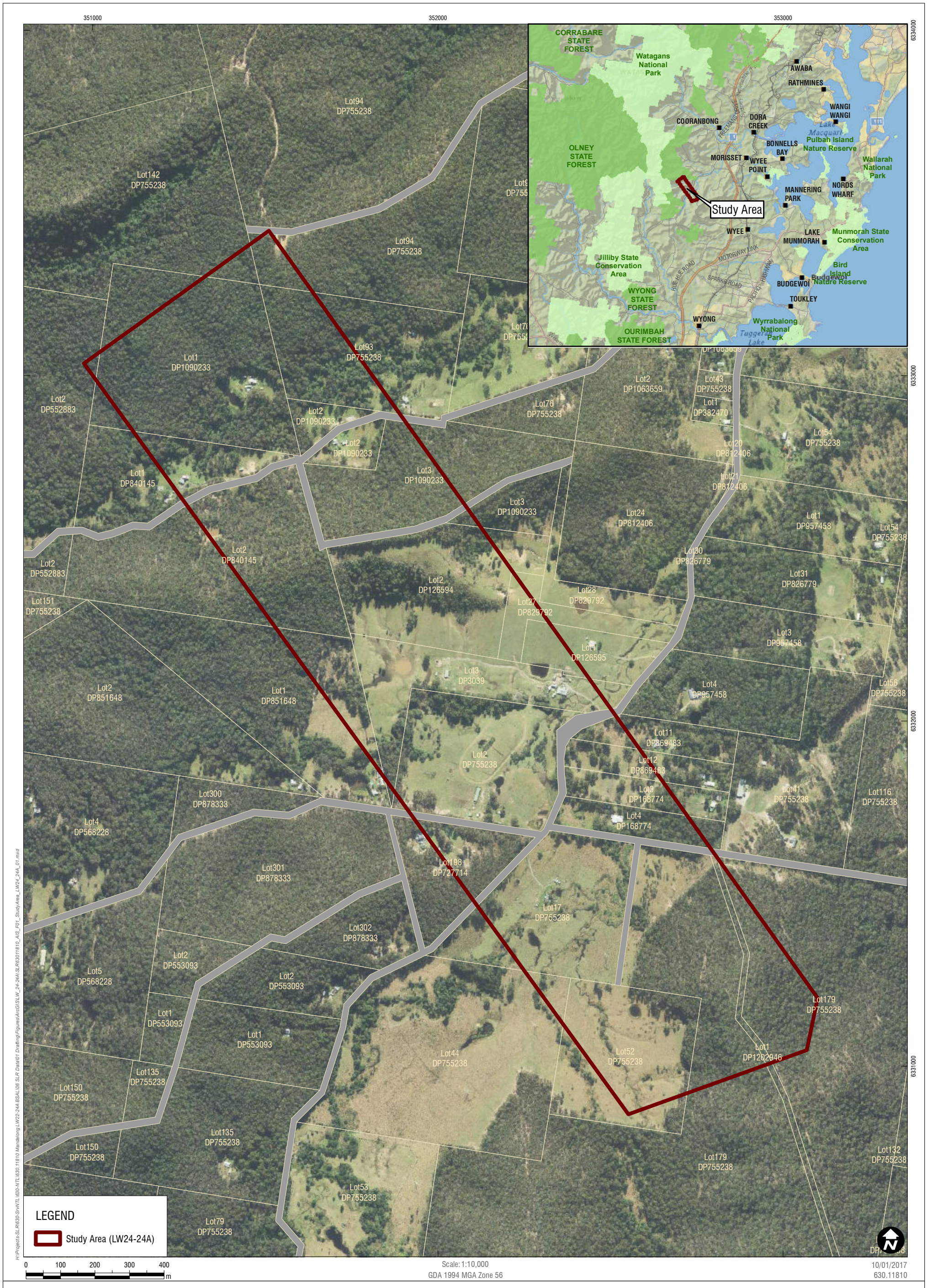
1.3 Study Area

The Study Area is shown on **Figure 1** which includes the limit of subsidence defined by the 26.5^0 angle of draw from the LW24 – LW24A voids. The proposed modification does not require any additional surface infrastructure. The Study Area encloses a total area of approximately 180 hectares, comprising both native vegetation and cleared grassland.

1.4 Purpose of this Report

This report has been prepared to address the *Strategic Regional Land Use Policy* (the Policy) (DP&I, 2012a). The Policy aims to assist the development of a long term strategy for continued progress of the mining industry that also ensures local community sustainability and on-going viability of existing agricultural industries. The Policy applies to areas within NSW where there is high value agricultural land and increasing activity in the coal and coal seam gas industries.

Part of this policy requires all state-significant mining development proposals, whether or not they are located on land mapped as strategic agricultural land (SAL), to prepare an AIS for consideration at the development application stage. The purpose of an AIS is to assess and report on the potential impacts of the Project on agricultural resources and/or industries within and surrounding the Study Area. The term ‘agricultural resource’ is used to describe the land on which agriculture is dependent and the associated water resources (quality and quantity) that are linked to that land.



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Study Area
LW24-24A

FIGURE 1

1.5 Structure of this Report

This AIS, in accordance with the *Strategic Agricultural Land Use Policy: Guideline for Agricultural Impact Statements* (DP&I, 2012b), addresses the information listed in **Table 1.**

Table 1 AIS Requirements

This AIS must include the following information	Section addressed:
Information Relating to the Site and Region	
Detailed assessment of the agricultural resources and agricultural production of the project area	
This section should include detailed information (including maps) on:	
• the soils, slope, land characteristics, water characteristics (availability, quality);	Section 2
• relevant history of the agricultural enterprises from within the project area and also surrounding land acquired as part of the development's buffer and/or offset zone.	Sections 2 & 3
For the project area this should include a description of:	
• any land identified as SAL in a Strategic Regional Land Use Plan on or within two kilometres of the project site;	Section 2
• the location and area of land to be temporarily removed from agriculture during operation of the project, and the period of time;	Section 4
• the location and area of land to be returned to agricultural use post-project, and its productive potential relative to pre-project;	Section 4
• the location and area of land that will not be returned to agriculture, including areas to be used for environmental plantings or biodiversity offsets;	Section 4
• the agricultural enterprises to be undertaken on any buffer and/or offset zone lands for the life of the project, comparison with enterprises undertaken prior to the project.	Section 4
Identification of the agricultural resources and current agricultural enterprises within the surrounding locality of the project area	
The AIS must contain maps/information for areas within the locality surrounding the project describing existing agricultural resources. This should include:	
• soil characteristics, including soil types and depth;	Section 2
• topography/slope;	
• key agricultural support infrastructure (e.g. roads, railways, processing facilities);	Section 3
• water resources and other water users' extraction locations;	Section 2
• location and type of agricultural industries;	Sections 2 & 3
• climate conditions.	Section 2
Describe the location and production levels of each commodity produced by all agricultural enterprises within the locality surrounding the project area.	Section 3
Assessment of Impacts	
Identification and assessment of the impacts of the project on agricultural resources or industries	
The AIS should identify any adverse impacts on agricultural resources and production on the site and in the local area during the operation and post-operation phases of the project. The AIS should include a risk-based assessment (guided by the DGRs) of:	
• the effects of the project on agricultural resources;	Section 4
• consequential productivity effects of this on agricultural enterprises, including productivity impacts of any water moved away from agriculture and any water quality issues as they affect agriculture (this should extend to farm productivity, land values and flow on impacts to regional communities and environment);	
• uncertainty associated with the predicted impacts and mitigation measures and the consequences of and likelihood that these uncertainties will be realised;	
• further risks such as weed management, biosecurity, subsidence, dust, noise, vibration and traffic conditions. The AIS should also consider other aspects, e.g. proposed biodiversity offsets that may result in the loss or dislocation of agricultural resources/industries).	

This AIS must include the following information	Section addressed:
If the project site is located on or within two kilometres of any land identified as SAL in a Strategic Regional Land Use Plan, the AIS must specifically address the potential impacts of the project on the relevant SAL. This should include a consideration of the relevant Gateway criteria which include matters such as:	
• surface area disturbance, subsidence and soils;	Section 4
• salinity, soil pH and groundwater;	
• access to agricultural resources and infrastructure; and	
• agricultural scenic and landscape values.	
Account for any physical movement of water away from agriculture	
Any water that is transferred or will no longer be available for agricultural use as a result of the proposal should be identified and fully accounted for.	Section 4
The potential impacts of the development on water resources should be assessed against the minimal impact considerations, consistent with the requirements of the Aquifer Interference Policy.	
All predicted impacts should be based on robust modelling.	
Assessment of socio-economic impacts	
The AIS should include an assessment of the impacts on agricultural support services, processing and value adding industries and regional employment.	Section 4
The socio-economic impact assessment must detail agricultural support services and value adding industries relevant to affected agricultural enterprises including potential impacts on local and regional employment.	
The socio-economic impact assessment must also address any potential impact on visual amenity, landscape values and tourism infrastructure relied upon by agricultural enterprises.	
Mitigation Measures	
Identification of options for minimising adverse impacts on agricultural resources, including agricultural lands, enterprises and infrastructure at the local and regional level	
The AIS should document feasible options to avoid, minimise or mitigate potential impacts on agricultural resources including:	
• project design review/alternatives;	Section 5
• proposed monitoring programs to assess predicted versus actual impacts;	
• trigger response plans and trigger points at which operations will cease or be modified or remedial actions will occur to address impacts including unforeseen impacts;	
• the proposed remedial action to be taken in response to a trigger event;	
• the basis for assumptions made about the extent to which remedial actions will address and respond to impacts;	
• demonstrated capacity for the rehabilitation of disturbed lands to achieve the final land use and restore natural resources;	
• demonstrated planning for progressive rehabilitation minimising extent of disturbances.	
Consultation	
Document consultation with adjoining landusers and Government Departments	
An AIS should include details of an engagement strategy including:	
• consultation undertaken to date, including consultation undertaken at the EL stage;	Section 6
• consultation with relevant government agencies;	
• consultation with impacted landholders and community groups;	
• the issues identified and measures to address these issues;	
• the outcomes of the consultation;	
• any commitments for further consultation.	

1.6 Methodology

The AIS was completed using the following methodology:

- A desktop review of all publicly available information relating to the Project.
- Field visit and inspection of the Study Area and surrounding locality in September 2016 by SLR's Senior Agronomist, Murray Fraser.
- Description of the biophysical environment for the Study Area and surrounding locality.
- A review of specialist impact assessments prepared for the Project.
- Assessment of potential impacts on agricultural resources and industry, including mitigation measures for any identified impacts.
- Provision of Centennial Mandalong's demonstrated capacity for rehabilitation.

2 AGRICULTURAL AND WATER RESOURCES

2.1 Climate

A continuous daily rainfall dataset was obtained as SILO Patched Point Data, which is based on historical data from a particular Bureau of Meteorology (BOM) station with missing data 'patched' in from interpolations from nearby stations. SILO data was obtained for the BOM Cooranbong (Avondale) Station (station number 61012) which is located approximately 10 kilometres to the north-east of the Study Area. Daily rainfall records from January 1889 to December 2014 were utilised. The average annual rainfall for the area was 1,123 millimetres, with a range from 531 millimetres to 1,994 millimetres.

The BOM classifies the Study Area as being located in a temperate climate zone with no designated wet season, although the area can be susceptible to occasional heavy showers and thunderstorms due to easterly troughs during warmer months. Summer winds are generally from the south or south-east, with a tendency for afternoon north-easterly winds. During winter, winds are predominantly from the south or south-west.

2.2 Topography

The Study Area is typified by relatively flat, low lying areas surrounded by densely timbered ridgelines. Elevations on these ridgelines reach up to 100 metres Australian Height Datum (AHD). The small areas of relatively flat land adjacent to these ridgelines has generally been cleared and is used for small scale rural production, as shown in **Figure 2**. The flats are relatively low lying with surface elevations generally less than 30 metres AHD. The slope analysis (**Figure 3**) further highlights the low lying flats, in green, which have been cleared for grazing.

2.3 Hydrology

2.3.1 Surface Water

The Study Area is located in the upper reaches of the Mandalong Valley Floodplain and has four main drainage channels flowing through it (**Figure 2**) which form part of the Lake Macquarie catchment. These drainage channels and the properties they flow through are shown in **Table 2**.

Table 2 Drainage Channels

Channel Name	Flow Direction	Associated Properties
Tobins Creek	North-Easterly	Lot 1 DP840145, Lot 2 DP1090233, Lot 93 DP755238
Morans Creek	Northerly	Lot 3 DP3039, Lot 17 DP755238, Lot 179 DP755238, Lot 2 DP755238
Morans Creek Tributary	Easterly	Lot 2 DP755238, Lot 3 DP3039, Lot 1 DP851648,
Morans Creek Tributary	Northerly	Lot 17 DP755238, Lot 52 DP755238

Source: *Centennial Mandalong Flood Assessment Longwalls 24 to 24A* (Umwelt, 2017)

In addition to these drainage channels there a numerous small farm dams which have been constructed both as flood mitigation measures and stock water sources.

All drainage channels within the Study Area are considered intermittent watercourses with limited or zero flow during low rainfall periods, suggesting that the number of users dependent on flows from these watercourses is limited.

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Topography and Hydrology
LW24-24A

FIGURE 2

351000
352000
353000
6333000
6332000
6331000

LEGEND

Study Area (LW24-24A)

SlopeCode

- < 3%
- 3 - 5%
- 5 - 10%
- 10 - 18%
- 18 - 32%
- 32 - 50%
- > 50%

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

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Slope Analysis
LW24-24A

FIGURE 3

2.3.2 Groundwater

The *Water Resources Impact Assessment* (GHD, 2017) found the groundwater sources within the Study Area are predominantly within the Quaternary alluvium, weathered and/or fractured sandstone and coal seams. Due to the relatively high silt and clay content of the alluvium, the groundwater sources are generally low yielding and are classified as 'less productive' according to the NSW Office of Water (NOW) *NSW Aquifer Interference Policy* (NOW, 2012), as the yields are generally less than 5 litres per second and/or the total dissolved solids concentration is typically greater than 1,500 milligrams per litre.

2.3.3 Licenced Surface Water Users

Due to the ephemeral nature of Morans Creek and Tobins Creek, the dependence of downstream water users on flows within these watercourses is expected to be very limited. GHD (2017) conducted a search of the NSW Water Register for surface water licences within a 5 kilometre radius of the Study Area. No surface water extraction licences were found within the Study Area.

Surface water licences were found for extraction from the Dora Creek water source of the Hunter Unregulated and Alluvial Water Sources Water Sharing Plan and the Jilliby Jilliby Creek Water Source Water Sharing Plan. The designated use or purpose of these licences includes irrigation, farming and industrial. No approvals for basic landholder rights were identified from GHD's search of the NSW Water Register.

2.3.4 Licenced Groundwater Users

GHD's (2017) search of the NSW Water Register for groundwater licences within a 5 kilometre radius of the Study Area found 59 registered stock, irrigation, farming and domestic users, as shown in **Table 3**. There are two registered bores within the Study Area (GW105311 and GW078043) with Centennial Mandalong confirming neither of these bores are in use.

Table 3 Licenced Groundwater Users

Bore Number	Depth (m)	Licence Status	Use
GW015275	4.5	Active	Stock, irrigation, domestic
GW015287	44.1	Active	Stock, irrigation
GW021578	3.6	Active	Stock, domestic
GW029567	3.0	Active	Stock, irrigation, domestic, farming
GW033618	30.4	Active	Stock
GW033619	21.3	Active	Stock
GW034950	76.2	Active	Stock, domestic
GW043431	38.1	Active	Stock
GW044189	3.6	Active	Stock, domestic
GW048538	26	Active	Domestic
GW050694	30	Active	Stock, domestic
GW050982	24.4	Active	Domestic
GW051320	46	Active	Stock, domestic
GW051321	46	Active	Stock, domestic
GW051322	53	Active	Stock, domestic
GW051542	38	Active	Stock, domestic
GW051560	33	Active	Stock, farming
GW051778	41	Active	Stock, domestic
GW052111	49	Active	Stock

Bore Number	Depth (m)	Licence Status	Use
GW052255	114	Active	Stock
GW052374	38	Active	Stock, domestic
GW053438	53	Lapsed	Stock, irrigation, domestic
GW054183	18.3	Active	Domestic
GW056461	23	Active	Stock, domestic
GW056862	45	Active	Stock, domestic
GW057310	61	Active	Stock, domestic, farming
GW059558	5	Active	Stock, domestic, farming
GW060965	33.6	Active	Stock, domestic
GW061202	50.3	Active	Stock, domestic
GW061226	117.3	Active	Stock, domestic
GW062618	34.5	Active	Domestic
GW064033	49.4	Active	Stock, domestic
GW064116	21.3	Active	Stock, domestic
GW064143	24.3	Active	Stock, domestic
GW064662	24	Active	Domestic
GW067263	10	Active	Stock, domestic
GW078043	33	Active	Stock, domestic
GW078060	28	Active	Domestic
GW078084	62	Active	Stock, domestic
GW078094	30.4	Active	Stock, domestic
GW078214	36	Active	Stock, domestic
GW078220	23	Active	Stock, domestic
GW078390	3	Active	Domestic
GW078601	18.85	Active	Stock, domestic
GW078608	60	Active	Stock, domestic
GW078609	70	Active	Stock, domestic
GW078610	316.2	Active	Stock, domestic
GW080372	75	Active	Stock, domestic
GW080394	42	Active	Stock, domestic
GW080608	48	Active	Stock, domestic
GW105311	198	Abandoned	Stock, domestic
GW200210	4.5	Active	Domestic
GW200505	54	Active	Stock, domestic
GW200509	100	Active	Stock, domestic
GW200765	8	Active	Domestic
GW200915	60	Active	Stock, domestic
GW200938	36	Active	Stock, domestic
GW201578	3.6	Active	Stock, domestic
GW202180	30	Active	Stock, domestic

2.4 Geology

The Study Area is located in the south-western part of the Newcastle Coalfield, which occupies the north-eastern portion of the Sydney Basin. The coal seams found here are the Wallarah and the Great Northern, which together form the upper part of the Permian Newcastle Coal Measures.

Above the Wallarah and Great Northern Seams lies the Narrabeen Group, which are comprised of variable sequences of interbedded claystones, siltstones and fine to coarse-grained sandstones. The Munmorah Conglomerate is a sandstone-dominated formation within the Narrabeen Group, which typically occurs between 60 metres and 140 metres above the Newcastle Coal Measures.

2.5 Soil Landscape Units

The Soil Landscapes Units within the Study Area have been mapped by the former NSW Department of Land and Water Conservation, incorporating the NSW Soil Conservation Service (now part of NSW Department of Primary Industries (DPI)), on the *Soil Landscapes of the Gosford – Lake Macquarie Sheet 1:100 000 Sheet* (Murphy, 1993) shown in **Figure 4**. Four soil landscapes occur in the Study Area and are summarised in **Table 4**.

Below is a summary of the key agricultural features of each Soil Landscape Unit:

- The majority of the Study Area (74%) is highly to severely constrained for cultivation.
- The Mandalong Soil Landscape Unit is highly to severely constrained for any agricultural enterprises, which covers 29% of the Study Area.
- Agricultural land best suited to grazing enterprises includes the Gorokan, Yarramalong and Wyong Soil Landscape Units, which covers 71% of the Study Area.
- Agricultural land suited to both cultivation and grazing enterprises is associated with the Yarramalong and Wyong Soil Landscape Units, which covers 26% of the Study Area. It should be noted that localised areas within the Yarramalong and Wyong Soil Landscape Units have high to severe limitations for cultivation due to waterlogging.
- The land area associated with the Yarramalong Soil Landscape Unit has previously been mapped as Biophysical Strategic Agricultural Land.

Table 4 Soil Landscape Units

Soil Landscape	Study Area		Agricultural Limitation Rating	
Unit	**Hectares**	**%**	**Grazing**	**Cultivation**
Mandalong	53	29	High – Severe	High – Severe
Gorokan	81	45	Low	High – Severe
Yarramalong	46	26	Low	Low (High – Severe*)
Wyong	<1	<1	Low – Moderate	Low (High – Severe*)
Total	**180**	**100**	**for localised waterlogged and floodplain areas*	

351000
352000
353000
6333000
6332000
6331000

LEGEND

Study Area (LW24-24A)

Soil Landscapes

GOROKAN

MANDALONG

WYONG

YARRAMALONG

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

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Soil Landscape Units
LW24-24A

FIGURE 4

2.6 Dominant Soil Types and Inherent Fertility

The dominant soil types with the Study Area were ground-truthed by SLR at the scale of approximately 1:20,000 and determined using the Australian Soil Classification (ASC) System (Isbell, 2002). This assessment consists of 10 detailed laboratory assessed soil profiles. Full soil profile descriptions are presented in **Appendix A**. The key assessment points are listed below.

- Three major soil orders are present in the Study Area, Kurosols, Sodosols and Dermosols (**Table 5**)

- Kurosols are soils with a strong texture contrast between the A horizon and strongly acidic B horizons. Many Kurosols have unusual subsoil chemical attributes such as high magnesium, sodium and aluminium. The Brown Kurosol comprises 4% of the Study Area

- Sodosols are soils that have a strong texture contrast between the topsoil and subsoil horizons and contain sodic subsoil. The Brown Sodosol comprises 54% of the Study Area.

- Dermosols are soils with structured B2 horizons and lacking strong texture contrast between the A and B horizons. The Brown Dermosol comprises 75% of the Study Area.

- Kurosols range from moderately low to moderate inherent fertility, depending on ASC Great Group classification, with a Magnesic Kurosol (moderately low) occurring within the Study Area. The Dermosol is classed as having moderately high inherent fertility whilst the Sodosol has moderately low inherent fertility (Office of Environment & Heritage (OEH), 2012).

Table 5 Dominant Soil Types and Inherent Fertility

Australian Soil Classification	Inherent Fertility	Hectares	%
Brown Kurosol	Moderately Low	8	4
Brown Sodosol	Moderately Low	97	54
Brown Dermosol	Moderately High	75	42
	Total	**180**	**100**

2.7 Acid Sulfate Soils

The likelihood of acid sulfate soils occurring within the Study Area is very low due to its position away from the coast and potential acid sulfate landform type. This is supported by the Lake Macquarie City Council (2012a) Local Government acid sulfate soil maps. Furthermore, none of the Soil Landscape Units mapped within the Study Area have acid sulfate soil potential.

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352000
353000
6333000
6332000
6331000

5
3
2
4
M4
M5
10
8
9
M6

LEGEND

October Field Points
June Field Points
Study Area (LW24-24A)

Soil Types

Dermosol
Sodosol
Kurosol

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

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Soil Units
LW24 - 24A

FIGURE 5

2.8 Vegetation and Land Use

Review of recent aerial images shows that the majority of the Study Area remains under native vegetation (approximately 62%), as shown in **Figure 2**. The remainder is land that has been previously cleared and may be suitable for agricultural enterprises. A site inspection in September 2016 by SLR's Senior Agronomist, in conjunction with a desktop assessment, has shown that small scale cattle and horse grazing of native grass species such as kangaroo grass (*Themeda australis*), Poa tussock (*Poa labillardierei*) and red grass (*Bothriochloa* spp.) is the dominant agricultural enterprise. In addition, there are isolated areas where cattle graze improved pasture, with the pasture dominated by kikuyu grass (*Pennisetum clandestinum*|). No intensive cropping activities were observed at the time of the inspection and assessment.

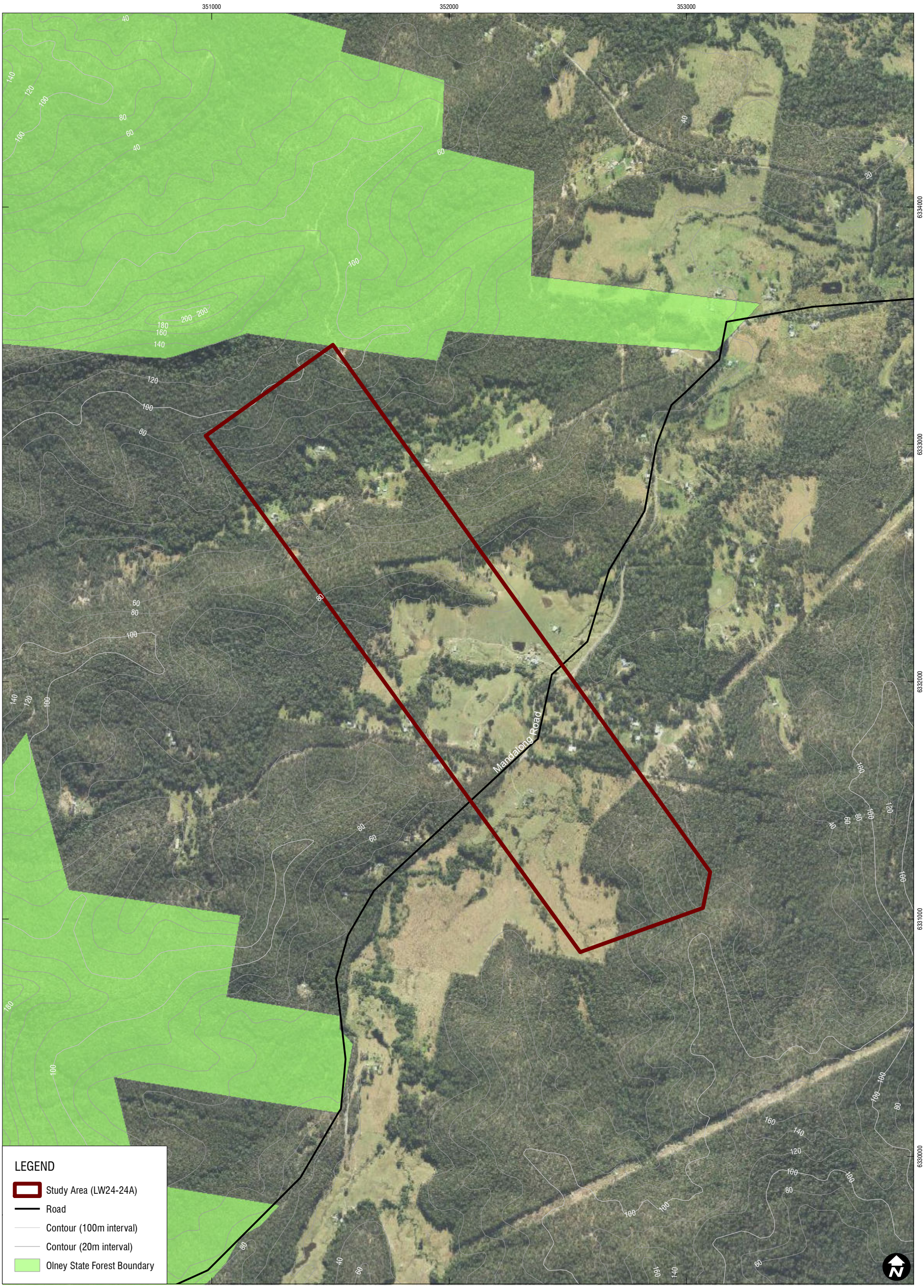
Grazing within the Study Area appears to be commonly used as a grass and vegetation management tool rather than an income generating agricultural enterprise. Overall farm size is considered small and many would be classified as hobby farms with a very low potential to produce significant agricultural income. Approximately 69 hectares of potential grazing land is currently available for agricultural use.

The Study Area is adjacent to the Olney State Forest in the north-east (**Figure 6**).

Plate 1 Cattle grazing grass pasture on a cleared flat at Site M5

Plate 2 Eucalypt wooded area on a steep slope east of Site M5

Plate 3 Eucalypt wooded area on a plateau at Site 5



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State Forest Areas
LW24 24A

FIGURE 6

2.9 Land and Soil Capability Classification

In NSW, the Rural Land Capability System developed by the former NSW Soil Conservation Service, which has been widely used to evaluate agricultural potential of land, has now been replaced by *The Land and Soil Capability Assessment Scheme: Second Approximation* (Office of Environment and Heritage (OEH), 2013a).

Full details regarding the Land and Soil Capability (LSC) assessment are provided in the Project's *Soil and Land Resource Assessment* (SLR, 2016a). The LSC Assessment for the Study Area is summarised in **Table 6** and shown in **Figure 7**. The major assessment points are listed below.

The three dominant LSC Classes present in the Study Area are Classes 5, 6 and 7, comprising 75 hectares, 53 hectares and 52 hectares, respectively, as shown in **Figure 7**. The limitations associated with each LSC Class are discussed below and the land area of each LSC Class is shown in **Table 7**.

Table 6 Land and Soil Capability Areas

LSC Class	Agricultural Capability Rating	Hectares	%
5	Moderately Low	75	42
6	Low	53	29
7	Very Low	52	29
	Total	**180**	**100**

LSC Class 5 Land

Class 5 land is represented by a Brown Sodosol. This classification indicates a moderate to low land capability, with severe limitations to high impact land management uses such as cropping. This land is generally more suitable for grazing with some limitations, or very occasional cultivation for pasture establishment. The limiting factor for LSC Class 5 within the Study Area is slope with sodic subsoil. It covers the major portion of the Study Area (42%).

LSC Class 6 Land

Class 6 land is represented by a Brown Dermosol. This classification indicates Low capability land with very high limitations for high-impact land uses. Careful management of limitations is required to prevent severe land and environmental degradation. It is considered capable for a limited set of low impact land uses such as grazing, forestry, nature conservation and some horticulture. The limiting factor for LSC Class 6 land within the Study Area is waterlogging. It comprises 29% of the Study Area.

LSC Class 7 Land

Class 7 land is represented by a Brown Sodosol. This classification indicates very low capability land, with extremely severe limitations for most land uses. It is generally unsuitable for any type of cropping or grazing due to its limitations. The limiting factor for 9% of LSC Class 7 within the Study Area is shallow soil, whilst steep slope is the limiting factor for 20% of the Study Area. Overall LSC Class 7 covers 29% of the Study Area.

Within the Study Area, 58% of the land area is considered to have low to very low agricultural capability according to definitions given in *The Land and Soil Capability Assessment Scheme: Second Approximation* (OEH, 2013a), whilst the remainder has a moderately low agricultural capability.

2.10 Biophysical Strategic Agricultural Land Assessment

The Project's *Biophysical Strategic Agricultural Land Assessment* (SLR, 2016b) found there is no BSAL within the Study Area according to the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH, 2013b).

Limiting factors for BSAL were:

- The Kurosol failed BSAL **Criteria 7** (low fertility), **9** (poor drainage), **10** (pH < 4.5 CaCl2) and **12** (estimated rooting depth to a chemical barrier < 750 millimetres).
- The Sodosol failed **BSAL Criteria 7** (low fertility), **9** (poor drainage), **10** (pH < 4.5 CaCl2) and **12** (estimated rooting depth to a chemical barrier < 750 millimetres).
- The Dermosol failed BSAL **Criteria 9** (poor drainage) **10** (pH < 4.5 CaCl2) and **12** (estimated rooting depth to a chemical barrier < 750 millimetres).
- Nine of ten sites which underwent laboratory analysis failed **BSAL Criteria 10**, with pH in CaCl2 being less than 4.5
- Eight of ten sites which underwent laboratory analysis failed **BSAL Criteria 12**, with either exchangeable sodium percentage being greater than 15 and/or having a calcium to magnesium ratio of less than 0.1.

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LEGEND

Study Area (LW24-24A)

LSC Class and Limiting Factor

LSC 5 - Sodic and Slope

LSC 6 - Waterlogging

LSC 7 - Shallow Soil and Steep Slope

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

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Land and Soil Capability
LW24 - 24A

FIGURE 7

3 LOCAL AND REGIONAL AGRICULTURAL ENTERPRISES

3.1 Regional Agricultural History

The Mandalong locality was settled in the mid 1850's, with farming and timber cutting being the mainstays of employment. Farming consisted of cattle and sheep grazing and some crop growing. In the late 1800's the timber industry declined and the poor soil could not sustain farming on a commercial scale. Mandalong is now regaining popularity as a hobby farming area (Lake Macquarie City Council, 2012b).

Within the Study Area, agricultural enterprises have traditionally been small farm enterprises conducted in pockets of cleared native bushland, reliant upon off-farm income to be sustainable. Cattle grazing, pleasure horse agistment and small orchard areas are the main agricultural activities in the area.

3.2 Agricultural Enterprises and Associated Industries

3.2.1 Regional Land Use

The agriculture land uses for the Lake Macquarie LGA were taken from the Australian Bureau of Statistics (ABS) Census Data (2011) and is displayed in **Table 7**. The major points are summarised below.

- Agriculture is a minor land use for the regional area, accounting for 6% of land use.
- Agricultural land is almost exclusively used for grazing, utilising more than 99% of all agricultural land. The primary enterprise is meat cattle farming, which accounts for 70% of livestock numbers, followed by milk cattle (30%). There is no sheep or pig farming present in the LGA.
- Cropping enterprises comprise a very minor portion of agricultural activities. The primary crops grown are vegetables, fruit and other non-cereal crops. No cereals for grains are grown in the region.
- Minimal irrigation cropping is carried out with agriculture only a minor water user in the Lake Macquarie LGA, with 325 ML used for irrigation and an additional 179 ML utilised for other agricultural purposes, such as poultry and egg production.

Table 7 Lake Macquarie LGA Agricultural Land Use

Classification	Units	Lake Macquarie LGA
Agricultural Land Area		
Total land area within LGA	Hectares	64,020
Area of agricultural land	Hectares	3,763
Proportion of agricultural land	%	6
Agricultural Enterprise		
Land under cropping activities	Hectares	18
Land under grazing activities	Hectares	3745
Proportion of agricultural land used for grazing	%	>99
Grazing Enterprises		
Sheep, lambs and pigs	Number	0
Meat cattle	Number	776
Milk cattle (excluding house cows)	Number	328
Total	Number	1,104

Classification	Units	Lake Macquarie LGA
Cropping Enterprises		
Cereals for grain	Hectares	0
Vegetables for human consumption	Hectares	6.6
Orchard trees (including nuts)	Hectares	5.5
All fruit (excluding grapes)	Hectares	6.1
Total land cropped	Hectares	18.2
Irrigation		
Irrigation volume applied	Megalitres	325
Other agricultural uses	Megalitres	179
Total water use	Megalitres	504

3.2.2 Regional Employment

Agriculture is a very minor employer in the Lake Macquarie LGA, according to the ABS Census Data (2011), there were 83,592 persons employed in the Lake Macquarie LGA, with agriculture accounting for only 0.3% of this total (2,508 people).

The majority of persons employed in agriculture work in poultry farming and processing, horse farming, vegetable production and floriculture production.

3.3 Regional Agricultural Production Value

Agricultural production values for the Lake Macquarie LGA (ABS, 2011) totals $27.3 million per annum, as presented in **Table 8**. The main agricultural production by value is from nurseries and cut flowers, along with poultry (meat and eggs).

Table 8 Regional Agricultural Production

Agricultural Production Gross Value	Total (million)
Nurseries and cut flowers	$11.2
Livestock slaughtering	$2.4
Livestock products (including eggs)	$13.7
Total gross agricultural production	**$27.3**

3.4 Potential Agricultural Production Value of the Study Area

Potential agricultural productivity was determined using Department of Primary Industries (DPI) agricultural gross margin productivity data for agricultural enterprises suitable for each of the LSC classes (see **Section 2.9**) that are present within the Study Area. This analysis has been undertaken on the potential capability of the land rather than current land use. If potential agricultural production values were to be pursued, significant investment in land management and agricultural infrastructure would be required. However this information can be used to approximate potential farm incomes.

The *Beef Cattle Gross Margin Budget Yearling Southern/Central NSW* (DPI, 2012) has been applied to this assessment to determine potential agricultural income for the Study Area. The *NSW Department of Primary Industries Beef Stocking Rates & Farm Size* (DPI, 2006) was used to determine stocking rates in Dry Sheep Equivalents for the three LSC's found within the Study Area. Full agricultural gross margin information is contained in **Appendix B**.

Table 9 summarises the potential gross margins for each applicable agricultural enterprise per LSC Class. The major points are listed below.

- Class 5 land has the potential to generate approximately $109 per hectare from beef cattle grazing enterprises (yearling beef production).
- Class 6 land has the potential to generate approximately $82 per hectare from beef cattle grazing enterprises (yearling beef production).
- Class 7 land has the potential to generate approximately $54 per hectare from beef cattle grazing enterprises (yearling beef production).

Table 9 Gross Margin per LSC Class

LSC	Carrying Capacity	Cow and Calf Equivalent	Revenue	Variable Costs	Gross Margin
Class	**Dry Sheep Equivalent**	**Per Hectare**	**Per Hectare**	**Per Hectare**	**Per Hectare**
5	4	0.24	$135	$26	$109
6	3	0.16	$101	$19	$82
7	2	0.12	$67	$13	$54

Based on the nominated gross margins, and assuming the required agricultural capital costs and fixed costs are outlaid (not included in the calculations in **Table 9**, the Study Area has the capacity to generate an estimated gross margin of $14,729 per annum (see **Table 10**). It is important to note that these figures are derived from the optimum potential uses and are likely to be much higher than the actual incomes being achieved from the area under actual production.

Table 10 Annual Gross Margins per LSC Class

LSC	Gross Margin	Study Area	
Class	**Per Hectare**	**Hectares**	**Gross Margin**
5	$109	75	$8,175
6	$82	53	$4,346
7	$54	52	$2,808
	Total	**180**	**$15,329**

It is expected that income generated from agricultural enterprises within the Study Area would be minimal due to the small area (69 hectares) available for actual agricultural production (**Figure 8**). The majority of this cleared area is LSC Class 6 and using the gross margin information presented in **Table 9**, this area has a potential gross margin of $5,658 per annum.

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Study Area (LW24-24A)
Potential Grazing Area

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

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Potential Grazing Area
LW24 - 24A

FIGURE 8

3.5 Agricultural Support Infrastructure

Agricultural support infrastructure within the Lake Macquarie LGA includes the Sydney-Newcastle M1 Motorway as the major arterial road, and rail infrastructure providing transport from agricultural areas in the west and north of the state.

The main purpose-built agricultural support infrastructure is a number of large poultry sheds, which are used for raising meat chickens and egg production. There are a number of small retail agricultural suppliers that service the numerous hobby farms in the region. Outside of this, there is little formal infrastructure for the support of agricultural industries in the Lake Macquarie LGA.

Poultry processing is conducted outside the Lake Macquarie LGA. The Inghams Enterprises poultry processing facility (abattoir) is located at Mangrove Mountain in the Gosford LGA, while other poultry processors are located at in the Newcastle LGA (Baiada Poultry), Cessnock LGA (Valley Feeds) and Blacktown LGA (Red Lea).

4 ASSESSMENT OF POTENTIAL IMPACTS

The primary potential impact to agricultural resources is from subsidence. Seedsman Geotechnics (2016) predicts maximum vertical subsidence over LW24 and LW24A to be 960 millimetres. Given these levels of predicted subsidence, no cracking at the surface is anticipated in either rocks or soils, as has been the case with previous underground mining at Mandalong Mine (Seedsman Geotechnics, 2016)

4.1 Land Resources

4.1.1 Land Temporarily Removed From Agriculture

Remnant ponding as a result of longwall subsidence will temporarily remove approximately 0.25 hectare (0.001% of the Study Area) of land from potential cattle grazing (**Figure 9**) (Umwelt, 2017). Properties impacted by remnant ponding are shown in **Table 11**.

Table 11 Remnant Ponding

Property	Impacted Feature	Mitigation Measure
Lot 11 DP869483	Paddock	Drainage Works
Lot 2 DP755238	Trotting Track	Drainage Works
Lot 4 DP168774, Lot 3 DP168774	Paddock and Channel	Drainage Works

As LSC Class 5 is the most productive agricultural land within the Study Area, it is assumed all land impacted by remnant ponding is LSC Class 5. Using potential agricultural productivity information described in **Section 3.4**, the estimated economic impact on potential agricultural productivity as a result of ponding is $27 over a 12 month period. When compared to the gross annual value of agricultural production for the Lake Macquarie LGA ($27.3 million), this temporary impact is on agricultural enterprises and associated industry is considered negligible.

4.1.2 Land Permanently Removed From Agriculture

There is no land which will be permanently removed from agriculture as a result of the Project.

4.1.3 Acid Sulfate Soils

As outlined in **Section 2.7** there are no Soil Landscape Units associated with the Study Area with acid sulfate potential. The Project will not impact upon Acid Sulfate Soils.

4.1.4 Impact on Biophysical Strategic Agricultural Land

There is no Biophysical Strategic Agricultural Land within the Study Area (SLR, 2016b). The Project will not impact any Biophysical Strategic Agricultural Land.

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LEGEND

Study Area (LW24-24A)

Approved Mod 4 Remnant Ponding

Proposed Mod 5 Remnant Ponding

0 100 200 300 400 m

Scale: 1:10,000
GDA 1994 MGA Zone 56

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Potential Remnant Ponding
LW24 - 24A

FIGURE 9

4.2 Water Resources

4.2.1 Surface Water

The existing drainage channels within the Study Area have already experienced scouring of watercourse beds and banks due to construction of features such as road bridges and culverts which have resulted in impacts on water quality (turbidity). Umwelt (2017) found that the predicted levels of subsidence are not expected to significantly alter the flow conveyance capacity of the drainage channels within the Study Area. The potential to increase erosion of the landform is also expected to be minimal due to the limited amount of exposed soils, high levels of groundcover and relatively low flood velocities. Modelling indicated no significant difference in the maximum flow velocities between pre-mining and subsided landforms.

There are no expected measurable impacts to surface water quantity or quality within or downstream of the Study Area (GHD, 2017). Adverse impacts to downstream water users are unlikely, due to the low risk of potential impacts and the ephemeral nature of waterways.

Given the predictions by Umwelt (2017) and GHD (2017), and the fact that all drainage channels within the Study Area are considered intermittent watercourses with limited dependence by users, impact on surface water resources relied upon by agriculture will be negligible

4.2.2 Groundwater

Of the bores identified within a 5 kilometre radius, only GW078601, GW054183, GW078043 and GW105311 are located within 2 kilometres of LW24 – LW24A, which is the extent of the 2 metre drawdown contour. It is not anticipated that aquifer depressurisation will exceed 2 metres at these locations, noting that bores GW105311 and GW078043 are not in use.

GHD (2017) states that is unlikely there will be any reduction in the beneficial use category of fractured and porous rock groundwater as a result of the Project. The predicted impacts on fractured and porous rock groundwater sources are less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy. Therefore the Project will have negligible impact on groundwater resources relied upon by agriculture.

4.2.3 Water Reallocation

Mandalong Mine currently holds a water extraction licence for 365 ML for mine dewatering, however this water would not be considered as being taken from potential agricultural use as the water is not considered suitable for general agricultural production. Mine dewatering occurs in the porous and fractured rock groundwater sources with typical EC readings from 6,000 µS/cm to over 10,000 µS/cm (GHD, 2017) which according to *Measuring Water Salinity* (I&I, 2009) is well above the desirable limit for healthy growth in cattle and horses, and suitable only for crops with a very high tolerance to saline water.

Centennial Mandalong does not intend to purchase any further surface or groundwater licences for the Project. There will be no impact on agricultural users through water reallocation.

4.2.4 Water Resource Impacts on Agricultural Productivity

Given the very limited impacts described previously, longwall subsidence will result in negligible impacts on water resources relied upon by agricultural enterprises and will not result in any impact on agricultural productivity.

4.3 Impact on Agricultural Resources from Biodiversity Offsets

The Project is not expected to result in the establishment of any biodiversity offsets, therefore there will be no impact to agricultural resources resulting from biodiversity offsets.

4.4 Other Impacts

4.4.1 Visual Amenity and Landscape Values

The Study Area lies within a landscape context of sloping ridgeline formations with moderate to dense tree cover and a high visual absorption capacity. Field inspection by SLR's Senior Agronomist did not identify any agricultural enterprises which were reliant upon visual amenity or landscape values as components of their operations. On this basis, the Project is considered to have negligible impact on visual amenity and landscape values relied upon by local and regional agricultural enterprises.

4.4.2 Tourism

The assessment has not identified any tourism infrastructure in the local area upon which agricultural enterprises are reliant. Therefore the Project is not anticipated to impact on agriculture-related tourism.

4.4.3 Weed Management and Biosecurity

There is minimal risk from the introduction of weeds during the underground mining process. Weeds are managed within the framework of the Centennial Weed Management Plan, which includes issue-specific environmental management plans, such as weed control prior to any earthworks.

Giant Parramatta grass (*Sporobolus fertilis*) (**Plate 4** and **Plate 5**) has previously been identified by a stakeholder as a weed with potential for concern. Where Giant Parramatta grass is identified, control will be undertaken with registered herbicides including glyphosate, 2,2-DPA or flupropanate.

Plate 4 Mature Giant Parramatta Grass

Plate 5 Giant Parramatta grass seed head

Biosecurity is defined in the *NSW Biosecurity Strategy 2013 – 2021* (DPI, 2013) as 'protecting the economy, environment and community from the negative impacts of pests, diseases and weeds'. It includes measures to prevent new pests, diseases and weeds from entering our country and becoming established. On a regional level, appropriate weed management will reduce biosecurity risks. Any import of equipment or machinery from overseas will follow the standard procurement safeguards and quarantine procedures as per Australian requirements.

Given the processes above, there is negligible risk to the biosecurity of agricultural resources and enterprises within the region.

4.4.4 Air Quality

The Project involves the extension of two underground longwall panels and as such there will be no impact to air quality resulting from the Project.

4.4.5 Noise

The Project involves the extension of two underground longwall panels and as such there will be no impacts to agricultural production from noise generated by the Project.

4.4.6 Blasting

The Project does not involve any blasting as such there will be no impact to agricultural resources from blasting.

4.4.7 Traffic

The Project involves the extension of two underground longwall panels with no increased traffic movements, and as such the impact to agricultural resources as a result of increased traffic movements is considered negligible.

4.4.8 Farm Fencing

Given the subsidence predictions made by Seedsman Geotechnics (2016), farm fencing and gates are not expected to be impacted by longwall mining.

4.4.9 Farm Dams

No farm dams are expected to be impacted as a result of longwall mining (Seedsman Geotechnics, 2016).

4.4.10 Impact on State Forest

The Project it is not expected to impact the Olney State Forest.

4.5 Agricultural Regional Community Impacts

No other impacts which may affect the regional agricultural community, resource or enterprises have been identified in this assessment.

5 MITIGATION MEASURES

This section describes the proposed mitigation measures and management strategies recommended to minimise potential agricultural impacts. Whilst the majority of impacts on agricultural enterprises and resources have been assessed as negligible, as a matter of best practice, Centennial Mandalong has adopted a number of mitigation measures to further minimise these impacts. A summary of key measures specifically in relation to potential agricultural impact is provided below.

5.1 Soil Resources

Where potential impacts have been identified at the locations shown in **Table 11**, gypsum will be applied for any remediation earthworks where sodic subsoils (exchangeable sodium is greater than 5) are exposed. The application of gypsum will minimise the potential for tunnel erosion to occur on disturbed subsoil. The recommended application rates are shown in **Table 12**.

Table 12 Gypsum Application Rates

Exchangeable Sodium (ESP)	Gypsum Rate per Hectare	Gypsum Rate per Square Metre
5 to 10%	2 to 5 tonnes	0.2 to 0.5 kilograms
Greater than 10%	5 tonnes	0.5 kilograms

There are no soil stripping or stockpiling activities anticipated within the Study Area associated with the Project.

5.2 Farm Fencing

In the unlikely event of damage to fence tensioning or farm gate levels, Centennial Mandalong will remediate the damage in consultation with relevant stakeholders.

5.3 Ponding

Umwelt (2017) anticipates approximately 0.25 of a hectare of further remnant ponding, compared to a baseline (pre-mining) remnant ponded area of 9.04 hectares, as a result of subsidence. Engineered channel earthworks may be necessary to remediate drainage channels and drain paddocks on properties, Lot 11 DP957458, Lot 4 DP168774 and Lot 3 DP168774 (**Table 11**). Property owners will be consulted as to whether they wish the additional ponds to remain or be remediated by Centennial Mandalong in conjunction with the Mine Subsidence Board.

5.4 Farm Dams

All farm dams within the Study Area will be inspected by the Mine Subsidence Board for current water level and dam condition prior to and after mining. Should monitoring indicate potential for dam wall failure due to subsidence cracking, water will be transferred from the dam to a height that reduces the risk of dam wall failure. An alternate water supply will be provided to the owner until the dam can be reinstated.

In the event of subsidence damage to any farm dams, Centennial Mandalong will remediate the damage and reinstate the dam in consultation with relevant stakeholders.

5.5 Rehabilitation of Disturbed Lands: Demonstrated Capacity

Centennial Mandalong operates the Mandalong Mine which is an underground mine located to the north of the Study Area in the Lake Macquarie LGA. In order to demonstrate Centennial Mandalong's capacity for rehabilitation, examples of successful rehabilitation of surface disturbance are taken directly from the *2014 Centennial Coal Mandalong Mine Annual Environmental Management Report* (AEMR) (Centennial, 2014). The majority of Mandalong Mine site has been rehabilitated following the completion of construction activities in 2005. Rehabilitated sections of the Mandalong Mine's surface area are well established and have provided vegetation cover to effectively minimise the potential for erosion.

Centennial Mandalong will utilise successful rehabilitation techniques developed and refined at the Mandalong Mine during the life of the Project. Examples of two recent successful rehabilitation activities are given in the sections below.

5.5.1 VAM-RAB Installation Rehabilitation

Installation of a ventilation air methane regenerative after burner (VAM-RAB) unit in 2012 involved clearing of some native vegetation. Two endangered ecological communities were included in the areas to be cleared, Swamp Sclerophyll Forest and River-Flat Eucalypt Forest. Consent condition 76A included a requirement for a 1.25 hectare rehabilitation offset area to be established on cleared land adjoining the VAM-RAB construction site. An ecology survey prepared by Hunter Eco for the VAM-RAB Study described the area to be rehabilitated as mostly dominated by weeds. This being the case, active regeneration was required and this was commenced in January 2012.

The progress of rehabilitation has been monitored since 2012 by Hunter Eco, who concluded that the results to date are encouraging suggesting that the measures taken should result in successful rehabilitation.

5.5.2 Exploration Site Rehabilitation

Mandalong Mine carried out surface exploration at three drill sites during 2014. These three sites required minor clearing within the Olney State Forest and were rehabilitated following the sealing of the boreholes. Existing tracks were utilised to again access to these exploration drill sites where possible and required limited vegetation clearing.

Forestry Corporation of NSW (FCNSW) were consulted prior to commencing these works, in order for rehabilitation to meet with their land use requirements. All rehabilitation works were completed by November 2014 and inspected by a FCNSW representative on the 20th November, 2014. FCNSW were satisfied with the standard of the rehabilitation that had been achieved.

5.6 Demonstrated Planning for Progressive Rehabilitation

Progressive rehabilitation for the Project will be undertaken on areas of disturbance as soon as reasonably practicable. Centennial Mandalong's principal rehabilitation objectives for the Project include:

- Achieve an acceptable post-disturbance land use.
- Commencing progressive rehabilitation of disturbed areas as soon as practicable.
- Creating a stable post-construction landform that is consistent with surrounding areas and preserves downstream water quality.

In addition to the above key rehabilitation objectives, the Centennial Environment and Community Policy also makes specific reference to:

- Making appropriate decisions which comply with or exceed approvals, licences and agreements.
- Working constructively with local authorities, stakeholders and communities.
- Contributing to the conservation of biodiversity.
- Planning, designing and closing operations in a manner that enhances sustainable development.
- Engaging and communicating openly with communities, with due regard and respect for local interests, cultures and customs.

Centennial Mandalong has committed to a policy of post-mining land use being consistent with the pre-mining land use, including woodland and grassland commensurate with the surrounding area.

Regular monitoring of any rehabilitated areas will occur during the initial vegetation establishment period and beyond, to demonstrate whether the rehabilitation objectives are being achieved and whether a sustainable environment has been provided. In the event that monitoring confirms that rehabilitation is not successful or has achieved limited success, maintenance works will be undertaken to address the issue.

6 STAKEHOLDER CONSULTATION

Centennial Mandalong has undertaken consultation with government agencies, local Aboriginal groups, the Mandalong Mine Community Consultative Committee, surrounding residents and the wider community and service providers during pre-feasibility, feasibility and planning stages of the Project. Prior to the commencement of the Project, a *Stakeholder Engagement Strategy* was developed to provide a consistent management framework for the identification and consultation with stakeholders that have an interest in the Project. The objectives of the *Stakeholder Engagement Strategy* are to:

- Establish a process for engagement with stakeholders, with clear outcomes for Centennial Mandalong and the various stakeholders.
- Openly communicate with stakeholders about the Project.
- Provide a means of community access to the Centennial Mandalong Project Team via a dedicated information phone line.

A number of different strategies for communicating with the community throughout the Project were identified and undertaken, including:

- The Mandalong Mine Community Consultative Committee.
- Meetings with individual landowners and stakeholders.
- Community newsletters.
- Community open days and information sessions.

Full details of consultation undertaken by Centennial Mandalong are contained in the SEE prepared for the Project.

Two issues regarding impacts to agricultural resources, enterprises or stakeholders were raised during previous consultation regarding SSD-5144 Mod 1, which have been considered in this assessment. Stakeholder concern was expressed over the potential for:

- Giant Parramatta grass to be spread as a result of the Project. Control of Giant Parramatta grass, which is described in **Section 4.5.3** (Weed Management and Biosecurity).
- Increased tunnel soil erosion as a result of the Project. Mitigation measures to minimise the potential for increased soil tunnel erosion are described in **Section 5.1** (Soil Resources).

Centennial Mandalong is committed to on-going community consultation and will continue to engage with the community for the purposes of providing information relating to the Project and on-going operations at the Mandalong Mine.

7 KEY FINDINGS

This AIS has been prepared to be in accordance with the *Strategic Regional Land Use Policy* (DP&I, 2012a) and *Guideline for Agricultural Impact Statement* (DP&I, 2012b).

The purpose of the AIS is to assess and report on the potential impacts of the Project on agricultural resources and/or industries within and surrounding the Study Area with key findings listed below:

- The majority of agricultural land use within the Study Area is for hobby farms and small cattle grazing areas, which are not major contributors to income generation. Grazing is mostly carried out as a land and vegetation management tool.
- Post-mining agricultural economic potential in the Study Area is expected to be similar to pre-mining potential.
- The longwall mining will have negligible impact on surface and groundwater resources relied upon by agriculture (Umwelt, 2017 and GHD, 2017). Groundwater resources are expected to be less than the Level 1 minimal impact considerations as per the *NSW Aquifer Interference Policy* (NOW, 2012).
- Any impacts resulting from longwall mining are expected to be minor and temporary, and can be managed through application of appropriate mitigation measures and management strategies.
- Continuation of longwall mining by Centennial Mandalong will provide considerable positive economic benefits to the local and broader communities. These benefits are far greater than the potential income lost by existing or potential agricultural enterprises, calculated as a precautionary assessment on impacted agricultural resources, of $109 per annum.

In summary, the Project will provide considerable economic benefits to the region whilst having negligible impact on agricultural resources, enterprises or related industries.

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Seedsman Geotechnics (2016) *Centennial Coal Mandalong Pty Ltd Mine Prediction of Subsidence Impacts for LW22 – LW24A*

SLR (2016a) *Land & Soil Resource Assessment Mandalong Mine LW24 – LW24A Modification*

SLR (2016b) *Biophysical Strategic Agricultural Land Assessment Mandalong Mine LW24 – LW24A Modification*

Umwelt (2017) *Centennial Mandalong Flood Assessment Longwalls 24 to 24A*

Appendix A

Full Soil Profile Descriptions

Soil Unit 1: Brown Kurosol

Soil Unit 1 is a Brown Kurosol. Kurosols are soils with a strong texture contrast between the A horizon and strongly acidic B horizons. Many Kurosols have unusual subsoil chemical attributes such as high magnesium, sodium and aluminium. One representative site for Soil Unit 1 is described below.

Table 1 Summary: Magnesic Brown Kurosol (Site 9)

Overview	
	
Landscape Site 9	
ASC Name	Magnesic Brown Kurosol
Representative Site	Site 9
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Cattle Grazing
Vegetation	Spotted Gum, Annual Ryegrass, Kikuyu
Inherent Soil Fertility	Moderately Low
Slope	9%

Table 2 Profile: Magnesic Brown Kurosol (Site 9)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Brown (10YR 5/3) loam, weakly structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.25	Brown (10YR 6/2) loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <10% gravel 5-10 mm, abundant fine roots. Well drained with an abrupt and even boundary. Sampled 0.10 – 0.20
	B21 0.25 – 0.40	Yellowish brown (10YR 5/6^) heavy clay, strongly structured 20-40 mm subangular blocky peds with strong consistence and a rough fabric. 20% distinct orange mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.30 – 0.40
	B22 0.40 – 0.90	Yellowish brown (10YR 5/8^) heavy clay, strongly structured 30-50 mm subangular blocky peds with strong consistence and a rough fabric. 30% distinct grey mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.40 – 0.50 and 0.65 – 0.75

Table 3 Chemical Parameters: Magnesic Brown Kurosol (Site 9)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	3.8	Non-sodic	0.2	Non-saline	0.57	Low
A2	4.2	Strongly Acidic	4.3	Non-sodic	0.1	Non-saline	0.37	Low
B21	4.0	Strongly Acidic	4.0	Non-sodic	0.2	Non-saline	0.06	Very Low
B22	4.0	Strongly Acidic	4.1	Non-sodic	0.3	Non-saline	0.04	Very Low
B22	4.1	Strongly Acidic	4.9	Non-sodic	0.1	Non-saline	0.02	Very Low

Soil Unit 2: Brown Sodosol

Soil Unit 2 is a Brown Sodosol. Sodosols are soils with a strong texture contrast between the A horizon and a sodic B horizon which is not strongly acidic. The strongly sodic nature of the B horizon in these Sodosols leave them prone to dispersion and tunnel erosion if left exposed for prolonged periods to water movement or rainfall. Three representative sites for Soil Unit 2 are described below.

Table 4 Summary: Mesonatric Brown Sodosol (Site M6)

Overview	
	
Landscape Site M6	
ASC Name	Mesonatric Brown Sodosol
Representative Site	Site M6
Survey Type	Detail
Dominant Topography	Mid Hillslope
Current Land Use	Cattle Grazing
Vegetation	Sydney Blue Gum, Red Grass, Barbed Wire Grass
Inherent Soil Fertility	Moderately Low
Slope	7%

Table 5 Profile: Mesonatric Brown Sodosol (Site M6)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Brown (10YR 5/3) loam, weakly structured 5-20 mm crumb peds with a weak consistence and a rough fabric. Nil mottling, <5% gravel 5-15 mm, abundant fine roots. Well drained with a clear and even boundary. Sampled 0.0 – 0.10
	B21 0.15 – 0.40	Yellowish brown (10YR 5/4^) heavy clay, strongly structured 20-30 mm subangular blocky peds with strong consistence and a rough fabric. 25% faint grey mottles, nil stone content, common coarse roots. Poorly drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B22 0.40 – 0.90	Yellowish brown (10YR 5/8^) medium clay, strongly structured >40 mm subangular blocky peds with strong consistence and a rough fabric. 30% distinct-grey mottles, nil stone content, few coarse roots. Poorly drained with a clear and even boundary. Sampled 0.50 – 0.60
	BC +0.90	Weathered parent material. Not sampled

Table 6 Field Chemical Parameters: Mesonatric Brown Sodosol (Site M6)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.1	Strongly Acidic	12.3	Sodic	0.5	Non-saline	0.04	Very Low
B21	4.3	Strongly Acidic	15.6	Strongly Sodic	1.2	Non-saline	<0.01	Very Low
B22	4.4	Strongly Acidic	19.4	Strongly Sodic	2.0	Non-saline	<0.01	Very Low

Table 7 Summary: Subnatric Brown Sodosol (Site 2)

Overview	
	
Landscape Site 2	
ASC Name	Subnatric Brown Sodosol
Representative Site	Site 2
Survey Type	Detail
Dominant Topography	Creek Flat
Dominant Land Use	Horse Grazing
Vegetation	Spotted Gum, Kikuyu
Inherent Soil Fertility	Moderately Low
Slope	9%

Table 8 Profile: Subnatric Brown Sodosol (Site 2)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.25	Greyish-brown (10YR 5/2) loamy sand, weakly structured 5-15 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.25 – 0.45	Brown (10YR 6/2) bleached loamy sand, weakly structured 5-10 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a clear and even boundary. Sampled 0.30 – 0.40
	B21 0.45 – 0.60	Yellowish brown (10YR 5/4^) clay loam, moderately structured 20-30 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.60 – 0.80	Yellowish brown (10YR 5/4^) clay loam, moderately structured 30-50 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct orange mottles, nil stone content, few coarse roots. Poorly drained with clear and even boundary. Sampled 0.65 – 0.75
	BC +0.80	Weathered parent material. Not sampled

Table 9 Chemical Parameters: Subnatric Brown Sodosol (Site 2)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	5.0	Moderately Acidic	1.2	Non-sodic	0.5	Non-saline	7.25	High
A2	5.4	Moderately Acidic	3.5	Non-sodic	0.2	Non-saline	4.07	Balanced
B21	4.9	Strongly Acidic	7.8	Marginally Sodic	0.3	Non-saline	0.94	Low
B22	4.5	Strongly Acidic	11.5	Strongly Sodic	0.6	Non-saline	0.39	Low

Table 10 Summary: Mesonatric Brown Sodosol (Site 4)

Overview	
	
Landscape Site 4	
ASC Name	Mesonatric Brown Sodosol
Representative Site	Site 4
Survey Type	Detail
Dominant Topography	Mid slope
Dominant Land Use	Mown Lawn
Vegetation	Spotted Gum, Kikuyu
Inherent Soil Fertility	Moderately Low
Slope	10%

Table 11 Profile: Mesonatric Brown Sodosol (Site 4)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Greyish-brown (10YR 5/2) silty loam, moderately structured 5-10 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.30	Light brownish-grey (10YR 6/2) bleached loam, moderately structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with an abrupt and even boundary. Sampled 0.15 – 0.25
	B21 0.30 – 0.60	Yellowish brown (10YR 5/4^) light-medium clay, moderately structured 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 +0.60	Yellowish brown (10YR 5/6^) light clay, moderately structured 30-50 mm subangular blocky peds with strong consistence and a rough fabric. 30% distinct yellow mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 12 Chemical Parameters: Mesonatric Brown Sodosol (Site 4)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	3.1	Non-sodic	0.2	Non-saline	1.17	Low
A2	4.4	Strongly Acidic	14.3	Strongly Sodic	0.4	Non-saline	0.43	Low
B21	4.3	Strongly Acidic	19.2	Strongly Sodic	1.7	Non-saline	0.15	Low
B22	4.2	Strongly Acidic	26.4	Strongly Sodic	2.5	Slightly Saline	0.10	Low

Soil Unit 3: Brown Dermosol

Soil Type 3 is a Brown Dermosol. Dermosols are soils with structured B2 horizons and lacking strong texture contrast between the A and B horizons. The sodic nature of the B horizon in some of these Dermosols leave them prone to dispersion and tunnel erosion if left exposed for prolonged periods to water movement or rainfall. Six representative sites for Soil Unit 3 are described be

Table 13 Summary: Eutrophic Brown Dermosol (Site 3)

Overview	
	
Landscape Site 3	
ASC Name	Eutrophic Brown Dermosol
Representative Site	Site 3
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Horse Grazing
Vegetation	Spotted Gum, Kikuyu
Inherent Soil Fertility	Moderately High
Slope	6%

Table 14 Profile: Eutrophic Brown Dermosol (Site 3)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Brown (10YR 5/3) loamy sand, weakly structured 5-15 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.35	Pale brown (10YR 6/3) loam, moderately structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B21 0.35 – 0.60	Yellowish brown (10YR 5/4^) loam, moderately structured 20-30 mm blocky peds with weak consistence and a rough fabric. 30% distinct yellow mottles; <5% gravel 5-15 mm; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 +0.60	Yellowish brown (10YR 5/8^) loam, moderately structured 20-40 mm blocky peds with moderate consistence and a rough fabric. 40% distinct grey mottles, <5% gravel 5-15 mm, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 15 Chemical Parameters: Eutrophic Brown Dermosol (Site 3)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	5.0	Moderately Acidic	1.6	Non-sodic	1.2	Non-saline	2.38	Low
A2	4.4	Strongly Acidic	2.2	Non-sodic	0.3	Non-saline	1.00	Low
B21	4.4	Strongly Acidic	4.9	Non-sodic	0.2	Non-saline	0.19	Low
B22	4.1	Strongly Acidic	16.4	Strongly Sodic	0.7	Non-saline	0.02	Very Low

Table 16 Summary: Eutrophic Brown Dermosol (Site 5)

Overview	
	
Landscape Site 5	
ASC Name	Eutrophic Brown Dermosol
Representative Site	Site 5
Survey Type	Detail
Dominant Topography	Lower Slope
Dominant Land Use	Mown Lawn
Vegetation	Melaleuca, Spotted Gum, Kikuyu
Inherent Soil Fertility	Moderately High
Slope	1%

Table 17 Profile: Eutrophic Brown Dermosol (Site 5)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Greyish-brown (10YR 5/2) silty loam, weakly structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.20 – 0.40	Greyish-brown (10YR 5/2) silty loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.25 – 0.35
	B21 0.40 – 0.60	Dark-yellowish brown (10YR 4/4^) loam, moderately structured 20-30 mm blocky peds with weak consistence and a rough fabric. 20% distinct grey mottles; <5% gravel 5-10 mm; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.60 – 0.75	Dark-yellowish brown (10YR 4/6^) loam, moderately structured 20-40 mm blocky peds with moderate consistence and a rough fabric. 20% distinct grey and 20% distinct yellow mottles, 5% gravel 5-15 mm, few coarse roots. Poorly drained an abrupot and even boundary. Sampled 0.65 – 0.75
	BC +0.75	Weathered parent material. Not sampled

Table 18 Chemical Parameters: Eutrophic Brown Dermosol (Site 5)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	2.0	Non-sodic	0.2	Non-saline	0.78	Low
A2	4.4	Strongly Acidic	3.9	Non-sodic	0.1	Non-saline	0.48	Low
B21	4.2	Strongly Acidic	6.3	Marginally Sodic	<0.1	Non-saline	0.21	Low
B22	4.2	Strongly Acidic	10.7	Sodic	0.1	Non-saline	0.03	Very Low

Table 19 Summary: Dystrophic Brown Dermosol (Site 8)

Overview	
	
Landscape Site 8	
ASC Name	Dystrophic Brown Dermosol
Representative Site	Site 8
Survey Type	Detail
Dominant Topography	Lower Slope
Dominant Land Use	Cattle Grazing
Vegetation	Melaleuca, Kikuyu, Rhodes Grass
Inherent Soil Fertility	Moderate
Slope	7%

Table 20 Profile: Dystrophic Brown Dermosol (Site 8)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Greyish-brown (10YR 5/2) loam, weakly structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.35	Pale brown (10YR 6/3) sandy loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B21 0.35 – 0.50	Yellowish brown (10YR 5/6^) clay loam, moderately structured 20-30 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.50 – 0.80	Yellowish brown (10YR 5/8^) light clay, strongly structured 30-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct orange mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75
	BC +0.80	Weathered parent material. Not sampled

Table 21 Chemical Parameters: Dystrophic Brown Dermosol (Site 8)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	2.9	Non-sodic	0.1	Non-saline	1.48	Low
A2	4.2	Strongly Acidic	4.0	Non-sodic	0.1	Non-saline	0.32	Low
B21	3.9	Strongly Acidic	3.3	Non-sodic	0.1	Non-saline	0.07	Low
B22	3.8	Strongly Acidic	3.4	Non-sodic	0.2	Non-saline	0.04	Very Low

Table 22 Summary: Mesotrophic Brown Dermosol (Site 10)

Overview	
	
Landscape Site 10	
ASC Name	Mesotrophic Brown Dermosol
Representative Site	Site 10
Survey Type	Detail
Dominant Topography	Lower Slope
Dominant Land Use	Cattle Grazing
Vegetation	Melaleuca, Kikuyu, Rhodes Grass
Inherent Soil Fertility	Moderately High
Slope	1%

Table 23 Profile: Mesotrophic Brown Dermosol (Site 10)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.15	Greyish-brown (10YR 5/2) loam, weakly structured 5-10 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.15 – 0.30	Pale brown (10YR 6/3) sandy loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B21 0.30 – 0.50	Yellowish brown (10YR 5/4^) clay loam, moderately structured 10-30 mm blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; nil stone content; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.50 – 0.90	Dark yellowish brown (10YR 4/6^) loam, moderately structured 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct yellow mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 24 Chemical Parameters: Mesotrophic Brown Dermosol (Site 10)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	5.0	Moderately Acidic	1.8	Non-sodic	0.3	Non-saline	4.59	Balanced
A2	4.4	Strongly Acidic	4.6	Non-sodic	0.0	Non-saline	1.02	Low
B21	4.3	Strongly Acidic	8.3	Marginally Sodic	0.2	Non-saline	0.48	Low
B22	4.4	Strongly Acidic	8.7	Marginally Sodic	0.3	Non-saline	0.39	Low

Table 25 Summary: Eutrophic Brown Dermosol (Site M4)

Overview	
	
Landscape Site M4	
ASC Name	Eutrophic Brown Dermosol
Representative Site	Site M4
Survey Type	Detail
Dominant Topography	Mid Slope
Dominant Land Use	Cattle Grazing
Vegetation	Spotted Gum, Kangaroo Grass, Kikuyu
Inherent Soil Fertility	Moderately High
Slope	<1%

Table 26 Profile: Eutrophic Brown Dermosol (Site M4)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.10	Brown (7.5YR 4/2) loamy sand, weakly structured 5-10 mm blocky peds with weak consistence and a rough fabric. Nil mottling, <5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.10 – 0.30	Brown (10YR 4/3) loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, 5% gravel 5-10 mm, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.15 – 0.25
	B21 0.30 – 0.50	Yellowish brown (10YR 5/8^) clay loam, moderately structured 20-40 mm subangular blocky peds with moderate consistence and a rough fabric. 20% distinct orange mottles; <5% gravel 5-10 mm; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.40 – 0.50
	B22 0.50 – 0.90	Yellowish brown (10YR 5/8^) light clay, strongly structured 30-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct orange mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 27 Chemical Parameters: Eutrophic Brown Dermosol (Site M4)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.4	Strongly Acidic	4.7	Non-sodic	0.5	Non-saline	0.65	Low
A2	4.3	Strongly Acidic	6.2	Marginally Sodic	0.0	Non-saline	0.20	Low
B21	4.3	Strongly Acidic	7.0	Marginally Sodic	0.1	Non-saline	0.07	Very Low
B22	4.0	Strongly Acidic	16.4	Strongly Sodic	0.9	Non-saline	0.01	Very Low

Table 28 Summary: Mesotrophic Brown Dermosol (Site M5)

Overview	
	
Landscape Site M5	
ASC Name	Mesotrophic Brown Dermosol
Representative Site	Site M5
Survey Type	Detail
Dominant Topography	Creek Flat
Dominant Land Use	Cattle Grazing
Vegetation	Melaleuca, Kikuyu, Rhodes Grass
Inherent Soil Fertility	Moderately High
Slope	3%

Table 29 Profile: Mesotrophic Brown Dermosol (Site M5)

Profile	Horizon / Depth (m)	Description
	A1 0.0 – 0.20	Brown (10YR 5/3) loam, weakly structured 5-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.0 – 0.10
	A2 0.20 – 0.50	Light brownish-grey (10YR 6/2) sandy loam, weakly structured 10-20 mm blocky peds with weak consistence and a rough fabric. Nil mottling, nil stone content, abundant fine roots. Well drained with a gradual and even boundary. Sampled 0.20 – 0.30
	B21 0.50 – 0.60	Yellowish brown (10YR 5/4^) clay loam, moderately structured 10-30 mm blocky peds with moderate consistence and a rough fabric. 20% distinct yellow mottles; <5% gravel 5-10 mm; coarse roots common. Poorly drained with a gradual and even boundary. Sampled 0.50 – 0.60
	B22 0.60 – 0.90	Yellowish brown (10YR 5/6^) light clay, strongly structured 30-40 mm subangular blocky peds with moderate consistence and a rough fabric. 30% distinct orange mottles, nil stone content, few coarse roots. Poorly drained with layer continuing beyond sampling depth. Sampled 0.65 – 0.75

Table 30 Chemical Parameters: Mesotrophic Brown Dermosol (Site M5)

Layer	pH ($CaCl_2$)		ESP		ECe (1:5)		Ca:Mg	
	Unit	rating	%	rating	dS/m	rating	ratio	rating
A1	4.5	Strongly Acidic	4.2	Non-sodic	0.2	Non-saline	2.38	Low
A2	4.4	Strongly Acidic	6.2	Marginally Sodic	0.0	Non-saline	1.06	Low
B21	4.3	Strongly Acidic	9.7	Marginally Sodic	0.1	Non-saline	0.26	Low
B22	4.2	Strongly Acidic	9.9	Marginally Sodic	0.2	Non-saline	0.05	Very Low

Note 1 Where mottling presence was 20% or greater Munsell field colour, indicated by ^ was used as a more representative soil colour.

Appendix B

Beef Cattle Gross Margin Budget

BEEF CATTLE GROSS MARGIN BUDGET

Farm enterprise Budget Series: June 2012

Enterprise: **Yearling (Southern/Central NSW)**

Enterprise Unit: **100 cows**

Pasture: **Improved**

INCOME:				**Standard Budget**	**Your Budget**
42	steers 12-15 months @		$687 /hd	$28,844	
22	heifers 12-15 months @		$611 /hd	$13,431	
1	CFA Bull @		$1,253 /hd	$1,253	
7	CFA cows @		$701 /hd	$4,909	
11	Other culls @		$701 /hd	$7,714	
83					
	A. Total Income:			**$56,150**	

VARIABLE COSTS:					
Replacements	1	Bull @	$5,000 /hd	$5,000	
Livestock and vet costs: see section titled beef health costs for details.				$1,203	
Ear tags @	$2.00			$40	
Fodder crops				$0	
Hay & Grain				$0	
Droughts can increase feed costs. For example costs see main menu.				$0	
Pasture maintenence (211 ha improved pasture per 100 cows)				$10,550	
Livestock selling cost (see assumptions on next page)				$4,437	
B. Total Variable Costs:				**$21,230**	

	GM including pasture cost	GM excluding pasture cost	
GROSS MARGIN (A-B)	**$34,920**	**$45,470**	
GROSS MARGIN/COW	**$349.20**	**$454.70**	
GROSS MARGIN/DSE*	**$20.67**	**$26.92**	
GROSS MARGIN/HA	**$165.50**	**$215.50**	

Change in gross margin ($/cow) for change in price &/or the weight of sale stock

(Note: Table assumes that the price and weight of other stock changes in the same proportion as steers. As an example if steer sale price falls to 325c/kg and steer weight to 195 kg, gross margin would fall to $281 per cow. This assumes that price and weight of all other sale stock falls by the same percentage.

Dresses wt kgs / **Stock sold**		**Steer sale price cents/kg dw** 315	325	335	345	355
Steer dw						
-40 kgs	**185**	217	230	243	256	269
-20 kgs	**195**	267	281	296	311	325
0	**205**	317	333	**349**	365	382
+20 kgs	**215**	366	384	402	420	438
+40 kgs	**225**	416	436	455	475	495

GM $ per Cow

An increase of 5% in weaning percentage increases gross margin per cow by $29.59

Assumptions **Yearling (Southern/Central NSW)**

Enterprise unit is 100 cows weighing on average 500 kg
Weaning rate: 86%, conception 92%

Sales

100% steers sold at 12-15 months	205 kg	@335c/kg	dressed weight
100% sale heifers sold at 12-15 months	185 kg	@330c/kg	dressed weight
20 heifers retained for replacement.			
Cull cows cast for age at 10 years	255 kg	@275c/kg	dressed weight
100% of preg tested empty cows culled	"	"	"
4% cows culled for other reasons	"	"	"
Bulls run at 3% & sold after 4 years use	432 kg	@290c/kg	dressed weight

Selling costs include: Commission 5%, MLA levy $5/hd, average freight cost to abattoirs 5.5c/kg dw, NLIS tags @ $2.90 for all sale cattle.

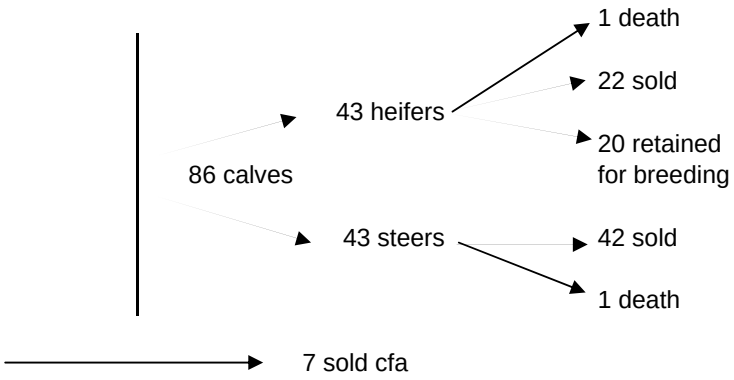
Cows: age at first calf : 24 months

Mortality rate of adult stock: 2%

The average feed requirement of a cow + followers is rated at 16.89 dse's*. This is an average figure and will vary during the year.

Age structure

Age	Number
2	20
3	17
4	15
5	13
6	11
7	9
8	8
9	7
Total Joined	**100**
10	7



Marketing Information:
Suited to the domestic supermarket trade and could access MSA grading with careful preparation. Note that for MSA grading producers need to be licensed. Good frame, well muscled, later maturing steers can be suited to the Japanese grain fed markets at heavier turn off weights than above. Steer portion may also be suited for live export to the Japanese feeder steer market (Angus and Murray Grey and Shorthorn breeds preferred) as a lighter weight option.

Production Information:
A common production system in the south west slopes; and the southern and central tablelands areas.