Centennial Coal
Mandalong

STATEMENT OF ENVIRONMENTAL EFFECTS

Mandalong Mine

State Significant Development 5144 – Modification 4

November 2016

Mandalong Mine

State Significant Development 5144 – Modification 4

Statement of Environmental Effects

Prepared on behalf of:

Centennial Mandalong Pty Limited

By:

Centennial Coal Company Limited

Level 18, BT Tower, 1 Market Street
Sydney NSW 2000

Phone: 02 9266 2700

Centennial Coal
Mandalong

November 2016

Submission of Statement of Environmental Effects (SEE)

Prepared under Section 96(2) of the *NSW Environmental Planning and Assessment Act 1979*

SEE Prepared By:

Name:	Iain Hornshaw Approvals Coordinator
Qualifications:	BSc (Hons); MSc
Company:	Centennial Coal Company Limited
Address:	Level 18, BT Tower, 1 Market Street, Sydney, NSW, 2000

Development Application:

Proponent Name:	Centennial Mandalong Pty Limited
Proponent Address:	Level 18, BT Tower, 1 Market Street, Sydney NSW, 2000
Land to be Developed:	Mandalong Mine Kerry Anderson Drive, Mandalong, NSW, 2264 Lake Macquarie City Council Local Government Area Refer to attached Schedule of Land
Development Description:	Modification 4 to State Significant Development SSD-5144 regarding an extension of approved longwall panels 22 and 23.

Declaration:

I hereby certify that I have prepared the contents of this document and to the best of my knowledge:

- It contains all available information that is relevant to the environmental assessment of the proposed development to which the document relates; and
- It is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Name:	Iain Hornshaw (Centennial Coal Company Limited)
Signature:	
Date:	November 2016

EXECUTIVE SUMMARY

Background

Mandalong Mine is an existing underground longwall coal mine 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 (NSW). Mandalong Mine is 100 percent owned and operated by Centennial Mandalong Pty. Limited (Centennial Mandalong), a subsidiary of Centennial Coal Company Limited. Centennial Coal Company Limited is a wholly owned subsidiary of Banpu Public Company Limited.

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 NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), and provided for the continued extraction 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 facility is 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, 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.

In March 2016 Centennial Mandalong lodged an application to modify SSD-5144 for the Mandalong Transmission Line TL24 Relocation Project. This was subsequently approved by the NSW Department of Planning and Environment (DP&E) on 14 June 2016. A second Modification to SSD-5144 was approved on 22 September 2016 regarding extended first workings associated with the maingates for longwall panels 22 and 23 beyond the current approved mine plan. Modification 3 to SSD-5144 regarding an increase to the annual extraction limit from 6 million tonnes per annum to 6.5 million tonnes per annum was lodged with DP&E for exhibition on 6 October 2016 and approved on 16 November 2016.

This Statement of Environmental Effects (SEE) has been prepared to support an application by Centennial Mandalong seeking to modify its existing development consent under Part 4 of the EP&A Act for the Mandalong LW22-23 Extension Modification.

Proposed Modification

Centennial Mandalong proposes to modify its State Significant Development Consent SSD-5144 pursuant to Section 96(2) of the EP&A Act for the Mandalong LW22-23 Extension Modification (the Modification).

An igneous sill exists to the west of approved longwall panels 22 to 24. Due to historic 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 longwall panels 22 and 23 within the Project Application Area of SSD-5144.

The modification is seeking to undertake the secondary extraction of longwall panels 22 and 23 as extended within the Project Application Area of SSD-5144.

Outlined below are the primary components of the Modification:

- Extension of Longwall 22 from 1,630 m to 2212 m. This yields 617,381 additional tonnes beyond 1,793,842 tonnes already approved.

- Extension of Longwall 23 from 1,631 m to 2,392 m. This yields 799,933 additional tonnes beyond 1,799,425 tonnes already approved.

No physical changes to the mine's infrastructure or the surface footprint as currently approved under SSD-5144 are proposed.

Potential Impacts

This SEE, which includes relevant technical specialist assessments, documents the various studies that have been undertaken to examine potential impacts that may occur as a result of the Modification.

The assessment of environmental issues has been multi-disciplinary and involved consultation with DP&E. Where a knowledge gap was identified, a technical specialist study was commissioned and appropriate management responses identified.

The Modification is anticipated to pose minimal environmental, social and economic impacts beyond those previously assessed and approved under SSD-5144. While the information presented in this SEE and within the appended technical specialist assessments should be read in their entirety, the following table provides a broad overview of the key outcomes.

Broad Overview of Assessed Environmental Issues

Assessment Issue	Overview of Key Findings
Subsidence	• It is unlikely that there will be any tensile cracking or compressive buckling developed in soil or rock. The compressive strains may be sufficient to cause bulging of sealed roads. • With the low values of tilt and strain combined with the relatively gentle topography, there will be no far-field movements (defined as measurable horizontal movements without vertical movements in excess of 20 mm) and there will be no 'upsidence' in the water courses. • There are no cliffs in the area so there can be no cliff falls induced. The mining-induced changes in the slope of the terrain will not be sufficient to generate rock falls or rock rolls. • The mine layout was selected so that any impact to dwellings would be less than safe, serviceable, and repairable and this has been demonstrated to date. All predicted strains and tilts are less than safe, serviceable, and repairable for residential dwellings. • The strains predicted to be imposed on Mandalong Road and Tobins Road are similar to those previously so similar impacts are likely. There may be some minor compression bumps develop in the bitumen seals. • The impact of the predicted subsidence on other surface and subsurface natural and built features (including shallow groundwater) have been assessed by relevant specialists.

Assessment Issue	Overview of Key Findings
Water Resources	• The predicted impacts on alluvial groundwater and fractured and porous rock groundwater attributable to the proposed extension of longwalls 22 and 23 is expected to be less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy and are therefore considered to be acceptable. • It is not expected that the proposed extension to longwalls 22 and 23 would reduce the beneficial use category of alluvial groundwater or fractured and porous rock groundwater in the vicinity of longwalls 22 and 23. • Flooding predicted by modelling include a reduction in freeboard at some properties and an increase in flood hazard at some properties. Changes in flooding regimes and increased potential remnant ponding areas were predicted to be isolated to the zone of predicted subsidence. • Only one area of channel erosion risk due to the predicted subsidence was identified within the Tobins Creek channel, where a low headcut in the order of 0.2 m was observed along Tobins Creek, where it crosses the proposed extension of Longwall 23. Given the location of the headcut, it is likely to be maintained as a result of the Project and is unlikely to be promoted. • Adverse impacts to downstream water users are unlikely to occur as a result of the Project due to the low risk of potential impacts and the ephemeral nature of waterways. The predicted impacts on groundwater sources are less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy. • Groundwater and surface water monitoring for the Project will be undertaken as a continuation of the monitoring currently undertaken. The main objective of monitoring is to ensure that water management measures implemented function as designed.
Biodiversity	• The Ecological Impact Assessment was prepared at a desktop level to assess any potential impacts on terrestrial biodiversity as a result of the Modification. One threatened species, *Melaleuca biconvexa* is known to occur within the study area. This species is listed as vulnerable under both the TSC Act and EPBC Act. Additionally, four EECs were considered as occurring or having high potential to occur within the study area, including: o Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion. o River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney basin and South East Corner Bioregions EEC. o Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC. o Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion. • An assessment of the subsidence related impacts upon terrestrial biodiversity, including threatened flora and fauna, EECs and GDEs, concluded that no significant impacts are expected to occur.
Cultural and Historic Heritage	• A survey of the Study Area was undertaken by RPS archaeologists and Centennial personnel on 14 and 15 June 2016. Registered Aboriginal Parties were invited to attend. • Four Aboriginal sites as listed on AHIMS were groundtruthed with no additional sites being located. • Based on the predicted subsidence there are no impacts identified for the four Aboriginal sites as a result of the extraction of Longwalls 22 and 23. There is no change in the level of impact from the original Development Consent (SSD-5144) as a result of the extended longwalls. • The management of Aboriginal heritage is to continue in accordance with Centennial Coal's Northern Region Aboriginal Cultural Heritage Management Plan. • No historic heritage sites were located within or are predicted to occur within the Study Area.

Assessment Issue	Overview of Key Findings
Land and Agricultural Resources	• The Soil and Land Resource Assessment was conducted based on the findings of a field investigation and a desktop review of reference information. The findings of the assessment include: o Soils types within the Study Area are dominated by texture contrast soils which commonly occur with acid and sodic characteristics. ASC soil types are Brown Kurosols (5%) defined by a strongly acidic nature and Brown Sodosols (72%) defined by subsoil sodicity. The remaining soil type is a Brown Dermosol comprising 23% of the Study Area. o LSC classes range from Class 5 (moderately low capability land) to Class 7 (very low capability land) with approximately 56% of the Study Area classified as having low to very low agricultural capability. o Agricultural Suitability ranges from Class 3 (land suitable for occasional but not continual cultivation) to Class 5 (land best managed by the presence of light green timber due to its highly erodible soils and steep slopes), with approximately 44% of the Study Area having moderately low agricultural capability. o No soil stripping within the Study Area is anticipated as a result of the Project. • Disturbance management techniques are presented to mitigate the negligible soil and land resource impacts associated with the proposed Modification.
Greenhouse	• The additional 1.4 Mt coal proposed to be extracted as part of the extension to longwall panels 22 and 23 will be achieved within the current annual extraction rate and mine life. • The estimated incremental GHG emissions are therefore regarded as a component of the total life of mine GHG emissions based on 6.5 Mtpa being extracted over 25 years. • Centennial Mandalong will continue to support research into suitable abatement technologies regarding ventilation air methane.

Modification Benefits

The socio-economic assessment prepared in relation to the Modification has considered the findings from the relevant technical specialist assessments which have assumed a worst case scenario, meaning that potential impacts may be less than predicted.

Overall the Modification results in no long term socio-economic impacts with the extension to longwall panels 22 and 23 being sought to optimise coal resources using existing infrastructure and equipment to sustain the ongoing efficient operation of Mandalong Mine.

Approval of the Modification will result in greater economic benefits in terms of royalties and labour spending associated with increase in the recoverable resource.

Conclusion

To date, significant effort by Centennial Mandalong has been invested to avoid or minimise potential impacts that could be associated with continued operations. The Modification involves the extraction of additional coal resources within the approved SSD-5144 Project Application Area with no physical changes to the mine's infrastructure.

The Modification will allow for continued operations at Mandalong Mine in accordance with the site's business plan to maximise the available resource within the mining lease area. This will sustain current employment levels for the life of Mandalong Mine. As a coal mine, Mandalong Mine's challenge is to maximise returns through the mineral wealth within existing lease areas whilst ensuring a minimal environmental impact. Mandalong Mine acknowledges the need to co-exist with its regional community as well as underpin the economic opportunity the mine represents.

Based on the assessment of environmental and socio-economic considerations undertaken as part of this SEE, the Modification is anticipated to pose minimal environmental, social and economic impacts, and as such poses minimal impacts beyond those already approved under SSD-5144.

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1.0 INTRODUCTION

1.1 Background

Mandalong Mine is an existing underground coal mine operation located in the Lake Macquarie and Central Coast Local Government Areas (LGAs). Mandalong Mine is situated approximately 130 kilometres north of Sydney and 35 kilometres south-west of Newcastle near Morisset in New South Wales (NSW). 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 *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) which relates to State Significant Developments (SSD).

In March 2016 Centennial Mandalong lodged an application to modify SSD-5144 for the Mandalong Transmission Line TL24 Relocation Project. This was subsequently approved by the NSW Department of Planning and Environment (DP&E) on 14 June 2016. A second Modification to SSD-5144 was approved on 22 September 2016 regarding extended first workings associated with the maingates for longwall panels 22 and 23 beyond the current approved mine plan. Modification 3 to SSD-5144 regarding an increase to the annual extraction limit from 6 million tonnes per annum to 6.5 million tonnes per annum was lodged with DP&E for exhibition on 6 October 2016 and approved on 16 November 2016.

This Statement of Environmental Effects (SEE) has been prepared to support an application by Centennial Mandalong seeking to modify its existing development consent under Part 4 of the EP&A Act for the Mandalong LW22-23 Extension Modification.

1.2 The Proponent

Mandalong Mine is owned and operated by Centennial Mandalong (the Proponent), a wholly owned subsidiary of Centennial Coal Company Limited (Centennial Coal). Centennial Coal is a wholly owned subsidiary of Banpu Public Company Limited (Banpu). Centennial has over 1,400 employees, with approximately 370 of these making up the workforce for Mandalong Mine; one of the largest underground coal producers in NSW.

Centennial Mandalong is the proponent for the Modification. The relevant address is:

Centennial Mandalong Pty Limited
Level 18, BT Tower
1 Market Street
Sydney NSW 2000

1.3 Document Purpose and Structure

This SEE has been prepared by Centennial Coal to support the application to modify SSD-5144 pursuant to Section 96(2) of the EP&A Act. It has further been prepared in accordance with the relevant provisions of the *NSW Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

In addition to describing the Modification, this SEE contains an assessment of the key environmental, social and economic issues.

In summary, this SEE is structured as follows:

Section 1: outlines the Project background, the Proponent, Modification and approval pathway and the Modification need.

Section 2: provides an overview of the Project Application Area, including land ownership and existing land uses.

Section 3: describes the existing approved Mandalong Mine operations.

Section 4: describes the proposed Modifications being sought for approval.

Section 5: describes the approval pathway and legislative framework for the Modification.

Section 6: contains an analysis of socio-economic factors.

Section 7: outlines the stakeholder consultation activities undertaken to identify and prioritise the issues to be addressed within the SEE.

Section 8: outlines the key issues identified for assessment within the SEE.

Section 9: contains an assessment of the potential environmental and socio-economic implications of the Modification, including cumulative impacts.

Section 10: provides a justification for the Modification and outlines ecologically sustainable development considerations.

Section 11: lists the reference documents referred to within the SEE.

Section 12: lists the abbreviations used within the SEE.

1.4 Overview of the Modification

Centennial Mandalong proposes to modify its State Significant Development Consent SSD-5144 pursuant to Section 96(2) of the EP&A Act for the Mandalong LW22-23 Extension Modification (the Modification).

The modification is seeking to undertake the secondary extraction of longwall panels 22 and 23 as extended within the Project Application Area (PAA) of SSD-5144 as illustrated on **Figure 1**.

Outlined below are the primary components of the Modification:

- Extension of Longwall 22 from 1,630 m to 2212 m. This yields 617,381 additional tonnes beyond 1,793,842 tonnes already approved.

- Extension of Longwall 23 from 1,631 m to 2,392 m. This yields 799,933 additional tonnes beyond 1,799,425 tonnes already approved.

The increase will not affect the current production rate nor the delivery limits associated with the Cooranbong Entry Site and the Mandalong Coal Delivery System.

No physical changes to the mine's infrastructure as currently approved under SSD-5144 are proposed.

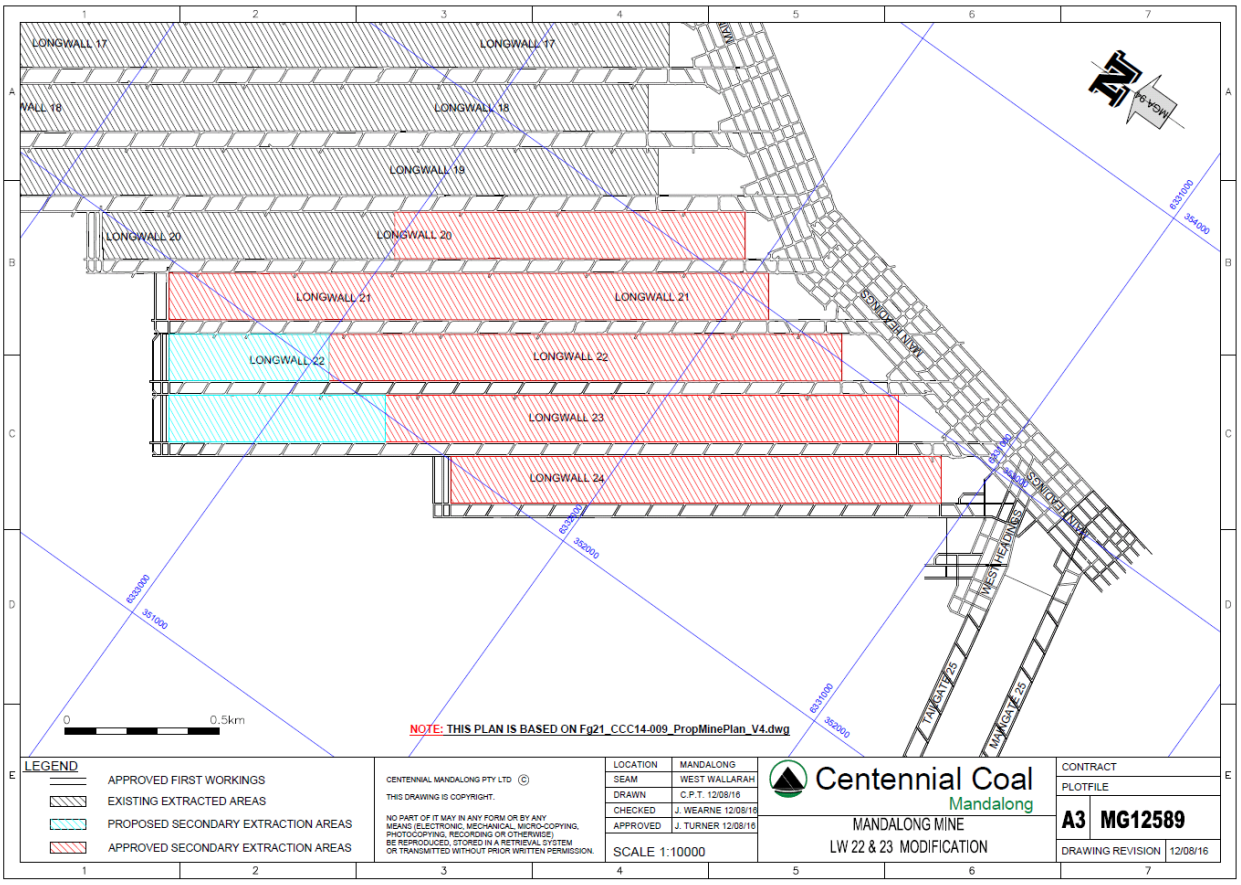


Figure 1 – Proposed Secondary Extraction of Longwall Panels 22 and 23

1.5 Modification Need

The extension to approved longwall panels 22 and 23 is required due to the mine optimising the coal resource within the existing Mining Lease boundary and SSD-5144 PAA. An igneous sill exists to the west of approved longwall panels 22 to 24. Due to historic 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 longwall panels 22 and 23 within the Project Application Area of SSD-5144.

The alternative of not extending longwall panels 22 and 23 will result in the sterilisation of 1,417,314 tonnes of saleable coal. This sterilisation would ultimately lead to any incremental economic benefit in terms of royalties and labour spending associated with increase in the recoverable resource not being realised.

2.0 SITE DESCRIPTION

2.1 Site Location

Mandalong Mine is an existing underground longwall coal mine located in the Lake Macquarie and Central Coast Local Government Areas (LGAs). Mandalong Mine is situated approximately 130 kilometres north of Sydney and 35 kilometres south-west of Newcastle near Morisset (**Figure 2**).

The nearest major population settlements to the Mandalong Mine Access Site (MMAS) are Morisset 2.5 kilometres to the east, Wyee 6.5 kilometres to the south-east and Cooranbong 4.5 kilometres to the north. The Sydney-Newcastle M1 Motorway and the Main Northern Railway Line both traverse through the Mandalong Mine Development Consent boundaries on a north-south alignment.

In addition to many private land owners, the Development Consent boundary covers parts of the Olney State Forest and exists within the Lake Macquarie and Wyong River catchment areas.

2.2 Project Application Area

The Mandalong Southern Extension Project (SSD-5144) Project Application Area (PAA) is applicable to this Modification and comprises of the existing MMAS, Mandalong South Surface Site (MSSS), Cooranbong Entry Site, underground workings and associated surface infrastructure. The PAA encloses approximately 13,467 hectares and, is illustrated on **Figure 3**.

2.3 Land Use and Ownership

The predominant land uses within the PAA include rural-residential, utility easements, underground mining and surface operations associated with the Mandalong Mine, cattle grazing and production and transport corridors.

The land within the PAA exists over privately-owned freehold (including residential and commercial areas) and land owned by the NSW State Government. A Schedule of Land indicating land ownership within and surrounding the PAA appears in **Appendix 1**.

2.3.1 Privately Owned Land

The population settlements of Morisset and Dora Creek are located within the PAA approximately 2.5 kilometres to the east and 5 kilometres of the north-east, respectively, of the existing MMAS. Wyee is also a population settlement and is located outside of the PAA approximately 6 kilometres to the east of the proposed MSSS. There are numerous small settlements within and surrounding the PAA.

The nearest privately-owned residences to the existing MMAS exist to the east of the site on Gimberts Road, which is on the eastern side of the M1 Pacific Motorway and to the south and west of the site on Mandalong Road.

Privately owned land applicable to the Modification is illustrated on **Figure 4**.

2.4 Geology, Topography, Hydrology and Soils

The PAA is located in the south-western part of the Newcastle Coalfield, which occupies the north-eastern portion of the Sydney Basin. The target coal seams are the West Wallarah seam and the Wallarah-Great Northern seam, which together form the upper part of the Permian Newcastle Coal Measures. Above the West Wallarah and Wallarah-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 60–140 m above the Newcastle Coal Measures.

Lake Macquarie, being the dominant natural feature in the area, extends into the north-eastern extent of the PAA. Dora Creek, which is a major tributary of Lake Macquarie, also flows into the north-eastern extent of the PAA.

The PAA is located in the Mandalong Valley. Diverse landforms are present, including broad flat floodplains of the Stockton Creek and Morans Creek catchment, and undulating hills and rugged ridgelines associated with the surrounding Watagan Mountain range.

The PAA is dominated by two densely timbered ridgelines which trend generally north-west to south-east and from the south to the north-east corner. Elevations on these ridgelines can exceed 200 metres Australian Height Datum (AHD). Spurs from these ridgelines descend toward drainages lines in relatively flat areas to the north, east and south of the ridgelines, some of which have been cleared or partially cleared for rural production. These valleys are relatively low lying with surface elevations generally less than 50 metres AHD.

The Mandalong soil landscape unit is the dominant unit within the PAA followed by the Gorokan soil landscape unit.

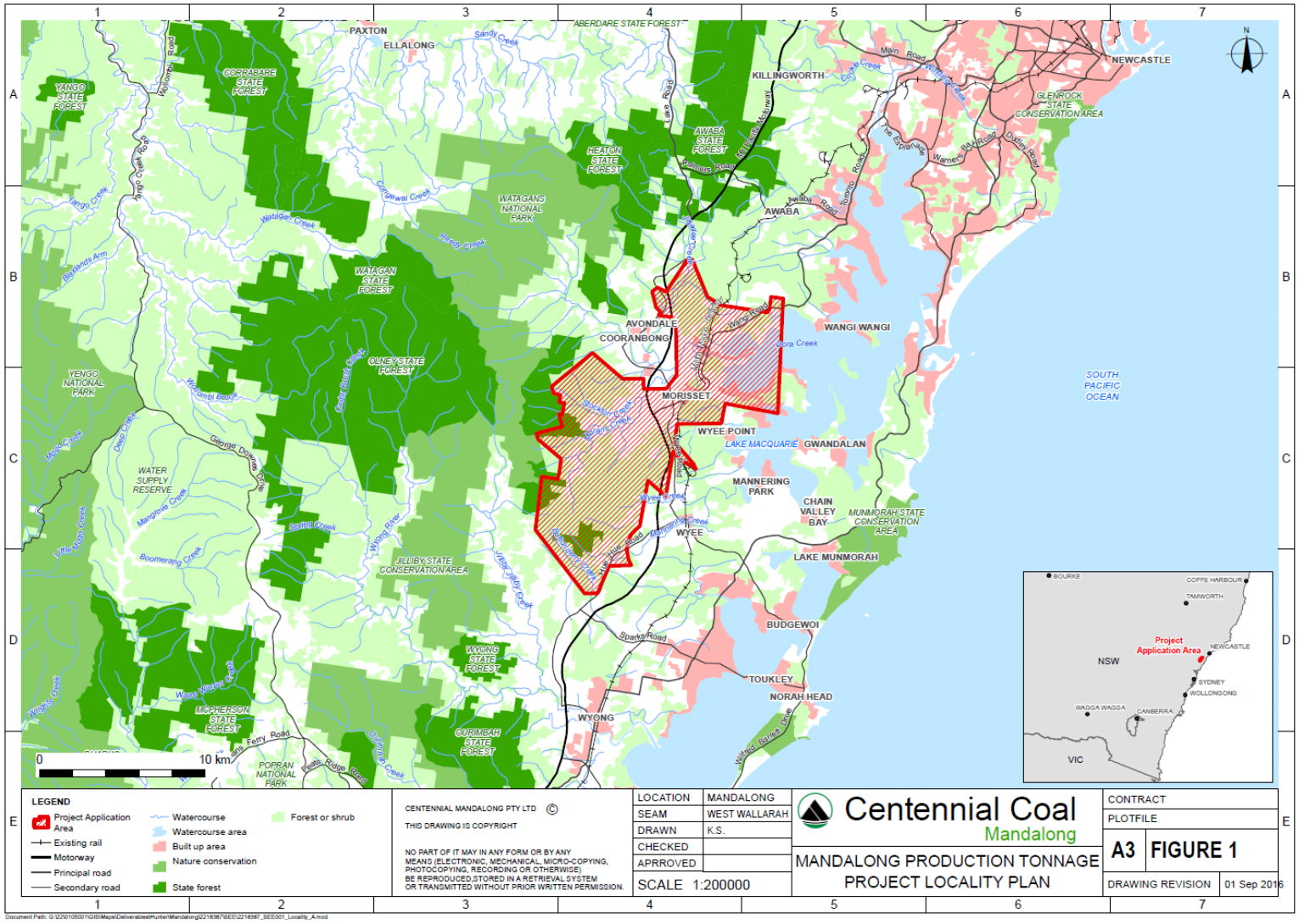


Figure 2 - Project Locality Plan

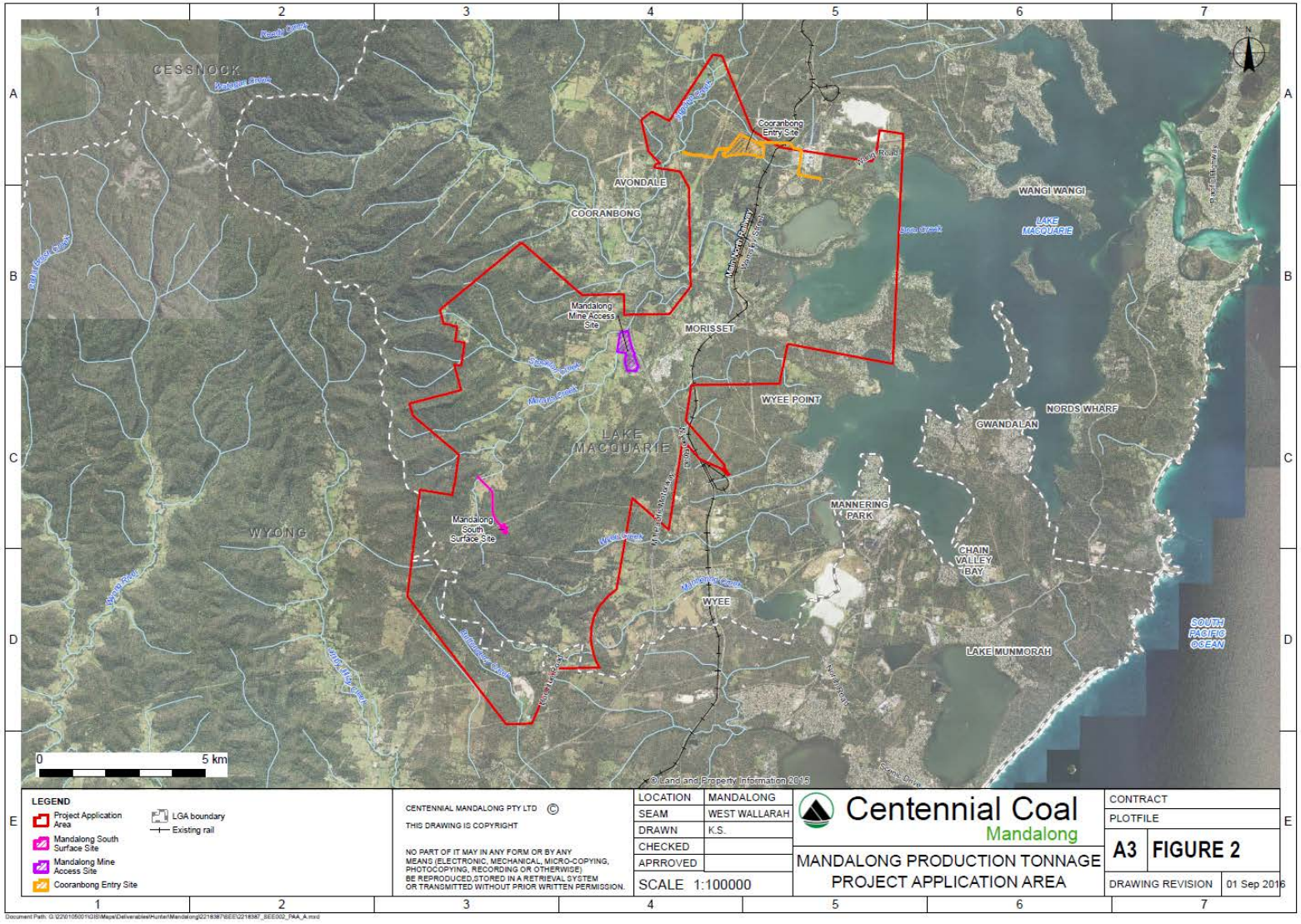


Figure 3 - Project Application Area

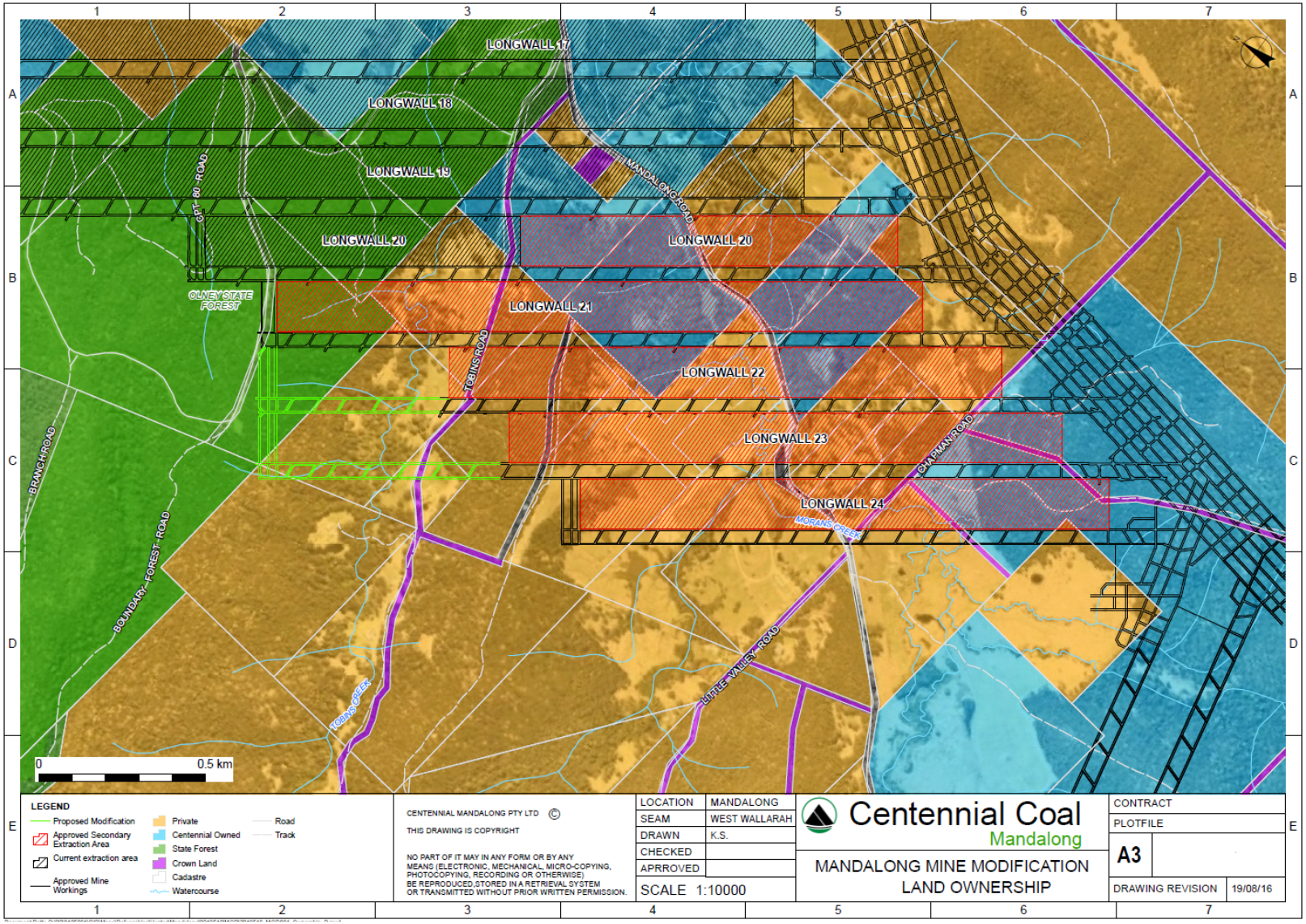


Figure 4 – Land Ownership

2.5 Climate

The meteorology data presented in this section has been sourced from long-term data collected at the Bureau of Meteorology's (BoM) nearest operational weather stations, along with information provided in recent assessment reports commissioned by Centennial Mandalong.

2.5.1 Temperature

The PAA is 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. The local climate is characterised by warm to hot summers and cool to mild winters. Based on the long-term climate statistics sourced from the BoM between 1994 and 2012, mean monthly maximum temperatures in the area range between 15.1 degrees Celsius (^{0}C) in July to 26.9 ^{0}C in January. Mean monthly minimum temperatures range between 6 ^{0}C in July to 17 ^{0}C in February. Autumn and spring are generally mild with sporadic temperature fluctuations.

2.5.2 Rainfall and Evaporation

GHD (2016a) obtained a continuous daily rainfall dataset as SILO Patched Point Data, using SILO data from the BoM Cooranbong (Avondale) weather station (station number 061012) with missing data "patched" in from interpolations from nearby stations. The available rainfall data extended from January 1889 through to December 2014, with the representative statistics reported as:

- Minimum annual rainfall – 531 millimetres (in 1944).
- Average annual rainfall – 1,106 millimetres.
- Median annual rainfall – 1,041 millimetres.
- Maximum annual rainfall – 2,040 millimetres (in 1990).

The average annual evaporation total was approximately 1,187 millimetres, compared to the annual average rainfall of 1,106 millimetres. This gives an annual deficit (difference between annual rainfall and annual evaporation) of approximately 81 millimetres.

2.5.3 Wind

The area predominantly experiences light to moderate winds (between 1.5 and 8 metres per second), with high-speed winds (greater than 8 metres per seconds) prevailing for a low fraction of time. Wind direction is seasonally dependent.

While winds occur reasonably evenly from all quadrants, summer winds appear to be generally from the east-northeast and winter winds appear to be predominately from the west-northwest. Calm wind conditions (less than 0.5 metres per second) generally occur just over 1 percent of the time during each year.

3.0 EXISTING MINE OPERATIONS

3.1 Overview of Operations

Underground longwall mining operations commenced at Mandalong Mine in January 2005. At present, Centennial Mandalong has approval to extract run-of-mine (ROM) coal from the West Wallarah and Wallarah-Great Northern Seams utilising a combination of longwall and continuous mining methods. Modification 3 to SSD-5144 was approved on 16 November 2016 by DP&E increasing the annual ROM coal extraction limit to 6.5 Mtpa.

3.2 Existing Approvals and Licences

3.2.1 Development Consents

On 12 October 2015 State Significant Development SSD-5144 was approved by the NSW Planning Assessment Commission (PAC) for the Mandalong Southern Extension Project. This approval exists as a single new development consent for the Mandalong Southern Extension Project to regulate its approved existing mining operations, extend existing underground mining operations into the Southern Extension Area and utilise existing and proposed new surface infrastructure integral to the mining operation. The primary activities authorised under SSD-5144 are as follows:

- Continue to operate the Mandalong Mine, with the exception of the infrastructure and operations at the surface of the Cooranbong Entry Site (however the mine ventilation shaft, ventilation fan and Borehole Dam at the surface of the Cooranbong Entry Site are part of SSD-5144).

- Extend Mandalong Mine's underground mining operations into the area covered by ML1722 (Southern Extension Area) using a combination of continuous miner and longwall mining methods.

- Extract ROM coal from the West Wallarah and Wallarah-Great Northern Seams within the current mining lease areas.

- Deliver ROM coal from the underground workings to the Cooranbong Entry Site at a rate of up to 6 Mtpa and to the Delta Entry Site at a rate of up to 6 Mtpa.

- Continue to utilise the existing surface infrastructure of the MMAS.

- Install and operate surface infrastructure at the proposed MSSS to service the extended underground mining operation.

- Increase manning to 420 full-time employees and up to 50 contractors during longwall relocations.

- Undertake on-going exploration drilling activities within the bounds of Centennial Mandalong's mining leases and exploration licences.

- Continue to operate 24 hours per day, seven days per week.

In addition to SSD-5144, Development Consent DA 35/2/2004 was granted in July 2004 by the Minister for Planning, approving the construction and operation of the coal handling and clearance system at the Delta Entry Site. This SEE only relates to a proposed modification of SSD-5144.

3.2.2 Approval Under the Environment Protection and Biodiversity Conservation Act 1999

An assessment of whether Mandalong Mine may have a significant impact on any Matters of National Environmental Significance (MNES) or on the environment of Commonwealth land was completed as part of the Mandalong Southern Extension Project. This assessment determined that no aspect of the Project posed a significant impact on any MNES. Mandalong Mine's operations have not been referred under the EPBC Act. As such, Mandalong Mine has no existing approval under the EPBC Act.

3.2.3 Subsidence Management Plan Approvals

Centennial Mandalong has approved Subsidence Management Plans to mine up to and including Longwall panel 21. An Extraction Plan is being prepared regarding Longwall panels 22 and 23.

3.2.4 Environment Protection Licence

Mandalong Mine is a premises-based activity under Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act). On this basis, the occupier of the premises must hold an Environment Protection Licence (EPL) administered by the Environment Protection Authority (EPA) under Section 43(b) of the POEO Act. Mandalong Mine operates under EPL 365, which covers coal mining to a scale of greater than 5 million tonnes produced per annum and coal works to a scale of greater than 5 million tonnes handled per annum.

3.2.5 Water Licencing

Centennial Mandalong currently holds several groundwater monitoring licences under the provisions of the *Water Act 1912* for the purposes of monitoring groundwater levels in the Mandalong Mine Development Consent Boundary.

A water access licence (WAL 39767) is also held by Centennial Mandalong under the Water Management Act 2000 permitting the extraction of up to 1,825 megalitres per year of groundwater from the coal seam as part of the process of mining (dewatering).

3.2.6 Mineral Authorities

Exploration, mining and mining-related operations at Mandalong Mine occur under the provisions of various mineral authorities as detailed in **Table 1** below.

Table 1: Mandalong Mine's Mineral Authorities

Reference	Title	Description	Expiry Date
CCL 762	Consolidated Coal Lease 762	Title of Cooranbong workings, includes some surface land.	13 Oct 2022
CCL 746	Consolidated Coal Lease 746 (sublease)	Title of Cooranbong workings, includes some surface land.	31 Dec 2028
ML 1722	Mining Lease 1722	Title for Mandalong Mine workings, includes surface mining lease for MSSS.	17 Dec 2036
ML 1443	Mining Lease 1443	Title for Mandalong Mine workings, includes MMAS.	1 Mar 2020
ML 1431	Mining Lease 1431	Title to surface land for proposed shaft at the back of Morisset.	27 May 2019
ML 1543	Mining Lease 1543	Title for Mandalong Mine workings.	25 Nov 2024
ML 1553	Mining Lease 1553	Title for Delta Link Project.	7 Sept 2025
MPL 191	Mining Purposes Lease 191	Title to surface land for water tanks at Cooranbong.	24 Feb 2023

ML 1744	Mining Lease 1744	Subsurface lease for part of Mandalong Southern Extension Area	6 Oct 2037
EL 6317	Exploration Licence 6317	Title for exploration activities in the Southern Extension Area.	8 Aug 2019
EL 4443	Exploration Licence 4443	Title for exploration activities over the former Cooranbong Colliery.	23 Oct 2017
EL 4968	Exploration Licence 4968	Title for exploration activities over part of Mandalong Mine.	31 July 2017
EL 4969	Exploration Licence 4969	Title for exploration activities over part of Mandalong Mine.	31 July 2017
EL 5892	Exploration Licence 5892	Title for exploration activities over part of Mandalong Mine.	31 July 2017
A 404	Authorisation 404	Title for exploration activities over part of Mandalong Mine.	31 July 2017

3.3 Life of Mine

Mandalong Mine's current Development Consent SSD-5144 will expire in 2040.

3.4 Hours of Operation

Mandalong Mine is approved to operate up to 24 hours per day, seven days per week.

3.5 Employment

Mandalong Mine is approved to employ up to 420 full-time equivalent employees. Up to an additional 50 contractors will be employed during longwall relocations.

3.6 Mining Operations

The approved Mandalong Mine comprises the underground workings and surface infrastructure of the Mandalong Mine, including the MMAS and MSSS, encompassing access to underground workings and associated surface infrastructure. Other operations directly related to the currently approved Mandalong Mine are the two facilities which comprise the Delta Entry Site and the Cooranbong Entry Site.

Underground longwall mining operations commenced at Mandalong Mine in January 2005. The primary components of Mandalong Mine are:

- Existing surface infrastructure at the MMAS (ventilation infrastructure, gas drainage, demonstration VAM RAB, administration, workshops and material storage).
- The mine ventilation shaft, ventilation fan and borehole dam at the surface of the Cooranbong Entry Site.
- Mandalong Mine's underground mining operations in existing and future approved mining areas as outlined in SSD-5144.
- Extraction of ROM coal from the West Wallarah and Wallarah-Great Northern Seams within the current mining lease areas. Modification 3 to SSD-5144 was approved by DP&E on 16 November 2016 to permit up to 6.5 Mtpa of ROM coal to be extracted.
- Delivery of ROM coal from the underground workings to the Cooranbong Entry Site at a rate of up to 6 Mtpa and to the Delta Entry Site at a rate of up to 6 Mtpa.
- Surface infrastructure at the MSSS (yet to be constructed) to service the extended underground mining operation.

3.6.1 Mine Ventilation

Mandalong Mine is currently ventilated by two surface fans located at the MMAS and Cooranbong Entry Site. One additional fan is approved, but not yet constructed, at the MSSS. These fans are used to ventilate the active mining areas of the underground mine. The fan located at the MMAS currently exhausts approximately 300 cubic metres per second with the ventilation fan at the Cooranbong Entry Site exhausting approximately 140 cubic metres per second.

3.7 Mine Support Facilities

All existing surface and underground infrastructure at Mandalong Mine, including previous surrounding workings (for ongoing ventilation and access), will continue to be relied upon. The existing MMAS is located off Mandalong Road (via Kerry Anderson Drive) west of Morisset. Existing surface and underground infrastructure includes the following:

- Decline tunnel;
- Administration buildings and bathhouse;
- Car parking areas;
- Mechanical workshop and store;
- Mine ventilation and gas drainage infrastructure;
- Water management infrastructure, and
- Pollution control infrastructure.

The MSSS when constructed will comprise of infrastructure to service the extended underground mining operation with key items including:

- Floxal unit and borehole;
- Ventilation fans;
- Hydrocarbon storage;
- Storage and delivery to underground of bulk materials;
- A small administrative office (no personnel will be permanently located at the site);
- Compressor shed;
- Tube bundle gas monitoring equipment;
- Electrical sub-station, and
- Water tanks.

3.8 Coal Handling Transport and Dispatch

Extracted coal is transported from the Mandalong Mine underground workings via underground drift conveyor systems to either the Cooranbong Entry Site at a rate of up to 6 Mtpa or the Delta Entry Site at a rate of up to 6 Mtpa. These conveyors operate 24 hours a day, seven days per week. Centennial's

Northern Coal Services Facility is responsible for processing, stockpiling and dispatching product coal at the Cooranbong Entry Site. Coal delivered via the Delta Entry Site is transported to Vales Point Power Station via the Delta Electricity owned overland conveyor belt.

3.9 Water Management

The water demands of the Mandalong Mine are for underground operations, surface facilities (including machinery operation and wash-down), dust suppression, fire-fighting storage and staff amenities. Potable water is obtained via the existing connections to Hunter Water's reticulated water supply infrastructure at the MMAS and Cooranbong Entry Site. Additional water sources comprise mine water and rainfall runoff.

The key functions of the Mandalong Mine water management systems are to:

- Separate clean and dirty water sources, and allow for diversion, collection and treatment as appropriate;
- Minimise discharges by maximising, where practicable, available water storages, and
- Manage water discharge, in terms of volume and quality, to a level that is acceptable for environmental management.

Surface runoff from areas where there is no coal storage, handling, processing or transportation and no equipment servicing is considered to be clean water. It is typically from undisturbed catchment areas and impervious areas such as sealed roads and car parks. This runoff is directed around dirty water catchments to avoid potential contamination and minimise the volume of dirty water required to be managed.

Dirty water is runoff from disturbed areas and areas likely to contain coal, oils, greases and hydrocarbons, including workshop and fuel storage areas. Dirty water is managed and treated to remove sediment and residual hydrocarbons prior to discharge in accordance with the relevant EPL.

3.9.1 Mine Dewatering

During mining operations, water is released from the coal seam and collects in the underground workings. Additional potable water used in the mining process also collects in the underground workings. The process whereby collected water is pumped out of the mining area is called mine dewatering. Mandalong Mine's existing underground water management system collects mine water in various low points in the underground workings and subsequently pumps it to the Cooranbong Colliery goaf storage area, which has a capacity of approximately 4,200 megalitres. The goaf provides a large storage volume of approximately 4.2 gigalitres and enables filtration and sediment settlement prior to the water being pumped to the surface via a dewatering bore to the Borehole Dam at the Cooranbong Entry Site.

3.10 Environmental Management Strategy

Mandalong Mine has an established Environmental Management Strategy (EMS) that has been developed in accordance with the *Centennial Coal Environmental Management System Framework* (2011) and is generally consistent with the elements of ISO 14001. This EMS provides a framework to ensure the effective management of environmental issues and compliance with regulatory requirements for all activities and areas managed by Centennial Mandalong. It also provides a means for continued improvement in environmental performance.

As part of the EMS, a comprehensive set of environmental management plans has been developed and implemented at Mandalong Mine. The implementation of these plans and the integration of the *Centennial Coal Environmental Management System Framework* (2011) is a strong focus at the Mandalong Mine

and demonstrates environmental due diligence. These plans are reviewed and updated, as necessary, to reflect operational changes and incorporate additional/amended requirements.

The environmental management plans are backed by an environmental monitoring network. Monitoring results are reported monthly on the Centennial Coal website and in the Annual Review.

Mandalong Mine has also developed and implemented an Approvals Database which is used as the primary tool for tracking compliance with conditions of consent, licences and leases.

3.11 Rehabilitation and Final Landform

The underground nature of Mandalong Mine's operations means that surface disturbance and the need for progressive rehabilitation and revegetation is relatively minor compared to open cut mining operations. Regardless, Mandalong Mine has adopted a progressive approach to rehabilitation in accordance with a series of approved management plans; including on-going maintenance of previously rehabilitated areas.

The Mining Operations Plan (MOP) was approved by the Division of Resources and Energy (DRE) on 23 December 2013 for the two year period from 1 January 2014 to 30 November 2015. MOP Amendment A was sought and approved by DRE on 13 October 2015 for an additional 12 month period to 30 November 2016. MOP Amendment B was approved on 19 January 2016 to allow the development of main headings into ML1722.

A new MOP has recently been submitted (to also address the Rehabilitation Management Plan requirements specified by SSD-5144) for the Mandalong Mine and includes underground mining from Longwall 22 to 37 under the Development Consent SSD-5144.

4.0 PROJECT DESCRIPTION

4.1 Overview of Modification

Centennial Mandalong is seeking to modify its existing development consent SSD-5144 for the Mandalong LW22-23 Extension Modification pursuant to Section 96(2) of the EP&A Act. The modification is seeking to undertake the secondary extraction of longwall panels 22 and 23 as extended within the Project Application Area of SSD-5144 as illustrated on **Figure 1**.

Outlined below are the primary components of the Modification:

- Extension of Longwall 22 from 1,630 m to 2212 m. This yields 617,381 additional tonnes beyond 1,793,842 tonnes already approved.

- Extension of Longwall 23 from 1,631 m to 2,392 m. This yields 799,933 additional tonnes beyond 1,799,425 tonnes already approved.

The increase will not affect the current production rate nor the delivery limits associated with the Cooranbong Entry Site and the Mandalong Coal Delivery System.

No physical changes to the mine's infrastructure (including the ventilation system) as currently approved under SSD-5144 are proposed. **Table 2** provides a comparison between the approved operation and proposed modifications.

Table 2: Comparison of Existing Operation and Proposed Modification

Aspect	Existing Operation	Proposed Modification
Site Access	Access to the MMAS is via Kerry Anderson Drive off Mandalong Road adjacent to the M1 Pacific Motorway. Once constructed, access to the MSSS site will be via the approved MSSS Access Road.	No change.
Underground Mine Access	Access to the underground mine is via mine portals situated at the pit top and via existing headings and roadways.	No change.
Development	Mandalong Mine has an approved underground mining area under SSD-5144.	No change.
Longwall Mining and Production	Mandalong Mine has an approved underground mining area under SSD-5144. Approved to extract up to 6.5 Mtpa.	Extension of approved longwall panels 22 and 23.
Mine Life	Under Development Consent SSD-5144 mining operations are permitted to 31 December 2040.	No change
Underground mine ventilation	Two operating ventilation fans (MMAS and Cooranbong Entry Site) and one approved but yet to be constructed (MSSS).	No change
Hours of Operation	The mine currently operates 24 hours per day, 7 days per week.	No change
Employment	Mandalong Mine currently has provision to employ up to 420 full-time equivalent employees as well as an additional 50 contractors during longwall relocations.	No change

Aspect	Existing Operation	Proposed Modification
Supporting Surface Infrastructure	Mine supporting surface infrastructure designed to control and manage water, ventilation, materials delivery, equipment maintenance etc. is situated at the MMAS and when constructed at the MSSS.	No change
Coal Preparation and Handling	No coal preparation or handling is undertaken by Mandalong Mine. All ROM coal is delivered to Northern Coal Services for handling and dispatch.	No change
Waste Coal Management	As product coal is not washed at Mandalong Mine, coarse and fine reject material is not generated at the site.	No change
Surface Water Management	Current water management occurs in accordance with the Mandalong Mine Site Water Management Plan.	No change
Land Preparation	Land preparation required to establish the access road and construction area for the MSSS.	No change
Rehabilitation	Given that Mandalong Mine is an underground coal operation, rehabilitation is currently limited to small areas following exploration or construction or when surface infrastructure is decommissioned.	No change

4.2 Project Application Area

The PAA is illustrated on **Figure 3** and comprises of the existing MMAS, MSSS, Cooranbong Entry Site, underground workings and associated surface infrastructure.

4.3 Hours of Operation and Project Life

Mandalong Mine will continue to operate up to 24 hours per day, seven days a week.

The Modification does not seek to change the current limit of being able to undertake underground mining operations on the site until 31 December 2040.

4.4 Mining Operations

Mine planning and design at Mandalong Mine aims to create a safe underground working environment to optimise the extraction of coal. Centennial Mandalong will continue to undertake existing mining operations in accordance with SSD-5144 using longwall mining and bord and pillar extraction methods within the West Wallarah and Wallarah-Great Northern seams. The Modification is seeking to extend longwall panel 22 from 1,630 m to 2212 m and longwall panel 23 from 1,631 m to 2,392 m. Unless detailed within this SEE, all existing activities at Mandalong Mine approved under SSD-5144 will continue unchanged.

4.4.1 Mine Ventilation

No change is proposed to the current operating speeds regarding the two surface ventilation fans located at the MMAS and Cooranbong Entry Site or the approved but yet constructed surface ventilation fan at the MSSS. As all ventilation fan operations are not proposed to change their associated noise profiles will not change as a result of this modification.

4.5 Coal Handling

Utilising the existing approved coal delivery systems, the Modification proposes to continue to transport ROM coal extracted from the existing underground mine workings to either the Cooranbong Entry Site at

a rate of up to 6 Mtpa and/or the Delta Entry Site at a rate of up to 6 Mtpa. The underground conveyors will continue to operate 24 hours a day, seven days per week.

4.6 Employment

The Modification will not generate any change to the construction or operational employment numbers approved under SSD-5144.

4.7 Water Management

As a result of the proposed extension of approved longwall panels 22 and 23 it is considered that the Modification will have minimal impacts on surface water and groundwater with no changes proposed to the existing water management system.

4.8 Environmental Management Strategy

Mandalong Mine has an established Environmental Management Strategy (EMS) that has been developed in accordance with the *Centennial Coal Environmental Management System Framework* and is generally consistent with the elements of ISO 14001. The EMS provides a framework to ensure the effective management of environmental issues and compliance with regulatory requirements for all activities and areas managed by Centennial Mandalong. It also provides a means for continued improvement in environmental performance.

As part of this EMS a comprehensive set of environmental management plans have been developed and implemented at Mandalong Mine. These environmental management plans are backed by an environmental monitoring network.

4.9 Rehabilitation and Final Landform

Under SSD-5144, Centennial Mandalong has adopted a progressive approach to rehabilitation. Rehabilitation will continue to occur in accordance with SSD-5144.

5.0 REGULATORY FRAMEWORK

The Modification has been assessed with full consideration of the applicable legislative requirements of the Commonwealth and State, along with the local planning and environmental frameworks of the Lake Macquarie City Council and Central Coast Council LGAs, where applicable. This section describes the relevant regulatory framework applicable to the Modification.

5.1 Approval Pathway and Permissibility

Development consent SSD-5144 was granted to Centennial Mandalong by the Planning Assessment Commission on 12 October 2015 pursuant to Section 89E of the EP&A Act. Centennial Mandalong now seeks a modification to SSD-5144 pursuant to the provisions of Section 96 of the EP&A Act to allow for the extension of approved longwall panels 22 and 23.

Section 96 of the EP&A Act provides the mechanism for modification of the SSD-5144. Specifically, section 96(2) provides that:

> *A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if:*
>
> *(a) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which consent was originally granted and before that consent as originally granted was modified (if at all), and*
>
> *(b) it has consulted with the relevant Minister, public authority or approval body (within the meaning of Division 5) in respect of a condition imposed as a requirement of a concurrence to the consent or in accordance with the general terms of an approval proposed to be granted by the approval body and that Minister, authority or body has not, within 21 days after being consulted, objected to the modification of that consent, and*
>
> *(c) it has notified the application in accordance with:*
>
> > *(i) the regulations, if the regulations so require, or*
> >
> > *(ii) a development control plan, if the consent authority is a council that has made a development control plan that requires the notification or advertising of applications for modification of a development consent, and*
>
> *(d) it has considered any submissions made concerning the proposed modification within the period prescribed by the regulations or provided by the development control plan, as the case may be.*

Further, section 96(3) requires the consent authority to take into consideration the matters referred to in Section 79C(1) of the EP&A Act, in so far as they are relevant to the modification.

Clause 115(1) of the *Environmental Planning and Assessment Regulation 2000* (**EP&A Regulation**) sets out the information which must be contained in an application for modification to a development consent under Section 96. **Table 3** details where in this Statement of Environmental Effects this information has been provided.

Table 3: Section 115(1) Information to be Included in the Statement of Environmental Effects

Section 115(1) Matters	Section of SEE
a. the name and address of the applicant	See Section 1.2 of this SEE
b. a description of the development to be carried out under the consent (as previously modified),	See Section 3.0 of this SEE
c. the address, and formal particulars of title, of the land on which the development is to be carried out,	See Section 2.3 and Appendix 1 of this SEE
d. a description of the proposed modification to the development consent,	See Section 4.0 of this SEE
(i) a statement that indicates either: *(i) that the modification is merely intended to correct a minor error, misdescription or miscalculation, or* *(ii) that the modification is intended to have some other effect, as specified in the statement,*	The Project is substantially the same development as the original SSD-5144 application. The Modification is seeking to extend two existing longwall panels to optimise the coal resource within the existing SSD-5144 Project Application Area.
(ii) a description of the expected impacts of the modification	See Section 9.0 of this SEE
(iii) an undertaking to the effect that the development (as to be modified) will remain substantially the same as the development that was originally approved	The modification application is focused on the impacts associated with extending two existing longwall panels with the Project remaining substantially the same as the development that was originally approved.
(iv) if the applicant is not the owner of the land, a statement signed by the owner of the land to the effect that the owner consents to the making of the application (except where the application for the consent the subject of the modification was made, or could have been made, without the consent of the owner)	Landholder consent is not required. SSD-5144 was approved without landholder consent by way clause 49(2)(b) of the EP&A Regulation.
(v) a statement as to whether the application is being made to the Court (under section 96) or to the consent authority (under section 96AA)	Not applicable to the proposal.
(vi) and, if the consent authority so requires, must be in the form approved by that authority	Not applicable to the proposal.

The Minister for Planning (or their delegate) determines development applications for under section 96(2) of the EP&A Act.

The modification application is focused on the impacts associated with the extension of longwall panels 22 and 23 with the Project remaining substantially the same as the development that was originally approved.

5.2 Commonwealth Legislation

5.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance' (MNES). An action that "*has, will have or is likely to have a significant impact on a matter of National Environmental Significance*" may not be undertaken without prior approval from the Commonwealth Minister, as provided under Part 9 of the EPBC Act. Approval under the EPBC Act is also required where actions are proposed on, or will affect, Commonwealth land and its environment.

As the Modification does not involve any impacts to vegetation or water resources is not likely to have a significant impact on matters of NES listed under the EPBC Act. Consequently a referral to the Department of the Environment will not be made.

5.2.2 Native Title Act 1993

The *Native Title Act 1993* recognises that Aboriginal people have rights and interests to land and waters which derive from their traditional laws and customs. Native title may be recognised in places where Indigenous people continue to follow their traditional laws and customs and have maintained a link with their traditional country. It can be negotiated through a Native Title Claim, an Indigenous Land Use Agreement (ILUA) or future act agreements.

An ILUA is an agreement between a native title group and other parties who use or manage the land and waters. The ILUA process allows for negotiation between indigenous groups and other parties over the use and management of land and water resources, and the ability to establish a formal agreement. An ILUA is binding once it has been registered on the Native Title Tribunal's Register of Indigenous Land Use Agreements.

Native Title matters were addressed as part of the larger Mandalong Southern Extension Project (SSD 5144). Centennial Mandalong believes there to be no outstanding Native Title matters in relation to the Modification.

5.3 New South Wales State Legislation

5.3.1 Environmental Planning and Assessment Act 1979

Objects of the EP&A Act

The EP&A Act is the principal piece of legislation overseeing the assessment and determination of development proposals in NSW. It aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development.

The objects of the EP&A Act generally seek to promote management and conservation of natural and artificial resources, while also permitting appropriate development to occur. The principles of ecologically sustainable development and public participation are also objectives of the EP&A Act. The consistency of the Project with these objects is summarised in **Table 4**.

Table 4: Objects of the EP&A Act

Objects of the EP&A Act	Consistency of the Project
(b) to encourage:	
(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,	Specialist consultants have been engaged to assess and report on the potential for the Modification to impact upon the natural and artificial resources within the vicinity of the PAA in addition to socio-economic factors. Notably: • The impacts on the natural environment have been addressed within Section 9.0. • A socio-economic analysis is contained in Section 6.0.
(ii) the promotion and co-ordination of the orderly and economic use and development of land,	The orderly and economic use of land is best served by development which is permissible under the relevant planning regime and predominantly in accordance with the prevailing planning controls. The Modification comprises a permissible development which is consistent with the statutory and strategic planning controls. As detailed in this SEE, the proposal will result in positive economic impacts, with improved operational efficiencies. Appropriate mitigation measures and management strategies are examined with regard to adverse environmental impacts.
(iii) the protection, provision and co-ordination of communication and utility services,	Refer to Section 5.3.3.
(iv) the provision of land for public purposes,	Not applicable to the proposal.
(v) the provision and co-ordination of community services and facilities, and	Not applicable to the proposal.
(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and	Where relevant, specialist consultants have been engaged to assess and report on the potential for the Project to impact upon the local environment.
(vii) ecologically sustainable development, and	The proposal is consistent with the principles of ecological sustainable development as outlined in Section 10.4, addressing both this object of the EP&A Act and clause 7(1)(f) in Schedule 2 of the EP&A Regulation.
(viii) the provision and maintenance of affordable housing, and	Not applicable to the proposal.
(c) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and	The SSD proposal is subject to the provisions of Part 4 of the EP&A Act, where the Minister for Planning is the consent authority.
(d) to provide increased opportunity for public involvement and participation in environmental planning and assessment.	As outlined in Section 7.0, Centennial Mandalong has undertaken consultation in relation to the Modification with relevant stakeholders. This consultation process is continuing with respect to the progression towards obtaining development consent for this modification being

Objects of the EP&A Act	Consistency of the Project
	Modification 4 to SSD-5144. Any relevant public representations will need to be considered by DP&E during the assessment of the development application.

Section 79C Evaluation

Section 79C of the EP&A Act applies to the determination of development applications for SSD. In determining the Modification, the consent authority is required to consider the matters listed in Section 79C(1) of the EP&A Act as are of relevance to the development. Each of the relevant matters has been addressed in the SEE and will need to be considered by the consent authority during the assessment of the Modification.

Other Approvals

Pursuant to Section 89J of the EP&A Act, the following authorisations are not required for approved SSD proposals:

- The concurrence under Part 3 of the *Coastal Protection Act 1979* of the Minister administering that Part of the Act;
- A permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*;
- An approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977*;
- An Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974*;
- An authorisation referred to in section 12 of the *Native Vegetation Act 2003* (or under any Act to be repealed by that Act) to clear native vegetation or State protected land;
- A bush fire safety authority under section 100B of the *Rural Fires Act 1997*;
- A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000*; and
- An order under Division 8 of Part 6 of the *Heritage Act 1977* restricting harm to buildings, works or relics that are not protected by a heritage listing.

Pursuant to Clause 89K of the EP&A Act, an authorisation of the following kind cannot be refused if it is necessary for carrying out an approved SSD proposal, and must be granted "substantially consistent" with the SSD consent:

- An aquaculture permit under section 144 of the *Fisheries Management Act 1994;*
- An approval under section 15 of the *Mine Subsidence Compensation Act 1961*;
- A mining lease under the *Mining Act 1992*;
- A production lease under the *Petroleum (Onshore) Act 1991*;
- An environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* (for any of the purposes referred to in section 43 of that Act);

- A consent under section 138 of the *Roads Act 1993;* and
- A licence under the *Pipelines Act 1967.*

The need to obtain any of the above approvals for the Modification is outlined in the section below.

5.3.2 Other Key NSW State Legislation

The existing approvals relevant to the Project are described in Section 3.2.

In addition to the requirement for development consent under Part 4 of the EP&A Act, the Project requires approvals, licences and/or authorities under various other pieces of NSW State legislation. **Table 5** lists the key relevant pieces of NSW State legislation and indicates the implications, if any, for the Project.

Table 5: Relevant NSW State Legislation

NSW State Legislative Act	Project Implications (approvals, licences and/or authorities)
Protection of the Environment Operations Act 1997 (POEO Act)	Mandalong Mine is a premises-based "scheduled activity" under Schedule 1 of the POEO Act and currently operates under the provisions of EPL 365. Schedule 1 of the POEO Act lists activities that are scheduled activities for the purposes of the Act. As EPL 365 permits coal works and mining for coal at a scale in excess of 5,000,000 tonnes no variation to EPL 365 will be sought.
Mining Act 1992	Centennial Mandalong currently holds a number of mining leases. No change to existing mining tenements is required.
Water Act 1912	The *Water Act 1912* governs access, trading and allocation of licences associated with surface water and groundwater sources where a Water Sharing Plan is not in place. The *Water Act 1912* applies to groundwater interference, bore installation and extraction of groundwater. No further licenses or allocation are a required as a result of this modification.
Water Management Act 2000 (WM Act)	The WM Act is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. Water sharing plans prepared in accordance with the WM Act include rules for protecting the environment and administrating water licencing and trading. By the operation of Section 89J of the EP&A Act, the Project will not require water use approvals under Section 89 of the WM Act, water management approvals under Section 90 or a controlled activity approval under Section 91.
Work Health and Safety (Mines) Act 2013	Centennial Mandalong currently holds all necessary approvals under the WHS (Mines) Act, which aims to assist in securing and promoting the health, safety and welfare of people at work at coal operations. Gas drainage and management at Mandalong Mine will continue to be regulated under the provisions of the Act.
Mine Subsidence Compensation Act 1961	Whilst the PAA is located within the Mandalong Mine Subsidence Districts no additional infrastructure is required therefore no approval from the Mine Subsidence Board is required.
Dams Safety Act 1978	The Modification does not propose any underground mining or surface disturbance on or in the vicinity of any dams prescribed under the *Dam Safety Act 1978*.

NSW State Legislative Act	Project Implications (approvals, licences and/or authorities)
Crown Lands Act 1989	The PAA exists over Private land and Crown roads. The Project will not require a licence to use Crown Land under the provisions of the *Crown Lands Act 1989*.
Roads Act 1993	Section 138 of the *Roads Act 1993* requires consent be obtained prior to disturbing or undertaking work in, on or over a public road. Use of the local road network for site access will be required for the duration of the Project. By operation of Clause 89K of the EP&A Act, consent under Section 138 of the *Roads Act 1993* cannot be refused if it is necessary for carrying out an approved SSD proposal, and must be granted substantially consistent with the SSD consent.
Threatened Species Conservation Act 1995 (TSC Act)	The TSC Act provides protection for threatened plants and animals native to NSW (excluding fish and marine vegetation) and integrates the conservation of threatened species into development control processes under the EP&A Act. No impacts to vegetation will occur as a result of the Modification.
National Parks and Wildlife Act 1974 (NPW Act)	The NPW Act contains provisions for the protection and management of national parks, historic sites, nature reserves and Aboriginal heritage. By operation of Section 89J of the EP&A Act, the Project does not require any additional approvals under the NPW Act.
Aboriginal Land Rights Act 1983	The *Aboriginal Land Rights Act 1983* provides for the constitution of local, regional and State Aboriginal Land Councils and a mechanism for Land Councils to claim Crown land. There are no known granted claims over Crown Land in the PAA.
Heritage Act 1977	Historical archaeological relics, buildings, structures, archaeological deposits and features are protected under the *Heritage Act 1977*. There are no references to heritage items in the PAA within the World Heritage List, NSW Heritage Register, Australian Heritage Database or the relevant Local Environmental Plans. The Modification will not impact on heritage items. In any event, approval is not required due to the operation of Section 89J of the EP&A Act.
Contaminated Land Management Act 1997	The relevance of this legislation to the Modification is outlined below.
Forestry Act 1916	No permits are required for the Forestry Corporation of NSW regarding the Modification.

5.3.3 State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) are Environmental Planning Instruments prepared by the Minister to address issues significant to NSW. The SEPPs outlined in the below sub-sections contain provisions that are relevant to the Project and therefore are matters to be taken into consideration by the consent authority.

SEPP (State and Regional Development) 2011

SEPP (State and Regional Development) 2011 (SRD SEPP) came into effect upon the repeal of Part 3A of the EP&A Act and identifies development to which the SSD assessment and determination process under Division 4.1 in Part 4 of the EP&A Act applies.

SEPP (Mining, Petroleum Production and Extractive Industries) 2007

SEPP (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of NSW.

Part 3 of the Mining SEPP stipulates matters for consideration by the consent authority before determining an application for consent in respect of development for the purposes of mining. Specifically, Clauses 12 to 17 (inclusive), requires consideration to be given to the compatibility of projects with other surrounding land uses, including the existing and potential extraction of minerals, natural resource management and environmental management, resource recovery, transportation and rehabilitation.

The information presented in this SEE addresses each of the matters for consideration prescribed in the abovementioned clauses, and the assessment undertaken has been multi-disciplinary and involved consultation with relevant stakeholders. Emphasis has been placed on anticipation and prevention of potential environmental and social impacts, with various mitigation measures, management strategies, and monitoring activities proposed to minimise adverse impacts.

SEPP (Infrastructure) 2007

SEPP (Infrastructure) 2007 (Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across NSW by improving regulatory certainty and efficiency through a consistent planning regime and greater flexibility in the location of infrastructure and service facilities.

This Modification will result in no impact to infrastructure and services under this policy.

SEPP No. 55 – Remediation of Land

SEPP No. 55 – Remediation of Land (SEPP 55) provides for a state-wide planning approach to the remediation of contaminated land in order to reduce the risk to human health or any other aspect of the environment.

Clause 7(1) of SEPP 55 provides that a consent authority must not consent to the carrying out of any development on land unless:

- it has considered whether the land is contaminated, and
- if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and
- if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

Further, clause 7(2) of SEPP 55 provides that before determining an application for consent to carry out development that would involve a "change of use" in respect of certain land specified in clause 7(4) of SEPP 55, the consent authority must consider a report specifying the findings of a preliminary investigation of the land concerned carried out in accordance with the contaminated land planning guidelines (being the 1998 publication *Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land*).

For the disturbance areas of the existing Mandalong Mine in respect of which the Project does not involve any "change of use", Centennial Mandalong submitted Contamination Notifications to the EPA in February 2012 in accordance with section 60 of the *Contaminated Land Management Act 1997*. In accordance with commitments made to the EPA in the Notifications, Centennial Mandalong has

commenced undertaking Phase 2 assessments at both the MMAS and Cooranbong Entry Site. Following the completion of the Phase 2 assessments, remediation plans will be developed and implemented in consultation with the EPA and an accredited contaminated land auditor to address any contamination issues identified. In a letter dated the 6 July 2012 the EPA confirmed acceptance of the approach proposed by Centennial Mandalong.

Finally, Centennial Mandalong will implement best management practices for hydrocarbons, along with the approved EMS and occupation health and safety management systems, at the Mandalong Mine to ensure the potential for contamination and associated issues remains low.

SEPP No. 44 – Koala Habitat Protection

SEPP No. 44 – Koala Habitat Protection provides for the protection of koala habitat by ensuring that areas subject to development proposals are considered for their value as habitat or potential habitat for koalas. The Lake Macquarie LGA is listed under Schedule 1 of SEPP No. 44 as an area to which the SEPP applies.

SEPP No. 33 – Hazardous and Offensive Development

SEPP No. 33 - Hazardous and Offensive Development (SEPP 33) regulates, amongst other things, the determination of development applications to carry out what is defined in SEPP 33 as development for the purposes of a "potentially hazardous industry" or "potentially offensive industry". With the continued implementation of best management practices for hydrocarbons and explosives used within the PAA and the other measures outlined in this SEE to reduce or minimise the impact of the Modification, as well as effective implementation of the approved EMS and occupation health and safety management systems, the Modification would not pose any significant risk, in relation to its locality, to human health, life or property or to the biophysical environment.

The Project is not considered to comprise a "potentially hazardous industry" or a "potentially offensive industry" within the meaning of these expressions in SEPP 33, and therefore a preliminary hazard analysis was not prepared as required by clause 12 of SEPP 33 and nor does clause 13 of SEPP 33 apply to the consent authority's determination of the Modification application.

SEPP No. 14 – Coastal Wetlands

SEPP No. 14 - Coastal Wetlands aims to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State. The provisions of SEPP 14, insofar as they require the consent authority to obtain the concurrence of the Director-General of DP&E, do not apply to the Project by reason of the exclusion for SSD provided for in section 79B(2A) of the EP&A Act.

5.3.4 Local Environmental Plans

Local Environmental Plans (LEPs) are instruments that guide planning decisions for LGAs and allow Councils to manage the ways in which land is used through zoning and development consents.

Lake Macquarie Local Environmental Plan 2014

The objective of the *Lake Macquarie Local Environmental Plan 2014* (Lake Macquarie LEP) is

> (a) to recognise the importance of Lake Macquarie City and its waterways and the coast as an environmental, social, recreational and economic asset to Lake Macquarie City and the Hunter and Central Coast regions,
>
> (b) to implement a planning framework that protects areas of significant conservation importance, while facilitating development and public facilities in appropriate areas, that are accessible to a range of population groups, to accommodate Lake Macquarie City's social and economic needs,

(c) to promote the efficient and equitable provision of public services, infrastructure and amenities,

(d) to facilitate a range of accommodation types throughout Lake Macquarie City so that housing stock meets the diversity of community needs and is affordable to as large a proportion of the population as possible,

(e) to apply the principles of ecologically sustainable development,

(f) to encourage development that enhances the sustainability of Lake Macquarie City, including the ability to adapt to and mitigate against climate change.

The land zonings of the relevant components within the PAA pursuant to the *Lake Macquarie Local Environmental Plan (LEP) 2014* are:

- The existing MMAS is zoned in a mix of E2 Environmental Conservation, RU2 Rural Landscape and SP1 Special Activities (Mine);
- The proposed MSSS is zoned E2 Environmental Conservation; and
- The approved underground mining area is predominantly zoned a mix of E2 Environmental Conservation, E3 Environmental Management, RU2 Rural Landscape and RU3 Forestry.

Clause 8 of the Mining SEPP outlines its relationship to other environmental planning instruments:

The operation of the above provisions in respect of the Project are subject to the application of clause 8 of the Mining SEPP, which provides:

8 Determination of permissibility under local environmental plans

(1) If a local environmental plan provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if provisions of the plan are satisfied:

(a) development for that purpose may be carried out on that land with development consent without those provisions having to be satisfied, and

(b) those provisions have no effect in determining whether or not development for that purpose may be carried out on that land or on the determination of a development application for consent to carry out development for that purpose on that land.

(2) Without limiting subclause (1), if a local environmental plan provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if the consent authority is satisfied as to certain matters specified in the plan, development for that purpose may be carried out on that land with development consent without the consent authority having to be satisfied as to those specified matters.

On this basis, any provision in the Lake Macquarie LEP that would otherwise operate to prohibit the Project has no effect, and accordingly, the Project is permissible with development consent on the land in which the Project will be carried out that is within the Lake Macquarie LGA. Permissibility matters were considered as part of the Mandalong Southern Extension Project which was subsequently granted development consent SSD-5144. This application is seeking to modify this existing development consent pursuant to Section 96(2) of the EP&A Act.

Notwithstanding the application of clause 8 of the Mining SEPP, the assessment of the Project in this modification and the original EIS:

- Enables the consent authority to have regard to the vision, values and aims of the *Lifestyle 2030 Strategy*;

- Enables the consent authority to be satisfied as to the provision of adequate infrastructure to support the Project; and

- Demonstrates that the Project is consistent with the relevant objectives of the zones within which the Project is located and any special controls that would apply to the Project were it not development for the purpose of mining.

Wyong Local Environmental Plan 2013

As was approved under SSD-5144, the small area proposed for mining within the Southern Extension Area that falls within the Central Coast Council LGA is proposed to be zoned a mix of RU1 Primary Production, E2 Environmental Conservation, E3 Environmental Management and RE1 Public Recreation. Whilst underground mining is a prohibited land use within all these zones, sub-clause 7(1)(a) of the Mining SEPP states that development for the purpose of underground mining may be carried out on any land with developed consent. In relation to any inconsistency between the Mining SEPP and an LEP, sub-clause 5(3) provides that the Mining SEPP prevails to the extent of the inconsistency. On this basis, any provision in the Wyong LEP that would otherwise operate to prohibit the Project has no effect.

5.3.5 Other Considerations

Lake Macquarie City Council's Lifestyle 2030 Strategy

Lake Macquarie City Council's *Lifestyle 2030 Strategy* (LS2030) was adopted by LMCC on 11 March 2013. The LS2030 provides the long-term direction for the overall development of the City and describes LMCC's high level policies for managing private and public development in Lake Macquarie. LS2030 is the primary guiding document for the development of local plans, regulations and guidelines that control development of land. It is anticipated that major reviews of LS2030 will occur every five years.

Draft Central Coal Regional Plan

The *Draft Central Coal Regional Strategy* is the NSW Government's long-term land use plan for the region covering the Gosford City and Wyong LGAs. The Project is considered to be generally consistent with the objectives of the plan and will not adversely impact upon the opportunities identified for rural and resource lands.

5.3.6 Water Sharing Plans

Water Sharing Plans (WSP) prepared in accordance with the *Water Management Act 2000* include rules for protecting the environment, extractions, managing licence holders' water accounts, and water trading within defined areas and specified water sources. The PAA is within an area covered by the three water sharing plans listed below:

- Water Sharing Plan for the Jilliby Creek Water Source 2003;

- Water Sharing Plan for the Central Coast Unregulated Water Sources 2009, and

- Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009.

5.3.7 Strategic Regional Land Use Policy

The NSW Government's *Strategic Regional Land Use Policy* was introduced in September 2012 and sets out a range of initiatives to better balance growth in the mining industry with the need to protect agricultural land and water resources.

The Modification will not result in any impact to BSAL or changes to the land and soil capability classes.

Potential impacts to agricultural resources and BSAL are assessed by SLR Consulting in **Appendix 8** and **Appendix 9** and summarised in **Section 9.5** of this SEE.

5.3.8 NSW Aquifer Interference Policy

The *NSW Aquifer Interference Policy* (AIP) is a key component of the NSW Government's *Strategic Regional Land Use Policy*. The AIP clarifies the water licensing and approval requirements for aquifer interference activities, including the taking of water from an aquifer in the course of carrying out mining, and defines the considerations for assessing potential impacts to key water-dependent assets.

The AIP indicates that where mining results in the loss of water from an overlying source that is covered by a WSP, a water access licence is required under the WM Act to account for this take of water.

In water sources where WSPs do not yet apply, an aquifer interference activity that is taking groundwater is required to hold a water licence under Part 5 of the *Water Act 1912*. The requirements for proponents detailed in the AIP also apply to applicants for a *Water Act 1912* licence. An application for a licence made under the *Water Act 1912* will be assessed on the same considerations as an application for an access licence made under the *Water Management Act 2000.*

Potential impacts to water resources are assessed by GHD in **Appendix 5** and summarised in **Section 9.2** of this SEE.

5.3.9 Lower Hunter Regional Strategy 2006-31

The Department of Planning and Environment's *Lower Hunter Regional Strategy 2006-31* (Lower Hunter Regional Strategy) identifies how the expected growth in the Lower Hunter Region (encompassing the five local government areas of Newcastle, Lake Macquarie, Port Stephens, Maitland and Cessnock) will be managed to provide for both economic development and the protection of environmental assets, cultural values and natural resources. The Lower Hunter Regional Strategy is implemented primarily through local environmental plans, development control plans, through the State Infrastructure Strategy and through funds collected as developer contributions. The Lower Hunter Regional Strategy is to be comprehensively reviewed every five years, so that it can adjust to any demographic and economic changes. This will assist local councils will their five-yearly review of local environmental plans, required under recent reforms to the planning system. In February 2010, the NSW Government announced it had re-endorsed the Lower Hunter Regional Strategy as a sound platform to guide the region's future growth.

6.0 SOCIO-ECONOMIC ANALYSIS

6.1 Economic Analysis

The Modification's economic assessment was prepared by AIGIS GROUP (2016) and appears as **Appendix 2** to this SEE.

The economic assessment has been prepared to comply to the greatest extent practicable with *Guidelines for the economic assessment of mining and coal seam gas proposals* (DP&E 2015). The assessment compares the relative outcomes of continuing the Mandalong Mine as currently approved under SSD-5144 against the changes proposed under this modification.

The cost-benefit analysis (CBA) conducted indicates an incremental economic benefit associated with increase in the recoverable resource as stated. The principal sources of this benefit are an increase in royalty revenue of approximately $6 million and the labour surplus accruing to the local/regional economy associated with the additional works required to recover the resource, of approximately $9 million.

These benefits are offset by an increase in the likelihood of certain environmental effects occurring with associated social considerations. These are valued at approximately $10 million.

Overall, the Modification is estimated to increase beneficial economic and related social effects by approximately $5 million. The assessment also identifies a positive Benefit-Cost Ratio (BCR) of 1.5.

Local Effects Analysis (LEA) indicates that extraction of the additional resource results in a modest change in the socioeconomic effects in the regional and local economies estimated for the overall Project. The relatively short duration of the additional operations contributes to the limited effects that the Modification may entail. Public infrastructure and amenity effects remain similar to those for the SSD-5144 Project as approved, and thus have no discernible cumulative impact.

The Modification entails an increase in total production of the mine of approximately 1.4 million tonnes of ROM coal. Whilst this additional production will be conducted within the consent term of 2040, this volume will generate additional royalty revenue and employment benefits for the state and regional economies. The Modification will result in some increased environmental impacts, over the brief period in which the relevant operations will take place. The Modification returns positive net present value (NPV) and benefit-cost ratio (BCR) returns across a range of modelled possible economic outcomes, as demonstrated using sensitivity testing and application of alternative pricing data, including World Bank price forecasts for the export component of the mine's output. The analysis in this economic assessment suggests that the Modification would have a positive effect on the quantum of economic benefits accruing to NSW, and the regional economies, already associated with the SSD-5144 Project. As a result, the Modification is supportable on the basis of its likely positive socio-economic contribution.

6.2 Social Analysis

The Modification's Social Impact Assessment appears as **Appendix 3** to this SEE.

The Modification will result in no broad scale change to the land use characteristics and/or environment. The assessment of impacts arising from longwalls 22 and 23 has concluded that the primary social impact relates to properties identified as 73 and 207 due to the direct relationship to the proposed longwall mining.

Property 73 is utilised as a residential dwelling with agricultural activities including orchards (citrus and berries), biodynamic farming and hobby farm activities (cattle and horses). Property 207 is again utilised for residential purposes with hobby farm activities (horses). For both properties 73 and 207 it is determined that there will be no impact on the current land uses or lifestyle of these residents.

Through this process and despite minimal impact identified, it is reasonable to assume that affected residents will have a degree of angst in relation to the affect of subsidence. Ongoing consultation is to occur via the Property Subsidence Management Plan process with any exceedances of the relevant performance criteria triggering the need for the implementation of management and mitigation activities contained in the relevant Trigger Action Response Plans. Consultation with the affected landholders will be undertaken prior to and post mining in order to monitor the effect of subsidence and maintain contact with the landholder. Mitigation strategies documented in the Property Subsidence Management Plans are to be adhered to.

Overall, it is found that there is no adverse impact to amenity, land uses or residential dwellings. On that basis it is considered that the social impact is negligible. However ongoing consultation with each landholder is required to keep each landholder informed of the mining progress and any changes to the predicted impacts.

6.3 Conclusion

The changes to economic outcomes at Mandalong Mine that the modification would stimulate relate to changes in production schedule assumptions and the timing of realisation of economic benefits. The analysis suggests that the Modification would have a positive effect on the quantum of economic benefits accruing to NSW, which in effect is largely consistent with that identified for the Mandalong Southern Extension Project approved under SSD-5144.

Overall the project as modified results in no long term socio-economic impacts with the modification being undertaken to optimise the resource within the existing Project Application Area and mining tenements.

7.0 STAKEHOLDER ENGAGEMENT

7.1 Introduction

Centennial Mandalong places the utmost importance on maintaining effective communication with the local community and other key stakeholders. Centennial Mandalong has implemented a Stakeholder Engagement Strategy to undertake the following:

- Set a process for engagement with stakeholders of interest, with clear desired outcomes for the Company and stakeholders;
- Openly communicate with stakeholders about Mandalong Mine's operations;
- Serve as a tool for understanding the reasonable expectations and interests of stakeholders, and
- Provide a means of community access to the Project team.

Consultation has also been undertaken with stakeholders specifically in relation to this Modification. The sections below provide detail on the consultation undertaken.

7.2 Affected Landowners Requiring a Property Subsidence Management Plan

Two dwellings are affected with regard to the extension of Longwalls 22 and 23 as illustrated in **Figure 5.** Property Reference No. 73 is located directly above LW 23 as extended with Property Reference No. 207 located to the south of Longwall 23.

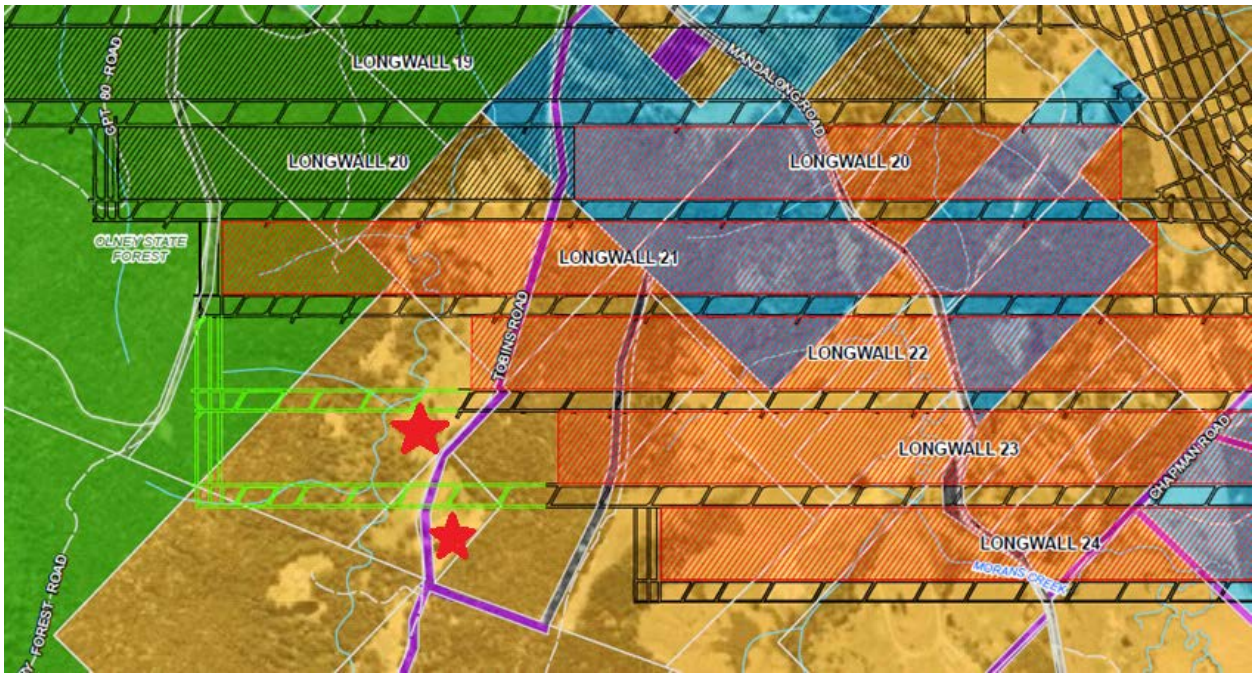


Figure 5 – Affecting Dwellings (indicated by red stars)

Consultation undertaken with both landowners is summarised in **Table 6** and **Table 7** below:

Table 6: Consultation with Property Reference No. 73: Lot 93, DP 755238

Date	Details of Consultation and Issues Raised	Outcome
2/09/2015	Mining notification letter posted to all landowners' affected by the Extraction Plan application for LW22-24A.	Mining notification provided to the landowner, detailing proposed application process, mining operations information and predicted subsidence.
9/09/2015	Landowner phone call to express concern that the mine layout now extends further beneath the property and now includes their dwelling that was previously determined to be intruded by igneous sill.	Agreed to meet on 11/09/2016 prior to landowner going overseas.
11/09/2015	Centennial Mandalong personnel met with landowner at the property. The change in mine plan due to current geological information and recent success in mining coal that had been partially intruded by the igneous sill was explained. Inspected the property including berry and orchard production areas, drainage paths and areas of tunnel erosion. Landowner requested that all necessary inspections and surveys be conducted on the property including archaeology, MSB inspection, structural inspection and subsidence monitoring.	All required inspections surveys arranged including drainage paths on the property and neighbouring property.
4/05/2016	Provided an update on the PSMP following return from six months overseas. Arranged for ecology, heritage and soil sampling.	Access agreement in place to conduct environmental studies.
28/08/2016	Centennial has agreed with the landowner to conduct a trial tunnel erosion remediation program on an area of existing tunnel erosion area along an internal access road and drainage line.	Trial tunnel remediation program is being developed and implemented.

Table 7: Consultation with Property Reference No. 207: Lot 2, DP 1090233

Date	Details of Consultation and Issues Raised	Outcome
25/06/2015	Meeting with landowners to provide information and discuss Mandalong Mine and potential mining near or beneath their property. Discussed the proposed exploration program to determine the extent of the igneous sill.	Discussed proposed mining and exploration on the property. Draft exploration access agreement was provided for review.
2/09/2015	Mining notification letter posted to all landowners' affected by the Extraction Plan application for LW22-24A.	Mining notification provided to the landowner, detailing proposed application process, the mining operation, predicted subsidence

Date	Details of Consultation and Issues Raised	Outcome
5/02/2015	Meeting with landowner to discuss mining application for LW22-24A and process for the development of their PSMP. Conducted property inventory. Offer payment for legal advice as required by Development Consent. Also inspected exploration drilling site to complete drilling program on property and rehabilitation.	Meeting to commence development of PSMP. Completed property inventory.
20/06/2016	Request to conduct structural inspection of dwelling by qualified civil/structural engineer in preparation for PSMP.	Dwelling is currently being renovated. Agreed to complete structural inspection when renovations works have been completed.
23/09/2016	Conducted soil sampling on property for inclusion in PSMP.	Soil sampling completed on property.

7.3 Broader Community and Local Government Engagement

Consultation with the broader community and local government has occurred as outlined below:

- The Mandalong Mine CCC, which is independently chaired and comprises representatives from the local community and Lake Macquarie City Council (LMCC), meets on a quarterly basis. In accordance with the DP&E guidelines, the CCC is a forum for open discussion between Centennial Mandalong, the community, LMCC and other stakeholders on issues directly relating to Mandalong Mine's operations, projects, environmental performance and community relations. The Modification was discussed during the meeting on 25 October 2016. Minutes from these meetings and the presentations made are available on the Centennial Coal website.

- A dedicated community information telephone number was established for the Mandalong Southern Extension Project which has continued to be in use for this Modification. The number exists as a freecall 1800 730 919 number to provide interested community members with access to the Project Team regarding any queries or concerns in relation to the Modification. The telephone number continues to be advertised through ongoing correspondence including the Mandalong Mailbox newsletter.

7.4 Indigenous Stakeholders

Consultation with relevant indigenous stakeholders is ongoing for Mandalong Mine. The objective of the consultation process is to ensure that an opportunity is given to a broad range of Aboriginal stakeholders to express their cultural heritage values, including spiritual connections, archaeological sites, and the natural environment and landscape values.

The consultation methodology to date involved the identification of Aboriginal Land Councils, Aboriginal elders and other interested parties in accordance with the *NSW Aboriginal Cultural Heritage Consultation Requirements for Proponents* (ACHCR), followed by consultation with Aboriginal communities and other stakeholders in the area.

Detailed consultation undertaken for this modification is provided in Section 9.4.2 of this SEE in addition to **Appendix 7**.

7.5 Utility and Service Providers

7.5.1 Ausgrid

Consultation was undertaken during October 2016 with Ausgrid regarding the development of the Powerline Management Plan to manage the risks associated with surface subsidence caused by the mining of longwall panels 22 and 23 and their interaction with the Ausgrid power transmission network. Consultation with Ausgrid on this matter is ongoing.

7.5.2 Telstra

The Communications Management Plan for longwall panels 22 and 23 has been prepared and developed in consultation with Telstra and their approved communications consultant. Comms Network Solutions (2016) conducted an audit of the Telstra infrastructure located over the extraction plan area and provided an impact assessment report against the predicted subsidence from LW22-23.

Mandalong Mine has successfully extracted 19 longwalls beneath Telstra infrastructure since the commencement of longwall mining in 2005. There have been five previous revisions of the Telstra Communications Management Plan. Each revision has been conducted in consultation with Telstra and Comms Network Solutions in preparation for each mining application (SMP/Extraction Plan).

Consultation with Telstra is ongoing.

7.6 Forestry Corporation of NSW

Consultation with Forestry Corporation of NSW (FCNSW) regarding ongoing mining operations and the impact on forestry resources is ongoing. Specifically regarding longwalls 22 and 23, FCNSW was notified of the forthcoming Extraction Plan being developed for these panels in correspondence during October 2016. It was outlined that the layout of the proposed mining is similar to the previous longwall panels, with the predicted subsidence to be consistent with previous mining beneath Olney State Forest.

7.7 Department of Planning and Environment

Centennial Coal personnel met with DP&E representatives on 9 August 2016 to discuss the proposed extensions and modifications required. Due to the mine's schedule, it was agreed to submit one modification application for the extraction of extended longwall panels 22 and 23 and a separate modification application for the extension of longwall panel 24 and addition of longwall panel 24A. Since this meeting a separate modification (Mod 2) has been lodged for assessment regarding the extended development of first workings associated with the maingates for longwall panels 22 and 23.

Subsequent correspondence dated 13 September 2016 clarified the modification and outlined the proposed assessments to be undertaken to support the application in addition to the approval pathway. The letter outlined the following which was supported by DP&E in email correspondence dated 16 September 2016:

- That the proposed modifications to the Mandalong Southern Extension Project 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 modifications will provide additional coal resources within the existing Project Application Area given the improved understanding regarding the extent and condition associated with the igneous sill. As such, it was considered the modifications could be modified pursuant to Section 96(2) of the EP&A Act.

- That Centennial Mandalong is currently completing separate Extraction Plans for longwall panels 22-23 and 24-24A in accordance with the requirements of Schedule 4, Condition 6 of SSD-5144.

Condition 6(e) requires data and information to be obtained as part of the Extraction Plan's development to determine revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed second workings. It was proposed to use this data and information to inform this SEE with additional desktop assessments and fieldwork has been commissioned as necessary to address the differences between the Extraction Plan requirements and Modification requirements.

8.0 IDENTIFICATION OF KEY ENVIRONMENTAL ISSUES

8.1 Introduction and Objectives

Centennial Mandalong utilises a risk-based approach to manage safety, environment and social issues as a result of its operations at Mandalong Mine. This process involves personnel identifying issues or recognising areas where further information is required in addition to recommending any necessary controls to address identified risks. This practice is guided by the overarching Centennial Environmental Policy which requires continual improvement of environmental performance through risk management strategies based on clear science and valid data.

The compilation of this SEE has been undertaken through a risk based and consultative approach. The key assessment issues warranting detailed investigation and discussion were identified through a range of measures including:

- The existing environmental context of the overall operation and its surrounding locality (see **Sections 2 and 3**).
- The regulatory framework applicable to the Modification (see **Section 5**).
- The outcomes of consultation undertaken with government agencies and other relevant stakeholders (see **Section 7**).
- Specialist studies completed as part of the preparation of the SEE (see **Section 9**).

The scope of the assessment was discussed with DP&E. Where there was a knowledge gap in the information available, or where risks were considered unacceptable, a technical specialist assessment has been undertaken to support the SEE.

8.2 Proposed Activities with the Potential to Cause Environmental Impacts

The activities identified for the Modification with the potential to cause environmental, social and economic impacts are as follows:

- Subsidence impacts on the built and natural environment. Specifically:
    - Private properties, roads and services;
    - Groundwater and surface water resources;
    - Biodiversity;
    - Cultural and historic heritage items, and
    - Land and agricultural resources.
- Change in groundwater make attributable to the proposed extension of longwall panels 22 and 23 in addition to any subsequent water management requirements.
- Increase in scope 1, 2 and 3 greenhouse gas emissions due to the approximate additional 1.4 million tonnes of coal to be extracted.
- Social and economic considerations.

8.3 Conclusion

In response to the risks identified the following technical specialist assessments were carried out to inform this SEE:

- Subsidence Predictions;
- Groundwater and Surface Water Impact Assessment;
- Biodiversity Impact Assessment;
- Cultural and Historic Heritage Impact Assessment;
- Land and Agricultural Resources Impact Assessment;
- Greenhouse Gas Assessment;
- Economic Impact Assessment, and
- Social Impact Assessment.

The following sections of this report contain an assessment of all relevant environmental issues.

9.0 ASSESSMENT AND MANAGEMENT OF KEY ENVIRONMENTAL ISSUES

From the technical specialist assessments, this section provides a summary of the potential impacts of the Modification and the measures that will be implemented to mitigate and manage such impacts.

9.1 Subsidence Predictions

9.1.1 Introduction

Subsidence predictions regarding longwall panels 22 and 23 as extended are outlined in the technical report *Centennial Mandalong Pty Ltd Prediction of Subsidence Impacts for LW22-LW23* (Seedsman Geotechnics 2016) (**Appendix 4**).

The mine layout is designed to take benefit from the presence of a very thick and strong conglomerate layer in the overburden in order to minimise subsidence impacts. As a result of the mine's design, vertical subsidence of less than 1 m is generally experienced across the mining area compared to maximum predicted subsidence of 2.98 m in the DA97/800 EIS which projects surface and subsurface features from significant impact. The mine layout has been successfully employed for 20 panels mined to date and the same approach to mine design has been adopted for LW22-23 as extended.

The primary objectives of the Subsidence Predictions report were:

- To review the measured subsidence over the panels extracted to date.
- Provide subsidence predictions in terms of vertical subsidence, tilt, strain and horizontal subsidence for longwall panels 22-23 as extended.
- Outline the effect of the subsidence predictions with regards impacts and consequences to the built and natural environment.
- Demonstrate confidence in the predictions through reliability testing.

9.1.2 Existing Environment

Subsidence above the chain pillars at Mandalong Mine has ranged between less than 100 mm to about 1 m depending on the depth of cover. This is no evidence that there has been any pillar collapse. Relative deflection of the surface between adjacent chain pillars has been consistent with the predictions. There has been no measurable subsidence above the main headings. The measured tilts and strains have also been consistent with the predictions.

- **Mine Geometry**

  The chain pillars are currently 37m wide with each longwall extraction void being 160 m. The development roadway height is 3.4 m and the depth of cover ranges between 250 m and 330 m with the surface topography lying between 20 m and 80 m above sea level.

  The longwall panel width at Mandalong Mine (initially 125 m for longwall panels 1-4 and since 160 m for longwall panels 5- 23) has been specifically designed to exploit the presence of a very thick and strong conglomerate layer in the overburden in order to minimise subsidence impacts. The mine layout is designed so that this layer can span across the longwall extraction panel and deform elastically. This has resulted in vertical subsidence of less than about 1 m (compared to a maximum subsidence of 2.98 m in the DA97/800 EIS) and has protected surface and subsurface features from significant impact.

In developing the mine layout in 2003 the approach was to have surface deformations that would be below safe serviceable and repairable (SSR) regarding dwellings and would not result in a significant change in the flood hazard. In 2003, this was converted to constraints of less than 7 mm/m tilt, 4 mm/m strain, and less than 500 mm subsidence under the flood plains – more than 500 mm was acceptable in the high ground where the depth of cover is deeper. These constraints have relaxed slightly as more experience has been gained. The mine layout has been has been successfully employed for the 20 panels mined to date and the same approach has been adopted for LW22 and LW23.

- **Mine Geology**

  Based on the available drilling, the West Wallarah Seam dips gently to the west (about 0.5°) so the depth of cover closely reflects the surface topography. The seam thickness is between 4.25 m and 5.25 m. At the north east end of the LW22 and LW23 the seam is partially intruded by igneous material. The igneous material will have no material impact on the predicted deformation of the pillars or the deflection of the conglomerate.

  Minor dykes, small faults, and more highly jointed zones have been encountered during mining. These have been of such a scale that they were not detected during borehole-based surface exploration prior to mining. From a subsidence perspective only the joint zones appear to have modified the surface subsidence outcomes.

  Based on the knowledge of the geological conditions, it is anticipated that similar geological conditions and similar subsidence outcomes will be encountered during LW22 and LW23 and on this basis the impacts and consequences will be similar.

  In common with the earlier longwalls at Mandalong, there is a thick conglomerate layer (30 – 35 m thick) in the overburden about 100 m above the West Wallarah coal seam. Past subsidence measurements from LW17 and LW18 do not indicate that the conglomerate layer failed , where the conglomerate beam thickness has been identified to be less than 25.

  The floor of the West Wallarah Seam is the geological formation known as the Awaba Tuff. In shallow mines around Lake Macquarie this unit has sometimes been associated with floor and pillar instability. At Mandalong this unit is of adequate strength and has not been observed to impact on pillar or floor stability or settlement/subsidence.

  The distance to the underlying Fassifern Seam decreases to the northwest generally coincident with the increase in depth of cover. Importantly for LW22 and LW23, the interburden thickness is similar to that in the previous longwalls at Mandalong such that the empirical prediction tool can continue to be used.

- **Surface Features**

  The location of dwellings and public roads and tracks are shown in **Figure 6** and the location of major power infrastructure is shown in **Figure 7** which also presents contours of the surface elevation. Above LW22 and LW23 the maximum terrain slope is in the range of 18° to 27° and there are no cliff-lines.

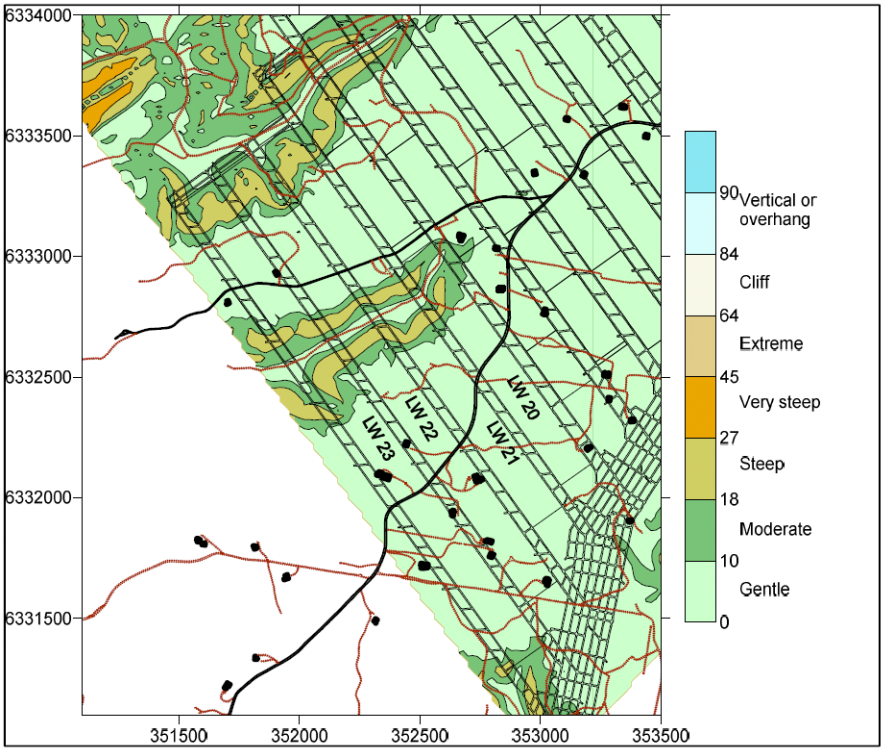


Figure 6 – Terrain Slope and Dwellings above LW20 to LW23

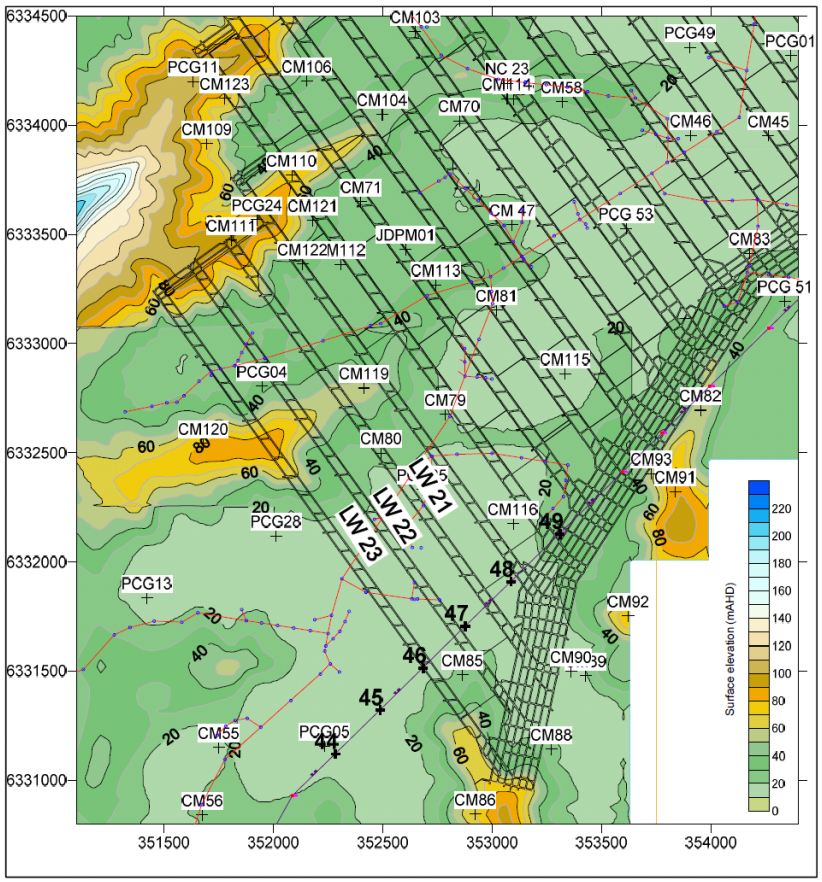


Figure 7 – Depth of Cover and Surface Infrastructure above LW20 to LW23

9.1.3 Predictions for LW22 and LW23

As discussed above, the geological evidence suggests that similar geotechnical conditions will be encountered in LW22 and LW23. It is assessed that the presence of the sill in parts of the seam will not have a material impact on the subsidence behaviour recorded to date.

The width of the chain pillars for MG22 and MG23 is 37 m as implemented in LW20 compared to the 46 m used previously. As yet, there has been no longwall extraction on both sides of 37 m wide chain pillars.

The same prediction methodology and visualisation procedures as adopted to date have been used to make the predictions for LW22 and LW23. The subsidence outcomes have been reviewed at the end of each longwall panel and there has been continuous improvement in the selection of some of the key input parameters.

The mine plan was subdivided into subpanels based on consideration of depth of cover, thickness of the massive conglomerate unit and whether there is to be subsequent extraction to the south west. The vertical subsidence above the chain pillar is a function of depth of cover, with a correction applied if the panel is the last one mined.

Figure 8 presents contour plans of the predicted vertical subsidence, tilt and strains at the end of LW23. The maximum values are:

- Vertical – 960 mm
- Tilt – 7.1 mm/m
- Tensile strain – 1.6 mm/m
- Compressive strain 3.0 mm/m

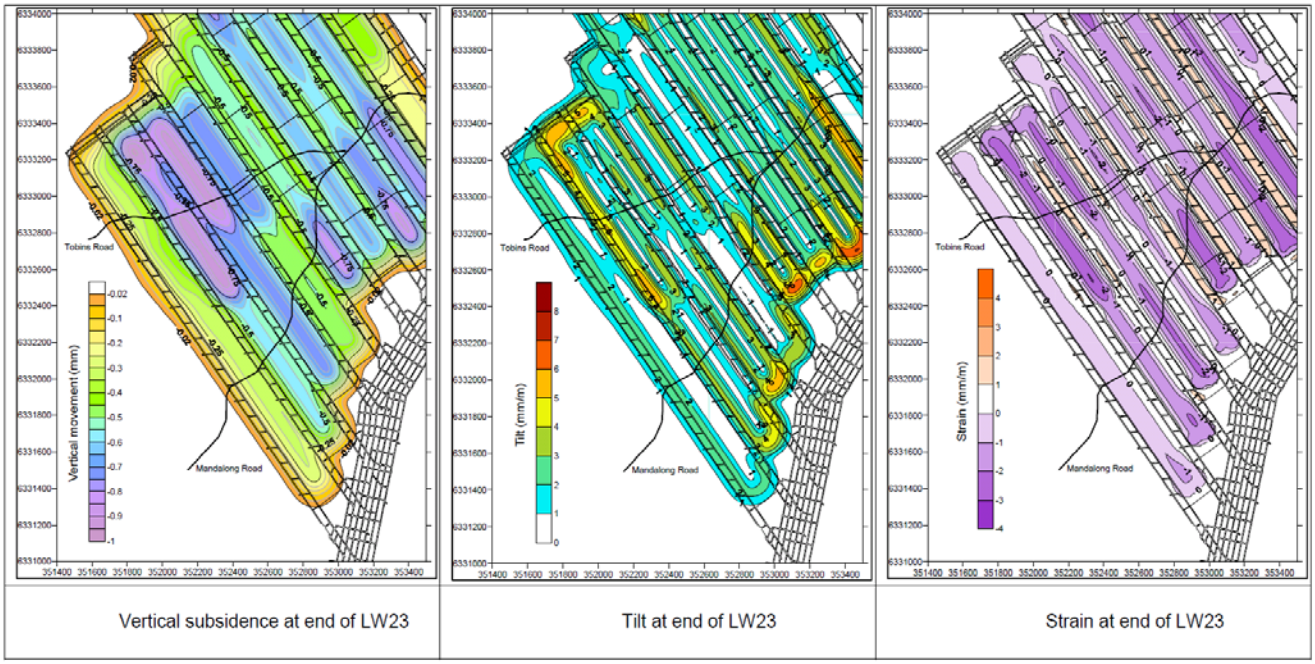


Figure 8 – Contour Plans of Predicted Vertical Subsidence, Tilt and Strains at the End of LW23

9.1.4 Predicted Subsidence Impacts

Given the predicted strains and experiences to date at Mandalong, it is unlikely that there will be any tensile cracking or compressive buckling developed in soil or rock. The compressive strains may be sufficient to cause bulging of sealed roads.

With the low values of tilt and strain combined with the relatively gentle topography, there will be no far-field movements (defined as measurable horizontal movements without vertical movements in excess of 20 mm) and there will be no 'upsidence" in the water courses.

There are no cliffs in the area so there can be no cliff falls induced. The mining-induced changes in the slope of the terrain will not be sufficient to generate rock falls or rock rolls.

The mine layout was selected so that any impact to dwellings would be less than safe, serviceable, and repairable and this has been demonstrated to date. Specifically with regard to LW22 and LW23, four specific locations have been nominated for specific predictions based on the location of two surface dwellings and two other buildings in the extension area (**Figure 9**). The predictions appear in **Table 8** below. Location B represents Property Reference No. 73: Lot 93, DP 755238 and Location D represents Property Reference No. 207: Lot 2, DP 1090233. All predicted strains and tilts are less than safe, serviceable, and repairable for residential dwellings.

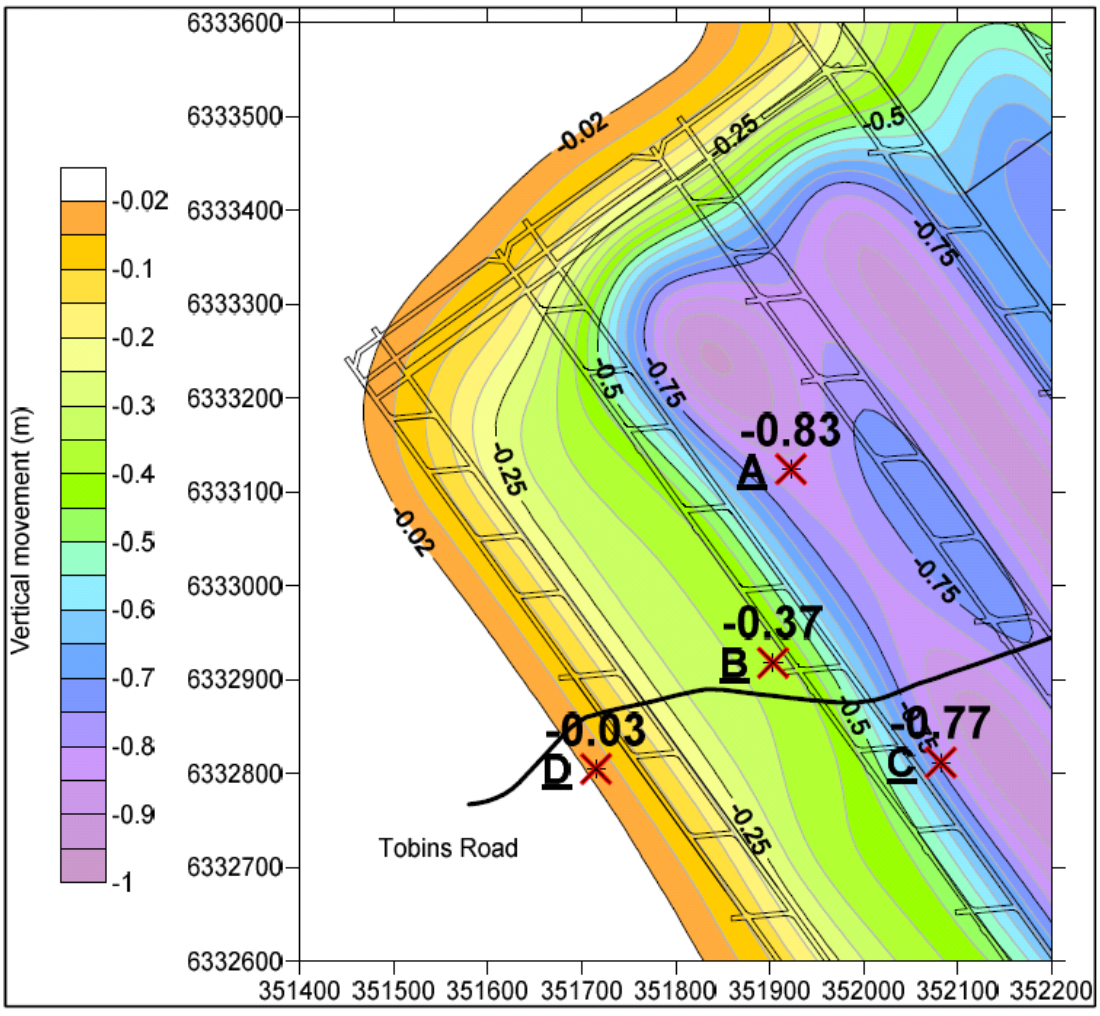


Figure 9 – Vertical Subsidence at North-Western end of LW22 and LW23

Table 8: Predicted Subsidence Above Affected Dwellings

Location	Vertical (m)	Tilt (mm/m)	Strain (mm/m)	Horizontal (m)
B (73)	-0.37	1.4	0.7	0.04
D (207)	-0.03	1.0	0.4	0.03

The strains predicted to be imposed on Mandalong Road and Tobins Road are similar to those previously so similar impacts are likely. There may be some minor compression bumps develop in the bitumen seals.

The performance measures regarding all surface electricity and communications infrastructure are to be consistent with the existing performance measures outlined in Table 7 of SSD-5144 being safe, serviceable and repairable.

The impact of the predicted subsidence on other surface and subsurface natural and built features (including shallow groundwater) have been assessed by relevant specialists. It is noted that the deflection of the massive conglomerate units without the onset of failure implies that longwall caving and fracturing will not extend more than about 100m above the coal seam.

9.2 Water Resources

9.2.1 Introduction

Potential impacts to water resources associated with the Modification were assessed by the technical study *Centennial Mandalong Pty Ltd Mandalong Longwall Panel 22 to 23 Modification Water Resources Impact Assessment* (GHD 2016a) (**Appendix 5**).

The objective of the Water Resources Impact Assessment was to determine the potential impact of the Modification on the groundwater and surface water environments. The identification of potential impacts will enable the development of measures to avoid or mitigate impacts or provide the framework of monitoring programs that may be required for the Modification. The specific objectives of the Water Resources Impact Assessment adopted from the relevant Director General's Requirements regarding the Mandalong Southern Extension Project were:

- To determine the potential impact of the Modification on the surface and groundwater environment within the vicinity of the existing Mandalong Mine and the broader regional environment.
- Undertake a detailed assessment of potential impacts on the quality and quantity of existing surface and groundwater resources through detailed modeling.
- Update and re-run the existing Mandalong Mine site water balance for the updated groundwater make predictions.
- Assess the proposed water discharge quantities and quality against the background of the receiving environment.
- Identify any licensing requirements or other approvals required under the *Water Act 1912* and/or *Water Management Act 2000*. Outline measures proposed to ensure that the development can operate in accordance with the requirements of any Water Sharing Plan or water source embargo.

- A detailed flood impact assessment which considers the subsidence effects and subsequent impacts on agricultural resources, transport, services, habitability, public safety and any environmental consequences.

- Develop measures to avoid, minimise and mitigate potential impacts of the Project and provide recommended management, monitoring and reporting requirements.

The assessment was completed in full consideration of the relevant legislation, guidelines in addition to any relevant stakeholder consultation.

9.2.2 Existing Environment of The Study Area

Topography

The terrain within the vicinity of the Modification is characterised by the floodplains of Morans Creek and Tobins Creek and the bounding valley slopes and elevated ridgelines. Rural residential areas around the floodplain are bordered by densely timbered ridgelines. Elevations within the vicinity of the Project range from less than 30 m Australian Height Datum (AHD) along floodplains of drainage lines, to over 100 m AHD along the ridgelines.

Soils

Soil landscape mapping indicates that the soil types within the study area are typically sandy loams of moderate erodibility (GHD, 2016a).

Areas of very high to extreme erodibility were identified within the Gorokan landscape. Both the top soil and subsoil within the Gorokan landscape is considered to be sodic (i.e. high in sodium) with a poor structure. As the soil profile deepens, the sodic nature increased (based on exchangeable sodium percentage).

The Gorokan landscape is typically located within the foot slope areas of the study area. These areas are typically cleared of taller vegetation (trees) as part of the rural land use of the Morans Creek floodplain areas. The clearing establishment of pasture within these areas typically results in an increase in the interaction between the groundwater and subsoil and topsoil layers. This increased groundwater interaction has the potential to increase the occurrence of tunnel erosion within the sodic soils of the Gorokan landscape. Other potential contributing factors to the occurrence of tunnel erosion include landowner activities and livestock.

Hydrology

The study area is located within the upper reaches of Morans Creek and Tobins Creek and includes several unnamed tributaries. Both Morans Creek and Tobins Creek are north-easterly flowing tributaries of Stockton Creek, which discharge into the estuarine reach of Dora Creek approximately 8 km north east of the study area. Both creeks are ephemeral, with periods of limited or no flow during low rainfall.

Hydrogeology

The groundwater sources in the vicinity of the PAA are generally low yielding and predominantly within the Quaternary alluvium, weathered and/or fractured sandstone and coal seams. GHD (2016a) advises, in accordance with the NSW Aquifer Interference Policy, they would be classified as “less productive”. These groundwater sources are described by GHD (2016a) as follows:

- **Alluvial Water Sources**

  The alluvium throughout the study area forms an unconfined shallow aquifer with a water table typically ranging in depth from less than 1 m and up to about 3 m below ground level and aquifer

thickness less than 20 m. The alluvial water sources within the study area are covered under the Hunter Unregulated and Alluvial Water Sources 2009.

- **Fractured and Porous Rock Groundwater Sources (Coal Seam and Overburden Rock)**

  Coal Seam - the piezometric head within the Permian coal seams tends to reflect the natural topography and the orientation and dip of the seams, with reduced pressures at major surface drainage areas and in areas of coal extraction. Where coal seam groundwater has not been depressurised, the groundwater head generally tends to be in the order of 0 metres AHD due to the coastal environment.

  The hydraulic conductivity of the West Wallarah Seam in the Southern Extension Area is generally expected to be lower than in the existing approved Mandalong Mine area given that the seam is deeper. Permeability testing of the West Wallarah and Wallarah / Great Northern Seams (at depths of 285 to 300 metres below ground level) undertaken in 2011 measured hydraulic conductivities ranging from approximately 0.75 to 35 metres per year (Sigra 2011, cited in GHD 2016). Groundwater inflows into the existing Mandalong Mine workings from the coal seam and adjacent strata are reported by Centennial Mandalong to be relatively low. This underground water is slightly alkaline and brackish to saline.

  Overburden Rock - The overburden and inter-seam strata within the Newcastle Coalfield tend to have very low hydraulic conductivities (in the order of 0.0003 to 0.03 metres per year), unless joints or fracturing create a secondary permeability (Pacific Power International 1997, cited in GHD 2016a). Groundwater within the overburden rock above the West Wallarah Seam primarily occurs within weathered or fractured Triassic sandstone. There is generally a downward vertical hydraulic gradient within the Triassic and Permian strata that overlay the West Wallarah Seam.

9.2.3 Methodology

Groundwater Environment and Hydrogeological Modelling

Potential groundwater impacts from the proposed extension to longwalls 22 and 23 were predicted by GHD (2016a) using two methods:

- Review of groundwater quality and quantity data within the existing Mandalong Mine area to identify groundwater impacts from the extraction of previous longwall panels.

- Utilising and updating the existing hydrogeological model developed for Mandalong Mine.

Hydrogeological modelling was undertaken to estimate groundwater seepage into the Mandalong Mine workings and determine groundwater drawdown associated with Mandalong Mine and the proposed workings. A hydrogeological model was previously developed for Mandalong Mine as part of the Mandalong Southern Extension Project. The hydrogeological model developed for the Mandalong Southern Extension Project reflected the most likely schedule of mining at Mandalong Mine. The hydrogeological model was recalibrated for updated groundwater inflow estimates as part of the Mandalong Tonnage Production Project (SSD-5144 Mod 3) (GHD, 2016b).

Observed groundwater inflow was calculated for the period from June 2013 to May 2014 and for the period from May 2014 to June 2015. The observed groundwater inflow was calculated through a water budget for the underground Cooranbong storage. The observed groundwater inflow was lower than the groundwater inflow modelled as part of the approved Mandalong Southern Extension Project. The hydrogeological model was recalibrated to observed groundwater inflows. The recalibrated hydrogeological model was updated and re-run for this assessment to reflect the proposed extension to longwalls 22 and 23. As part of the Mandalong Tonnage Production Project (SSD-5144 MOD 3) the recalibrated hydrogeological model was run for a mining schedule that reflected mining at a constant rate

of 6.5 Mtpa (GHD, 2016b). An overview of the revisions of the hydrogeological model is provided in **Table 9**.

Table 9: Predicted Subsidence Above Affected Dwellings

Project	Calibration Target	Mining Schedule
Mandalong Southern Extension Project (SSD-5144)	Calculated groundwater inflow between December 2011 and June 2012	Most likely schedule of mining defined by Centennial Mandalong
Mandalong Tonnage Production Modification (SSD-5144 Mod 3)	Re-calibrated model to observed groundwater inflow	Schedule that reflected mining at a constant rate of 6.5 Mtpa
Mandalong LW22-23 Modification (SSD-5144 Mod 4)	Utilised calibrated model from Mandalong Tonnage Production Project (SSD-5144 Mod 3)	Updated most likely schedule of mining defined by Centennial Mandalong

Surface Water Environment

A water and salt balance assessment was undertaken to quantify the water and salt budgets, including inflows, outflows and net change in storage, in relation to the groundwater and surface water management systems for Mandalong Mine. A site water and salt balance was previously developed in GoldSim for the Mandalong Southern Extension Project and is revised on an annual basis to assist in the management and reporting of water use at the site. This water and salt balance was also used to assess the Mandalong Tonnage Project (SSD-5144 MOD 3). The water and salt balance model was updated to reflect the groundwater inflows into the underground workings predicted by hydrogeological modelling over the mine life. The Modification does not propose any changes to the surface water management at MMAS, MSSS or Delta Entry Site and as such, these elements were omitted.

A flood assessment was prepared (Umwelt, 2016) to determine the impact on the flooding regime in the Mandalong Valley as a result of underground mining of longwalls 22 and 23 at Mandalong Mine. The flood assessment also considers longwalls 1 to 21 to allow for consideration of the cumulative impacts of underground mining.

A desktop assessment of existing information (GIS data and aerial imagery) was undertaken to identify and preliminarily map in GIS the waterway types (river style), geomorphic condition and stream order of waterways potentially impacted by the Modification. A site investigation was undertaken on 2 September 2016 to identify the current physical characteristics of the waterways potentially impacted by the Modification. The investigation focused on assessing the higher Strahler order waterways.

A surface water quality assessment was undertaken for the existing site conditions in order to establish baseline water quality for Morans Creek and Tobins Creek prior to proposed undermining. This water quality assessment has been undertaken in accordance with the assessment framework and methodologies outlined by ANZECC (2000).

Downstream water users

The potential impacts of the Modification on downstream water users were assessed by identifying sensitive groundwater and surface water receptors within the potential area of impact. The potential area of impact was estimated conservatively based on the results of the assessments on groundwater level and quality, water and salt balance, flooding, waterway geomorphology and surface water quality.

Groundwater users were identified by searching the NSW groundwater bore database for registered groundwater bores. Licensed surface water users and domestic and stock rights users with a water supply work approval were identified by searching for all lots within the potential area of impact in the NSW Water Register.

9.2.4 Existing Management Conditions

Underground Water Management

The underground water management system receives water from the Mandalong, Cooranbong and Delta underground workings. This water is transferred to a goaf (the Cooranbong underground storage area) via a series of collection points and pumps from various working areas underground. The goaf has a large volume and provides a filtration and sediment settlement function prior to being pumped to the Borehole Dam at the CES.

The inputs to the underground water management system consist of the following:

- Groundwater seepage from the coal seam and adjacent strata.
- Supply of potable water to mining equipment within the Mandalong workings (approximately 0.7 ML/day) and subsequent transfer of dirty mine water to the Cooranbong underground storage area (approximately 0.4 ML/day to 0.7 ML/day).
- Transfer of surface water from Sediment Dams 1 and 2 at the CES (approximately 80 ML/year).
- Transfer of surface water from the 5 ML Dam at the CES (approximately 50 ML/year).
- Transfer of water from the Gross Pollutant Trap at the CES (also referred to as Coal Handling Plant Settlement Tank).

Dirty water from the Mandalong workings is pumped at a rate of approximately 0.4 ML/day from the 69 cut through (c/t) area into the Cooranbong underground storage area. It is understood that some of the water within the Mandalong workings (originating from potable supply and groundwater seepage) remains within the longwall goaf areas.

The water transferred from the Mandalong workings is first allowed to settle at the Cooranbong settlement area. This water is then pumped at a rate of approximately 0.4 ML/day to 0.7 ML/day from the 151 c/t pump station to the Cooranbong underground storage dam. A dewatering bore extracts water from this underground storage dam, which is transferred to the Borehole Dam at the CES.

Water that is transferred from the CES enters the Cooranbong underground storage area via a series of passive infiltration bores. This water then drains under gravity to the Cooranbong underground storage dam.

Surface Water Management

Sources of water at the Mandalong Mine surface sites include potable water supply, rainfall, runoff and groundwater inflow into the underground mine workings. The primary water demands are for underground operations, machinery washdown, fire-fighting storage and staff amenities.

Surface water runoff from areas where there is no coal storage, transportation, handling or processing or any disturbance is considered to be clean water, as it is unlikely to be contaminated with coal fines or sediment. Runoff is diverted around dirty water and coal-contact catchments to avoid mixing with clean water runoff. Clean water runoff is typically from natural and impervious catchments such as areas of vegetation, sealed roads and sealed carparks.

Dirty water is runoff from disturbed areas and areas likely to contain suspended sediment, oils, grease and hydrocarbons. This typically includes workshop and fuel storage areas. Coal-contact water is runoff from catchments where coal storage, transportation, handling or processing occurs and is managed within the dirty water management systems.

Mandalong Mine has site-specific water management objectives that include:

- Maximise the separation of clean and dirty surface water systems.
- Manage water discharge from the sites, in terms of volume and quality, to a level that is acceptable for environmental management and community expectations.
- Minimise water discharges from the premises by maximising, where practicable, opportunities for the reuse and recycling of water on site.
- Manage discharge to natural waterways in accordance with the relevant EPL conditions or as agreed with the EPA.

Groundwater Environment

An analysis of deeper groundwater monitoring data indicates that depressurisation of fractured and porous rock groundwater sources (by greater than 2 m) occurs up to 230 m above the Mandalong longwall panels. The greatest depressurisation tends to occur up to 120 m above the longwalls. At a number of monitoring locations that have shown depressurisation due to mining, groundwater levels have stabilised or started to gradually increase towards pre-mining levels approximately three to five years after undermining occurring. It is also noted that groundwater levels/pressures have reduced in recent years at locations not yet affected by mining.

The groundwater pH and EC indicates that current fractured and porous rock groundwater quality is generally within the range reported as part of the Mandalong Southern Extension Project and no change in groundwater pH or EC resulting in a lowering of the beneficial use category is evident since longwall mining began in 2005.

Hydrogeological Modeling

The MODFLOW flow budget results for transient run 24 of the recalibrated hydrogeological model (best calibration under transient conditions) for current conditions in 2016 are presented in **Table 10**. This flow budget incorporates the entire model domain, which extends well beyond the Mandalong Mine footprint. The flow budget indicates that the inflow of groundwater into mine workings is 0.89 ML/day in 2016, which comes from fractured and porous rock groundwater source.

Table 10: Hydrogeological Model Predictions for Existing Conditions

	Alluvium and outcropping rock (ML/year)	Rock (ML/yr)
Inputs		
Recharge	4055	0
GHB	1326	351
Storage	7	313
Other zones	536	574
Total Inputs	**5924**	**1238**
Outputs		
Drains	3580	326
GHB	228	27
Storage	1542	349
Other zones	574	539
Total Outputs	**5924**	**1238**
Balance		
Inputs – Outputs	0	0

Surface Water Environment

The largest source of water into the water cycle under existing conditions in 2016 was potable water supply for underground mining activities, which accounted for approximately 394 ML/year on average. This was followed by groundwater inflows to the underground workings, which was modelled to be approximately 326 ML/year in 2016.

Discharge from the Borehole Dam to LDP001 at the Cooranbong Entry Site was modelled to represent the largest output from the site. The average annual contribution from the Borehole Dam to LDP001 was predicted to be 814 ML/year on average. It should be noted that overflows from Sediment Dam 2 at the CES also contributes to LDP001, however, the majority of LDP001 discharge is comprised of groundwater make, with less than 15 ML/year predicted to be discharged from Sediment Dam 2.

The largest source of salt under existing conditions was modelled to be associated with groundwater inflows into the underground workings, which accounts for approximately 1,283 tonnes of salt on average annually. The average salinity of groundwater inflows was estimated to be 5,880 µS/cm. The second largest annual salt inputs under existing conditions was modelled to be associated with the potable water supply for underground mining activities, which is estimated to input an average of approximately 62 tonnes of salt into the water management system annually.

Approximately 1,564 tonnes of salt on average was predicted to be output from the water management system at Mandalong Mine from the Borehole Dam to LDP001 for 2016. The average salinity of discharges from the Borehole Dam to LDP001 were modelled to be approximately 2,870 µS/cm under existing conditions.

Flood hazards were found to vary between Morans Creek and Tobins Creek. Tobins Creek was limited to a high hazard category (vehicles and wading unsafe) within the channel extent. Flow outside of the main channel of Morans Creek varied from low hazard (vehicles unstable but wading safe) increasing to high hazard (damage to light structures).

A desktop assessment and site visit were undertaken to assess the existing geomorphic characteristics of the reaches of watercourses that may be affected by the Project. Morans Creek and Tobins Creek are classified as fine-grained meandering systems. Banks are typically well-vegetated with a range of native and exotic species. As a result, in combination with relatively cohesive bank sediments, the occurrence and rates of bank erosion are low.

Baseline surface water quality monitoring indicated typical physiochemical, nutrient and metal concentrations present within Morans Creek, upstream of longwalls 22 and 23. Results indicated fresh waters with electrical conductivity between 150 µS/cm and 1,000 µS/cm. The pH levels indicated neutral to slightly acidic water, with samples typically ranging between 6 and 7.

The majority of results for dissolved arsenic, boron, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver and zinc were reported to be below relevant ANZECC (2000) default guideline values. Elevated concentrations of dissolved aluminium, cobalt and iron were identified from baseline monitoring.

Downstream Water Users and Groundwater Dependent Ecosystems

A total of 127 groundwater bores were identified in a 5 km radius of the existing, approved and proposed Mandalong Mine workings. The majority of the bores are registered as monitoring/test bores. Potential groundwater dependent ecosystems were identified to generally coincide with the reaches of Morans Creek and Tobins Creek.

A total of 14 properties within a 5 km radius of the study area were identified to be licensed for surface water extraction. The designated use or purpose of these licences includes irrigation, farming and industrial. No approvals for basic landholder rights were identified.

9.2.5 Impact Assessment

Water Management

Underground water will continue to be managed by water transfers within the underground workings of Mandalong Mine including the Cooranbong underground storage area. Water extracted from the underground workings will be managed via the existing pumping system of Mandalong Mine.

The overall layout of the Mandalong Mine surface sites will remain unchanged, with no changes proposed to the approved infrastructure as part of the Modification. The Cooranbong underground void capacity will cater for any increase in groundwater volume.

Potable water will continue to be serviced by the existing connections to Hunter Water Corporation's reticulated potable water system. There are not expected to be any appreciable increases in potable water usage as a result of the Modification.

No changes to any licences held by Mandalong Mine are required by the Project.

Groundwater Environment

The Level 1 mining impact considerations for less production fractured and porous rock water sources were adopted for the assessment of potential groundwater impacts in accordance with the NSW Aquifer Interference Policy.

The MODFLOW flow budget results for transient run 24 of the recalibrated hydrogeological model (best calibration under transient conditions) for 2018 (end of mining of longwalls 22 and 23) and 2036 (predicted maximum groundwater inflow) are presented in **Table 11**. The MODFLOW flow budget for the best fit transient model developed as part of the Mandalong Southern Extension Project (GHD, 2013) for the peak year of groundwater make (2035) are also presented in **Table 11** for reference.

Table 11: Hydrogeological Model Predictions for Existing Conditions

	2018		2036		2035	
	Alluvium and outcropping rock (ML/yr)	Rock (ML/yr)	Alluvium and outcropping rock (ML/yr)	Rock (ML/yr)	Alluvium and outcropping rock (ML/yr)	Rock (ML/yr)
Inputs						
Recharge	4055	0	4055	0	4055	0
GHB	1326	351	1323	349	1466	628
Storage	5	368	1	733	82	2291
Other zones	537	574	554	576	1372	802
Total Inputs	**5923**	**1293**	**5933**	**1658**	**6975**	**3721**
Outputs						
Drains	3606	384	3835	752	5944	2246
GHB	229	27	232	30	225	53
Storage	1514	345	1290	322	4	50
Other zones	574	537	576	554	802	1372
Total Outputs	**5923**	**1293**	**5933**	**1658**	**6975**	**3721**
Balance						
Inputs – Outputs	0	0	0	0	0	0

- **Alluvial groundwater sources**

  Transient run 24 of the recalibrated hydrogeological model predicts that underground mining at Mandalong Mine (including the proposed extension to longwalls 22 and 23) is unlikely to result in a water table drop greater than 0.1 m within the alluvial groundwater throughout the period of mining. This prediction is based on no increase in the hydraulic conductivity of strata within the surface zone.

  The MODFLOW flow budget results, shown in **Table 11**, suggest that there is unlikely to be an increase in the movement of shallow groundwater within the surface strata to underlying aquifers as a result of the proposed and approved workings. The flow budget predicts a net gain of groundwater into alluvium from the fractured and porous rock strata. The flow budget indicates that recharge into alluvial sediments and groundwater flow from the fractured and porous rock aquifer will generally remain in storage within the alluvial sediments or discharge to creek lines or drainage lines as seepage. These modelled results are consistent with the original EIS predictions.

  Any reductions in alluvial groundwater levels are expected to be temporary and localised and may occur during undermining as a result of the development of shallow tensile and compressive cracks and resulting localised increases in hydraulic conductivity and porosity. It is expected that these cracks would fill over time and the hydraulic conductivity and porosity should return to pre-mining values. Overall, the predicted impacts on alluvial groundwater within the vicinity of the proposed extension to longwalls 22 and 23 should be less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy and are therefore considered acceptable.

- **Fractured and porous rock groundwater sources**

  Total groundwater inflows into the connected Cooranbong, Mandalong and Mandalong South workings are predicted to peak at approximately 2.1 ML/day in 2036. The peak predicted groundwater inflow is less than the peak groundwater inflow assessed as part of the approved Mandalong Southern Extension Project (GHD, 2013). This is presented in **Figure 10**.

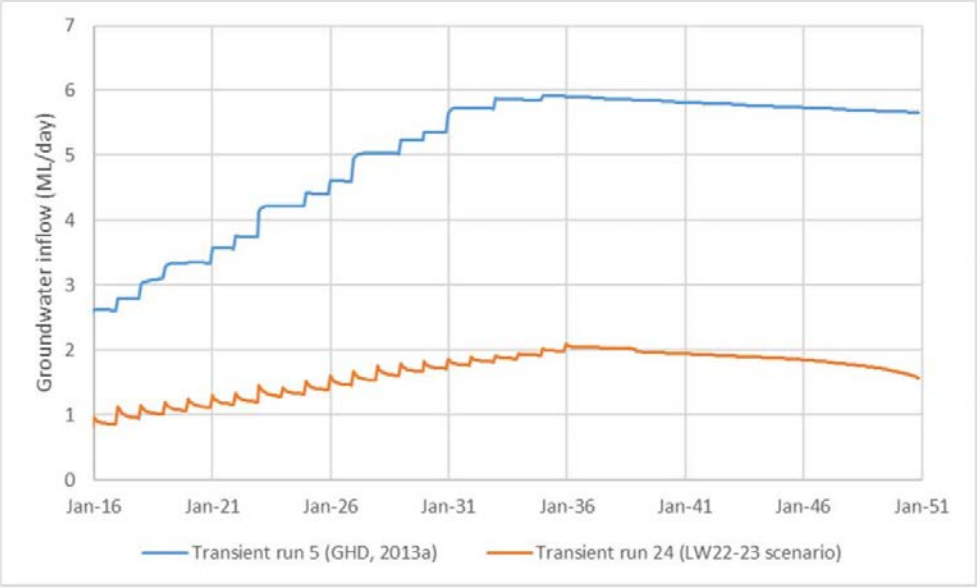


Figure 10 – Modelled Groundwater Inflows into the Cooranbong, Mandalong and Mandalong South Workings

The MODFLOW flow budget results for transient run 24 for current conditions (2016), for end of mining of longwalls 22 and 23 (2018) and predicted maximum groundwater inflow (2036) indicate that between 2016 and 2036 modelled outputs into drains from fractured and porous rock aquifer increase. This increased output is due to an increase in groundwater inflows into the mine over time. The increase in groundwater inflows into the mine is offset by a decrease in net groundwater storage in the fractured and porous rock aquifer as shown in **Table 11**.

The review of existing data at Mandalong Mine indicates that depressurisation greater than 2 m of fractured and porous rock water sources in the vicinity of longwalls 22 and 23 may occur up to approximately 230 m above the proposed longwalls. The greatest depressurisation is likely to occur up to 120 m above the longwalls. Depressurisation within 120 m of the longwalls may be due to continuous fracturing with groundwater pressures in this zone potentially starting to stabilise or gradually recover at least three to five years after undermining. Depressurisation within heights greater than 120 m is likely to be due to discontinuous fracturing. It is noted that depth of cover above the proposed extension of longwalls 22 and 23 is approximately 250 m and therefore it is unlikely that there would be depressurisation of shallow rock aquifers (and associated potential GDEs) within this area. The predicted 2 m drawdown is within 1.8 km of longwall panels 22 and 23.

Overall, the predicted impacts on fractured and porous rock groundwater sources attributable to the proposed extension of longwalls 22 and 23 should be less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy and are therefore considered to be acceptable.

The Modification is not expected to change the beneficial use category of alluvial or fractured and porous rock groundwater with regard to water quality issues.

Surface Water Environment

The water balance modelling results indicate that rainfall, runoff, evaporation, transfers from CES and potable water supply to the underground workings were predicted to be similar for existing and proposed conditions. The greatest change to the system is the predicted increase in groundwater make into the underground mining areas, which is estimated to peak in 2036 at approximately 751 ML/year.

The predicted increase in groundwater inflows will be managed through discharge from the Borehole Dam to LDP001 at CES. The average annual contribution of water from the Borehole Dam to LDP001 was predicted to be approximately 1,264 ML/year on average in 2036. This is attributable to the life of mine workings and not the extension of longwall panels 22 and 23 alone. This is lower that the LDP001 discharge predicted as part of the approved Mandalong Southern Extension Project.

The largest source of salt under proposed conditions is expected to be associated with groundwater inflows into underground workings, which accounts for approximately 1,504 tonnes in 2018 and 2,958 tonnes in 2036 on average. The average salinity of groundwater inflows was estimated to be 5,880 µS/cm.

- **Flood assessment**

  The main flood impacts associated with longwall panels 22 and 23 were found by Umwelt (2016) to be:

  - A total of 20 structures had reduced freeboard as a result of predicted subsidence. Of these, 19 are private residences, with floors remaining above the 100 year ARI storm event level.

  - An increase in flood hazard categories at six private structures during a 100 year ARI storm event.

- An increase in flood hazard categories along two private property access routes during the 100 year ARI storm event and three private property access routes during the 1 year ARI storm event.

- One section of Mandalong Road, near Deaves Road intersection, has been identified as requiring remediation measures to maintain the same degree of access during flooding as the pre-mining landform (identified in previous flood modelling assessments).

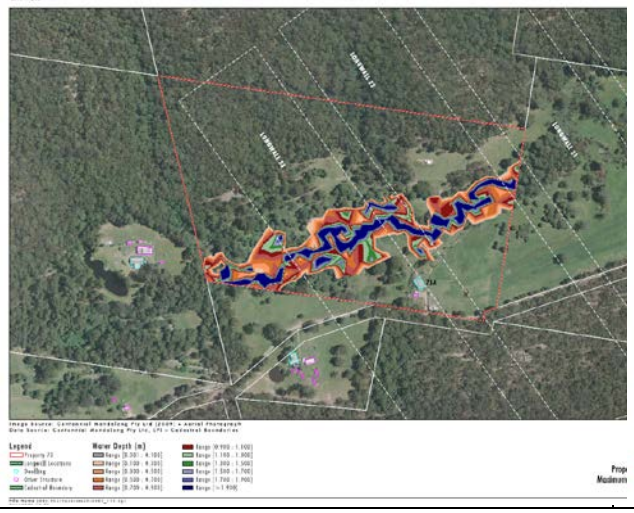
- Changes in flooding regimes for subsidence related to mining of longwalls 22 and 23 will be limited to the zone of predicted subsidence.

- Potential remnant ponding areas are predicted to increase both inside and outside of channel areas and will be isolated to zone of predicted subsidence.

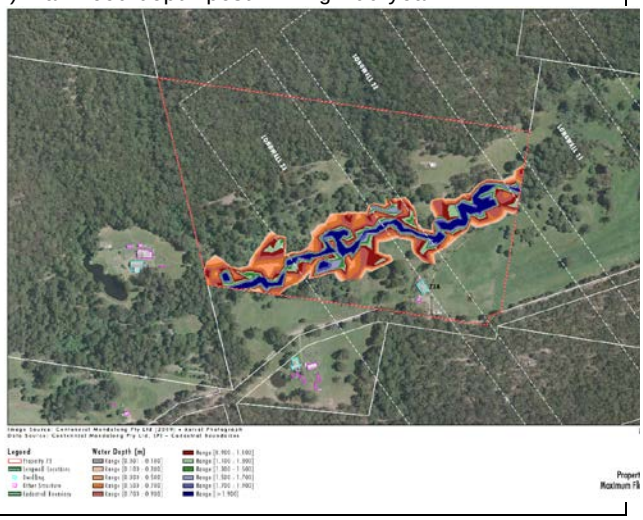
The proposed extension of longwalls 22 and 23 are likely to result in less channel variation than that predicted in Longwall 21. There were some predicted changes to Morans Creek channel and negligible changes to the predicted grade change in other channels assessed by Umwelt (2016) as a result of the predicted subsidence from the proposed extension of longwalls 22 and 23.

Two properties (identified as property 73 and 207) are within the study area associated with longwall panels 22 and 23 as extended. Property 73 will be directly undermined by longwall 23 and property 207 is within the angle of draw. Both of these properties are within proximity to Tobins Creek and therefore subject to potential flood and/or ponding increase. The Flood Assessment (Umwelt, 2016) has found that there will be no impact to each dwelling or access to either property. **Figure 11** provides an illustration of the predicted flooding to occur in the vicinity of both properties under both 1 year and 100 year ARI conditions. Property Subsidence Management Plans are being prepared for both properties in consultation with each landowner.

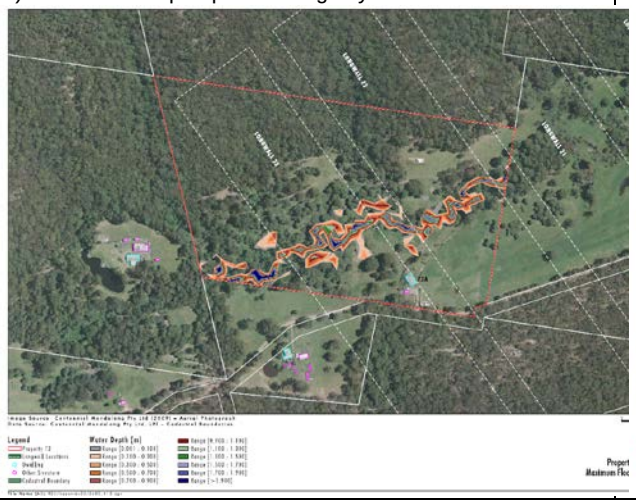
A) Max flood depth pre-mining 100 year ARI



B) Max flood depth post mining 100 year ARI



C) Max flood depth pre-mining 1 year ARI



D) Max flood depth post mining 1 year ARI

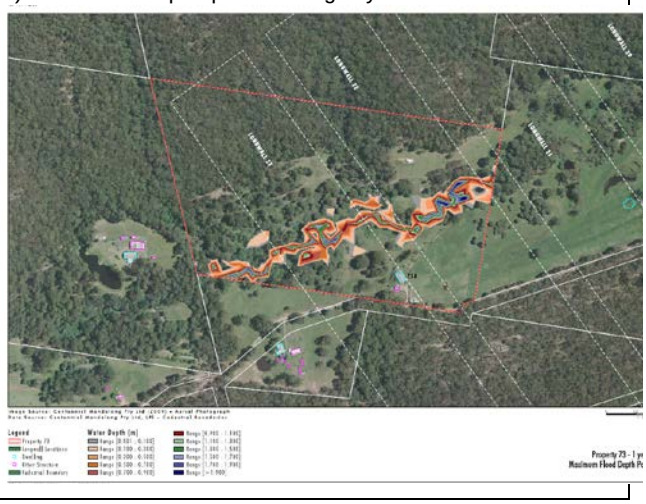


Figure 11 – Flood Modelling Properties 73 and 207

- **Waterway geomorphology**

  Given the nature of channels within the study area, the resilience to subsidence as a result of the Modification is high. The geomorphic field investigation identified only one area of risk due to the predicted subsidence as a result of the Modification. This area was within the Tobins Creek channel, where a headcut is located within approximately the centre of Longwall 23. Given the location of the headcut, it is likely to be maintained as a result of the Modification and is unlikely to be promoted. However, regular monitoring will be undertaken as part of the current visual inspections of flow paths by Mandalong Mine.

- **Surface water quality**

  There are not expected to be any changes to surface water quality at MMAS, MSSS or DES or the water quality of LDP001 discharge at CES as a result of the Modification compared to the surface water quality assessed as part of the approved Mandalong Southern Extension Project.

  Localised changes to water quality, including elevated levels of TSS and turbidity, may occur due to the mobilisation of sediments caused by changes to the surface as a result of subsidence. However, these changes are expected to be negligible (not measurable) and temporary. It is expected that the environmental value of the surface water will be maintained.

Downstream Water Users and Surface Water Users

It is unlikely that there will be any reduction in the beneficial use category (i.e. primary industry) of fractured and porous rock groundwater as a result of the Modification. The predicted impacts on fractured and porous rock groundwater sources are therefore less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy.

The Modification is not expected to result in any measurable impacts to water quantity or quality downstream of the Project. Adverse impacts to downstream water users are unlikely to occur as a result of the Modification due to the low risk of potential impacts and the ephemeral nature of waterways.

9.2.6 Mitigation, Management and Monitoring

A regional water management plan has been developed to provide an overview of the water management requirements across Centennial's northern operations. A site-specific water management plan for Mandalong Mine has also been developed to address specific water management requirements for the

site. An extraction water management plan will also be developed prior to extraction of longwalls 22 and 23. The water management plans ensure the operation of the mine, with respect to water, meets all relevant regulatory requirements. Trigger action response plans within water management plans should be referenced to determine the appropriate actions in response to any impacts of the Project identified as part of the monitoring program.

Groundwater and surface water monitoring for the Project will be undertaken as a continuation of the monitoring currently undertaken. The main objective of monitoring is to ensure that water management measures implemented function as designed.

9.3 Ecology

9.3.1 Introduction

RPS Australia East Pty. Ltd. (RPS) was engaged by Centennial Mandalong to undertake the assessment of ecological issues associated with the Modification. A copy of the Ecological Impact Assessment appears as **Appendix 6** to this SEE.

The scope of the Ecological Impact Assessment included:

- Detail of the findings of literature review.
- Determine the presence or likely occurrence of threatened species, populations and ecological communities (or their habitats) as listed under the *Threatened Species Conservation Act 1995* (TSC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Assess the potential of the Project to have a significant impact on any threatened species, populations or ecological communities known to occur or considered as having potential habitat in the study area.
- Provide recommendations and measures to avoid, reduce or mitigate impacts on biodiversity.

The study area was based on the 26.5 degree angle of draw determined by Seedsman Geotechnics (2016). The assessment aims to examine the likelihood of the Modification having a significant impact on any threatened species, populations or ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act 1995) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999). The assessment additionally recognises the relevant requirements of the *Environment Planning and Assessment Act* 1979 (EP&A Act) as amended by the NSW *Environmental Planning and Assessment Amendment Act 1997*. In the absence of field surveys to inform this assessment, the precautionary principal has been adopted with the presence of threatened species, populations and ecological communities being assumed where appropriate.

9.3.2 Methodology

Database searches included 10 km searches of the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife and the EPBC Act Protected Matters Search. A list of potentially occurring significant flora species from the locality (10 km radius) was compiled, which included, threatened species (Endangered or Vulnerable), Threatened Populations and Threatened Ecological Communities (TECs), listed under the TSC Act and/or the EPBC Act, as well as any other species deemed to be of local importance. A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring in the study area and wider region.

Targeted searches were undertaken by Hunter Eco across lots within the study area that were accessible, for all threatened flora species known to occur within the locality and in the habitat types present within the study area. Hunter Eco (2016) undertook vegetation surveys to delineate and

groundtruth vegetation communities across the longwall 22-23 study area. Previous existing vegetation mapping has been surpassed by Hunter Eco (2016) as a result.

No targeted fauna surveys have been undertaken within the study area, and this assessment encompasses desktop results only with reference to the previously cited literature.

The primary limitation to the assessment was that field investigations were unable to be undertaken in line with the relevant guidelines, and subsequently the assessment relies primarily on desktop results. Presence of threatened species where suitable habitat is considered available within the study area is assumed to occur. Due to land access issues not all sites were surveyed for flora by Hunter Eco (2016). Where flora surveys have been conducted by Hunter Eco (2016), flowering periods of all potentially occurring threatened flora species may not have been addressed.

The limitations have been taken into account throughout this assessment, specifically in relation to threatened species assessments, results and conclusions. In these instances, a precautionary approach has been adopted; as such 'assumed presence' of known and expected threatened species, populations and ecological communities has been made where relevant to ensure a holistic assessment.

9.3.3 Results

Database Interrogation

The results of database searches using the OEH Atlas of NSW Wildlife (accessed August 2016) and the EPBC Protected Matters Search (accessed August 2016) indicated that 20 threatened flora species, 44 threatened fauna species and five Endangered Ecological Communities (EEC) have been previously recorded within 10 km of the study area and/or have potential habitat within the study area. Marine species were excluded from the assessment.

Vegetation Community Mapping

A total of nine vegetation communities were mapped within the study area with five vegetation types being potentially commensurate with an EEC listing. These were:

- MU 1 Coastal Wet Gully Forest;
- MU 5 Alluvial Tall Moist Forest;
- MU 17o Hinterland Spotted Gum – Red Ironbark Forest;
- MU 37d Alluvial Floodplain Cabbage Gum Forest, and
- MU 46 Freshwater Wetland Complex.

The vegetation type MU1 – Coastal Wet Gully Forest is potentially commensurate with the TSC Act listed *Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion*. MU5 – Alluvial Tall Moist Forest and MU37d Alluvial Floodplain Cabbage Gum Forest are potentially commensurate with the TSC Act listed *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney basin and South East Corner Bioregions* EEC. MU46 – Freshwater Wetland Complex is commensurate with the TSC Act listed *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* EEC. MU17o is potentially commensurate with *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion* EEC.

Threatened Flora

Targeted flora surveys undertaken by Hunter Eco (2016) detected one threatened flora species within the study area, being *Melaleuca biconvexa* (Biconvex Paperbark). This species is listed as vulnerable under the TSC Act.

Potential Groundwater Dependent Ecosystems

The vegetation within the study area that is dependent on sub-surface flows (i.e. have rooting zones which overlap the sub-surface water interface such as floodplain vegetation) or are located such that surface flows originate from sub-surface flows (i.e. areas of impeded drainage) are all classified as GDEs.

The vegetation types within the study area that fall into this category are:

- MU 1 Coastal Wet Gully Forest;
- MU 5 Alluvial Tall Moist Forest, and
- MU 37d Alluvial Floodplain Cabbage Gum Forest.

All or parts of these vegetation communities are potentially GDEs.

Vegetation Corridors and Linkages

The study area is contained within a much larger area of contiguous vegetation that extends north, east and south. This expanse of continuous habitat facilitates the movement of many fauna species across the landscape. Animals move through habitats to obtain food, shelter and breeding resources, in response to seasonal resource ability and habitat conditions. Large tracts of habitat are generally required for successful dispersal away from natal areas or seasonal migrations.

Koala Habitat

A flora species compilation has not been acquired for the study area through surveys or existing data. Therefore, assessment of koala habitat within the study area is restricted. Based on the vegetation communities that are known to occur, there is potential for 'Potential Koala Habitat' to occur within the study area.

9.3.4 Impact Assessment

Potential impacts resulting from the Modification are limited to those associated with longwall mining such as subsidence. Maximum vertical subsidence as modelled by Seedsman Geotechnics (2016) is 960 mm. This is a significant reduction in the vertical subsidence predictions modelled for the DA 97/800 EIS which was 2.98 m. Subsidence can lead to potential impacts to flora and fauna through habitat modification resulting from surface cracking, soil erosion due to slumping and changes in gradients, increased mixing of groundwater and surface water and hydrological changes to groundwater and surface water, including ponding.

Cracking

According to Seedsman Geotechnics (2016) no surface cracking or compressive buckling is proposed to develop in soil or rock. No cliffs or caves have been identified as occurring in the area, so there is unlikely to be any cliff or cave falls induced by underground mining. Additionally, the mining-induced changes in the slope of the terrain will not be sufficient to generate rock falls or rock rolls.

Ponding

Subsidence from longwall mining can lead to increased ponding. Umwelt (2016) have predicted minor increases of ponding within the study area, which are largely confined to areas of predicted subsidence.

Melaleuca biconvexa (listed as vulnerable under the TSC Act 1995 and EPBC Act 1999) was detected in several locations within the study area. With a high association with drainage lines and swamps, it could potentially be impacted by ponding. The effects of longwall mining subsidence on *M. biconvexa* have been monitored in the Project Application Area but not specifically within the study area for longwall panels 22 and 23. The Project Application Area study found that the patch of *M. biconvexa* had increased in foliage area by approximately 6%, which was most likely due to increased rainfall and not because of increased ponding from subsidence. Similarly, the amount of available habitat for *Maundia triglochinoides* may increase.

Threatened flora species such as *Persicaria elatior, Melaleuca biconvexa* and *Maundia triglochinoides* have been detected or are known to occur within areas that are permanently or semi-permanently waterlogged. Since these habitats are not expected to be affected by cracking, ponding is the main concern of subsidence related impacts on these species. There is potential that the increase of ponding may alter habitats by expanding the areas of inundation or water logging. This may lead to an increase of potential habitat and a reduction of drier habitats around the ponded areas. Therefore, the reduction in drier habitats may be a concern for threatened flora species which prefer dry sclerophyll habitats such as *Cryptostylis hunteriana*, *Grevillea parviflora* subsp. *parviflora, Rutidosis heterogama, Tetratheca juncea, Acacia bynoeana* and *Angophora inopina.*

Similarly, potentially occurring threatened fauna may experience an increase in moist habitats which could be to the detriment to some threatened species or conversely it could be exploited by others based on their habitat preferences.

Subsidence impacts are expected to have a minor or temporary effect on ponding within the local watercourses and are not likely to significantly affect riparian vegetation, EECs, threatened species or their habitats.

Tilting

The maximum predicted tilt for the study area is 7.1 mm/m. This low value combined with relatively gentle topography is not expected to create far-field movements or upsidence in water courses (Seedsman Geotechnics, 2016).

Strains

The maximum predicted tensile strain for the study area is 1.6 mm/m with compressive strain maximum predictions reaching 3.0 mm/m. This prediction is unlikely to cause tensile cracking or compressive buckling in soil or rock (Seedsman Geotechnics, 2016).

Groundwater Dependent Ecosystems

The following vegetation types found within the study area have potential to be influenced by groundwater flows and consequently they may be considered as GDEs:

- MU 1 Coastal Wet Gully Forest;
- MU 5 Alluvial Tall Moist Forest; and
- MU 37d Alluvial Floodplain Cabbage Gum Forest.

These communities are situated on shallow unconfined alluvium and are likely to be utilising shallow aquifers associated with the ephemeral drainage lines within the study area and are therefore considered unlikely to be entirely groundwater dependent (GHD 2016a). This hypothesis is supported by the fact that the flora species within these vegetation communities are not restricted to alluvial drainage lines; they can occur along moist sheltered gully areas, creek lines, as well as dry slopes.

GHD (2016a) state that any reductions in alluvial groundwater levels are expected to be temporary and localised with any impacts on potential GDEs within the study area to be minor and acceptable under the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy. Therefore, it is unlikely that the local extent of GDEs would be significantly reduced as a result of the Modification.

Assessment of Significant Species/Communities

The following species/communities were deemed to require further detailed assessment via the application of 7-part tests as described in DECC (2007) due to potential levels of impacts likely to result from the Modification.

Threatened Flora

- *Rutidosis heterogama* (Heath Wrinklewort);
- *Tetratheca juncea* (Black-eyed Susan);
- *Maundia triglochinoides;*
- *Angophora inopina* (Charmhaven Apple);
- *Melaleuca biconvexa* (Biconvex Paperbark);
- *Persicaria elatior* (Knotweed);
- *Grevillea parviflora* subsp*. parviflora* (Small-flower Grevillea); and
- *Cryptostylis hunteriana* (Leafless Tongue-orchid).

Threatened Fauna

- Green-thighed Frog (*Litoria brevipalmata*);

Ecological Communities

- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions; and
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

The 7-part tests conducted for threatened flora and fauna species considered likely to occur within the study area are contained RPS (2016a). The 7-part tests concluded that the Modification is unlikely to have a significant impact on threatened species, ecological communities or their habitats.

9.3.5 Avoidance, Mitigation and Monitoring

Consideration of mine design is the first step of impact avoidance. The mine layout is designed such that the chance of unacceptable consequences is very low (Seedsman Geotechnics, 2016).

A monitoring program will be implemented as part of the Extraction Plan to detect any potential impacts to threatened flora and fauna, EECs and GDEs associated with longwall mining. The monitoring program will be designed to detect any changes to the existing environment in relation to control sites using a Before After Control Impact monitoring design. This monitoring program will aim to detect thresholds that can be identified prior to any significant impacts occurring by implementing a Trigger Action Response Plan (TARP). The TARP should include the following components as a minimum:

- A trigger exceedance will be investigated to ascertain whether it is mining related through increased monitoring of control and impact sites.
- If any trigger exceedance is deemed to be mining related then the associated actions and responses to mitigate the potential impacts will be taken.
- If any mining related impacts are identified in an area of environmental significance (e.g. EEC, GDE and threatened species or their habitats) active rehabilitation and remediation shall be implemented.

9.3.6 Conclusion

The Ecological Impact Assessment was prepared at a desktop level to assess any potential impacts on terrestrial biodiversity as a result of the Modification. One threatened species, *Melaleuca biconvexa* is known to occur within the study area. This species is listed as vulnerable under both the TSC Act and EPBC Act. Additionally, four EECs were considered as occurring or having high potential to occur within the study area, including:

- Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion.
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney basin and South East Corner Bioregions EEC.
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC.
- Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion.

An assessment of the subsidence related impacts upon terrestrial biodiversity, including threatened flora and fauna, EECs and GDEs, concluded that no significant impacts are expected to occur.

9.4 Cultural Heritage

9.4.1 Introduction

RPS was engaged by Centennial Mandalong to undertake the assessment of cultural heritage matters associated with the Modification. A copy of the Heritage Impact Assessment appears as **Appendix 7** to this SEE.

The Study Area for this Heritage Impact Assessment encompasses the 26.5 degree angle of draw around the secondary extraction areas of Longwalls 22 and 23. This Heritage Impact Assessment considers the environmental and archaeological context of the Study Area, a predictive model for the potential of Aboriginal cultural heritage sites occurring, reports on the results of an archaeological survey for Aboriginal and non-Aboriginal cultural heritage and an assessment of impacts for the proposed modification.

The Heritage Impact Assessment has been completed in accordance with the applicable legislative framework including the NPW Act and best practice guidelines for survey reporting. It has also been

completed in consultation with the Registered Aboriginal Parties (RAPs) who registered their interest in the Mandalong Southern Extension Project (SSD-5144) to meet the requirements of the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010) (ACHCR).

9.4.2 Aboriginal Community Consultation

Centennial Mandalong has undertaken extensive consultation with the Aboriginal community over a number of years. RAPs for the Mandalong Mine operations were identified through the implementation of the ACHCRs. This Heritage Impact Assessment has been prepared in consultation with the relevant RAPs for the Mandalong Southern Extension Project (SSD-5144) and the Centennial Coal's Northern Region Aboriginal Cultural Heritage Management Plan (ACHMP). The RAPs relevant to Mandalong Mine are detailed in **Table 12**.

Table 12: Registered Aboriginal Parties

Organisation
Awabakal Traditional Owners Aboriginal Corporation
Awabakal Descendants Traditional Owners Aboriginal Corporation
Cacatua Culture Consultants
Biraban Local Aboriginal Land Council
Bahtabah Local Aboriginal Land Council
Darkinjung Local Aboriginal Land Council
Kauwul (trading as Wonn 1)
Yula-Punaal Education and Healing Aboriginal Corporation
Guringai Tribal Link

Correspondence issued to the RAPs on 12 August 2016 provided a draft copy of the Heritage Impact Assessment for this Modification for review. In addition an invitation was provided for the RAPs to attend a field inspection of identified Aboriginal heritage sites and undertake a cultural ranking on the sites. No RAPs accepted the invitation to attend the field survey and no feedback was received from the RAPs on the draft Heritage Impact Assessment. No feedback was provided regarding the cultural significance ranking of the Aboriginal heritage sites located in the study area.

9.4.3 Existing Environment and Regional Context

The Study Area is considered to include the lands and boundaries of the Awabakal people, the Guringai/Kuringai people and the Darkinjang/Darkinjung peoples. In terms of previous Aboriginal occupation, the area has a good supply of fresh water. This would have resulted in a diversity of flora and fauna that would have provided food resources for local inhabitants. The presence of sandstone outcrops may have also provided rockshelters and suitable surfaces for grinding axes, ochre or seeds. Until recently Aboriginal occupation of the region was viewed in terms of the frequent utilisation of the large saltwater Lake Macquarie and Lake Munmorah to the east and south-east, which provided a number of resources. Further survey work indicates that there is also evidence for frequent Aboriginal occupation of the inland areas west of these lakes (RPS 2016b).

In 2011, LMCC released the *Sustainable Management of Aboriginal Cultural Heritage in the Lake Macquarie Local Government Area*. This report addresses each landform type within the LGA and identifies potentially sensitive Aboriginal cultural landscapes within each landform type. The sensitive landscapes of relevance to the Project are Mountain Landscapes, which have important links to ceremonial activities, traditional Awabakal stories and historical events, and Freshwater (Creek Corridor) Landscapes, which are significant as sources of freshwater and in providing important resources (RPS 2016b).

No historic European heritage sites were located within or are predicted to occur within the Study Area.

Aboriginal Heritage Information Management System

A search was undertaken of the Aboriginal Heritage Information Management System on the 31 May 2016. A total of 3 Aboriginal sites have been previously recorded in the Study Area (**Table 13, Figure 12**).

Table 13: AHIMS of Relevance to LW22-23

AHIMS Number	Site Type
45-3-3454	Grinding Groove
45-3-3537/45-3-3446	Artefact Scatter
45-3-3538	Isolated find

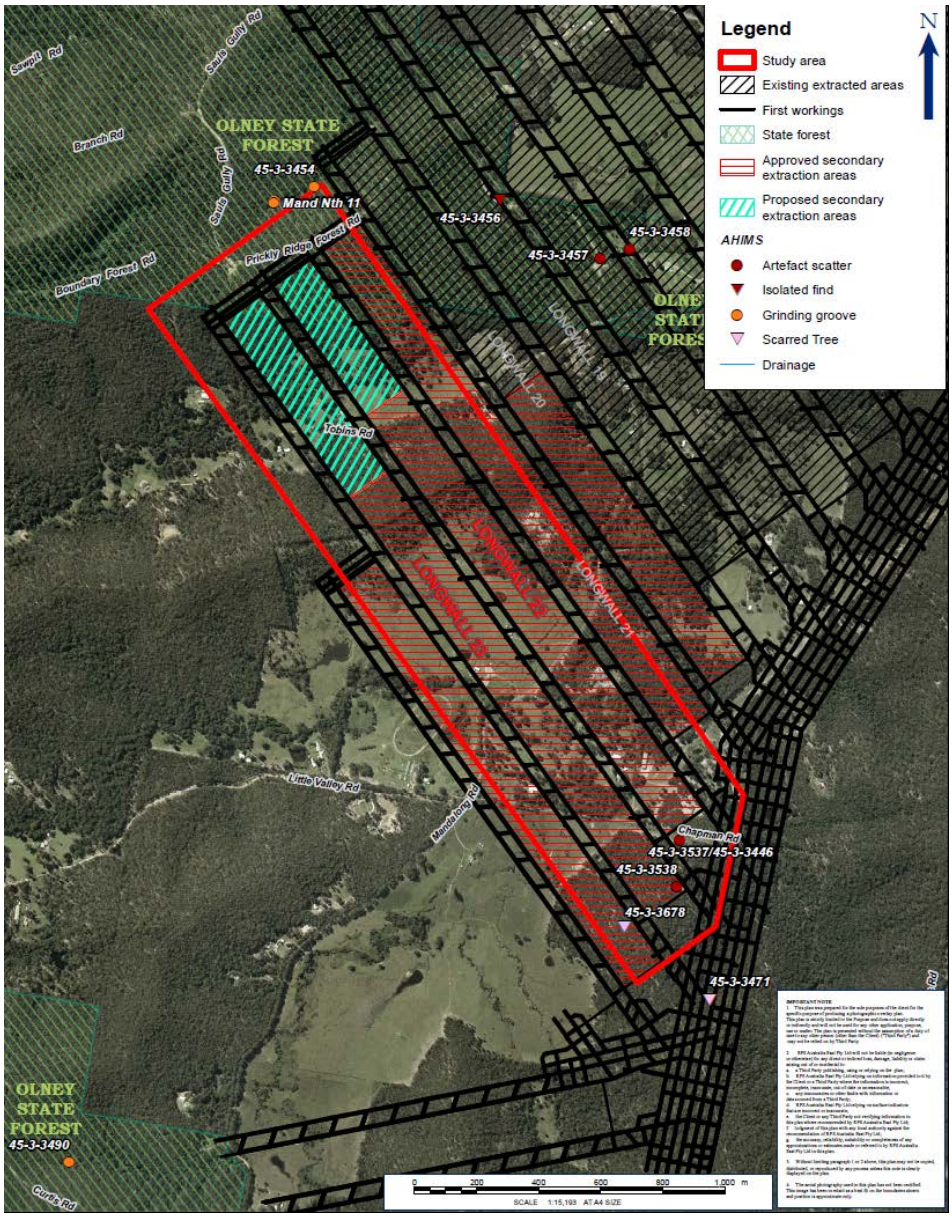


Figure 12 – Longwall Panels 22 and 23 with AHIMS

AHIMS site #45-3-3537 was recorded originally on AHIMS as #45-3-3446. Correspondence with the Office of Environment and Heritage concluded that #45-3-3537 is a duplication of #45-3-3446 that had been entered as an isolated find. RPS has asked that the AHIMS show that this site (#45-3-3537) is a duplication of #45-3-3446 and reflect that it is an artefact scatter. For this report, AHIMS site #45-3-3537 is considered to be #45-3-3446, and the impact assessment has reflected this.

Field Survey

A survey of the Study Area was undertaken by RPS archaeologists and Centennial Mandalong personnel on 14 and 15 June 2016. Based on the areas surveyed and ground truthing of existing sites, a total of four Aboriginal sites were located inside the Study Area. Three were previously identified in 2011, but have four AHIMS numbers, as #45-3-3446/45-3-3537 is a duplicate recording. One additional site was recorded during the survey being a scarred tree site referenced #45-3-3678 (RPS Mand 2016_1). Two of the sites inside the Study Area were artefact scatters (#45-3-3446/45-3-3537 and #45-3-3538), one was a grinding groove site (#45-3-3454) and the fourth was a scarred tree site (#45-3-3678 - RPS Mand 2016_1). While grinding groove site #45-3-3454 is located in the angle of draw for Longwall 21 it will not be directly undermined as a result of the extraction of Longwalls 22 or 23.

No registered historic sites were identified in the Study Area. No evidence of the Simpsons Track was identified in the Study Area by the field surveys.

Site Descriptions

AHIMS Site #45-3-3454

This site consisted of six grinding grooves on a large flat sandstone outcrop above a first order creek. It was not possible at the time of survey to determine if the outcrop was a large boulder or sandstone shelf. The largest of the grooves was 350 mm (L) x 80 mm (W) x 35 mm (D) with the smallest 310 mm (L) x 80 mm (W) x 10 mm (D). The grooves, rather than being V-shaped, were U-shaped, shallow and dish-like, indicating that the area could have been used for seed grinding rather than axe head production. This site has high local significance for rarity and representativeness, but moderate-low for integrity, education and research potential. Overall it is of moderate significance on a local scale and low significance on a regional scale. It has low significance on a regional scale.

AHIMS Site #45-3-3537/45-3-3446

Fourteen artefacts were identified on the top of B (clay) horizon, adjacent to the track (13 artefacts were concentrated within a 25 x 14 m area and one artefact was identified 54 m to the south-west). It is likely that the artefacts were eroding from vegetation 12 m to the south-west of the main concentration (scatter) of artefacts. This area to the south-west is considered to have potential for archaeological deposits (PAD). The identified artefact scatter contained artefacts which were not in-situ. It was observed that sheet erosion and runoff during seasonal downpours was moving artefacts down slope in a north-east direction (consistent with a slight slope in this direction) (observed on the 31st March 2011). A recent site visit in 2013 indicated that the artefact scatter had been further disturbed by plant movement, but the PAD area to the south of the artefact scatter remained intact. This site has high local significance for rarity and representativeness, but moderate-low for integrity, education and research potential. Overall, if is of low local and regional significance.

AHIMS Site #45-3-3538

This site was comprised of three silcrete flakes / flaked pieces, a silcrete cobble, and a mudstone flake. One of the silcrete flakes showed evidence of ventral retouch on one quadrant and therefore may be classified as a tool rather than a flake. The change of status from flake to tool occurs when a flake has been visibly modified through retouch. Retouch is used to reshape a flake/artefact or to sharpen an edge. This provides evidence that the flake, rather than just being a by-product of artefact manufacture has been put to a specific use. The site was found mid slope (10°) above Tobins Creek, approximately 50 m

to the west. The artefacts were in an exposed eroding area. This site is has moderate representativeness and research potential on a local scale, but low significance for representativeness, integrity and educational potential. Overall, it is of low local and regional significance.

#45-3-3678 (RPS Mand 2016_1)

#45-3-3678 (RPS Mand 2016_1) was a scarred tree site located in SU 3 on the mid slope of a steep hill, approximately 365 m north-west of AHIMS #45-3-3471. The site was set approximately 10 m east of a north-south trending ephemeral drainage line and surrounded by juvenile to moderately aged woodland trees. #45-3-3678 (RPS Mand 2016_1) was a stringy bark tree with a long symmetrical scar facing north-east toward the downward-sloping hill. Although the tree itself was not considered “old growth”, it was of sufficient maturity for bark removal. The dimension of the scar measures 140 cm (L) x 10 cm (W) x 13 cm (D) and with an elliptical shape that tapered off to points at the top and bottom (Plate 15; Plate 16; Plate 17). The scarred section was set approximately 30 cm off the ground and positioned at eye level to a standing person. The thickness of bark regrowth around the margins of the scar was 13 cm, suggesting that bark removal took place in the distant past. The hard wood remaining from the scar was in moderate condition, although evidence of termite intrusion was clear from bore markings. This site is moderately significant on a local scale for rarity and integrity, but is of low significance for representativeness, educational and research potential. Overall, it has low local and regional significance.

9.4.4 Impact Assessment

Four Aboriginal cultural heritage sites were identified in the study area (**Table 14**). Two of these sites are directly above longwall panels 22 and 23 (AHIMS#45-3-3537/45-3-3446 and AHIMS#45-3-3538) and two are beyond the panels however within the angle of draw (AHIMS#45-3-3678 and AHIMS#45-3-3454).

Table 14: Predicted Subsidence Levels for Aboriginal Sites

AHIMS No.	Site Type	Correlation to LW Panel	Tilt (mm/m)	Strain (mm/m)	Subsidence (mm)	Likelihood of Impact
45-3-3446/ 45-3-3537	Artefact Scatter	LW22	1	<0.5	40	Unlikely
45-3-3538	Artefact Scatter	LW23	1.5	<0.5	60	Unlikely
45-3-3454	Grinding Groove	Angle of Draw LW21	<0.5	<0.5	<20 (not directly undermined)	Unlikely
45-3-3678	Scarred Tree	Angle of Draw LW22	<0.5	<0.5	<20 (not directly undermined)	Unlikely

The effect of subsidence on Aboriginal sites depends on the physical characteristics of the Aboriginal sites and on the level of subsidence including tilts, tensile strains and vertical subsidence.

Artefact scatters comprise surface stone artefacts (usually less than 5cm) which have been exposed usually due to erosion and sometimes displace by sheet wash and rainfall. Subsidence which causes cracking or severe changes in slope has the potential to impact artefacts by displacement. Observed that natural ground swell movement in the Lake Macquarie region ranges between 7 mm and 58 mm with an average of 29 mm. Thus the potential vertical movement of artefacts at AHIMS#45-3-3446/45-3-3537 from subsidence is negligible compared with the magnitude of the natural soil swell. The tilts and strains for these sites are less 1.6mm/m and thus are very unlikely to cause surface effects which would displace the artefacts. The tilts, strains and vertical subsidence for the artefact scatters within the Longwall 22 and 23 subsidence zones are minimal.

Grinding grooves sites comprise sandstone sheets which have been utilised for sharpening stone tools such as hatchets. Due to the physical characteristics of the sandstone sheets, high level of tilts, strains or vertical subsidence has the potential to crack the sandstone sheets and harm this type of Aboriginal site. The predicted subsidence for grinding groove site AHIMS#45-3-3454 is minimal, tilts and strains are <0.5mm/m and vertical subsidence <20mm. Based on these subsidence predictions there will be negligible impact to AHIMS#45-3-3454.

Scarred tree site types comprise living or dead trees which have been scarred by extraction of the bark for shields, canoes and similar. The stability of this site type depends on whether the tree is living or dead, with dead trees tending to be less stable, but ground surface conditions and erosion can destabilise both living or dead trees. Scarred tree AHIMS#45-3-3678 is a living tree on solid ground and thus is considered stable. The predicted tilts and strains are <0.5mm/m and vertical subsidence <20mm for this site which are minimal and would have negligible impact to scarred tree AHIMS#45-3-3678.

Overall, the predicted tilts, strains and vertical subsidence for the four identified Aboriginal sites are minimal. The physical characteristics and stability of each of these site types have been evaluated against the predicted subsidence levels. Based on the subsidence predictions there will be negligible impact to the four identified sites: AHIMS#45-3-3537/45-3-3446 and AHIMS#45-3-3538 (artefact scatters), AHIMS#45-3-3454 (grinding grooves) and AHIMS# 45-3-3678 (scarred tree).

9.4.5 Mitigation and Management

Based on the predicted subsidence there are no impacts identified for the four Aboriginal sites as a result of the extraction of Longwalls 22 and 23. There is no change in the level of impact from the original Development Consent (SSD-5144) as a result of the extended longwalls. In compliance with the overall Development Consent, the management of Aboriginal heritage is to be continued in accordance with Centennial Coal's Northern Region Aboriginal Cultural Heritage Management Plan (ACHMP).

The following recommendations were made by RPS in consultation with the RAPs:

- Aboriginal heritage in the study area is to be managed under Centennial Coal's Northern Region ACHMP.
- The significance of Aboriginal sites and their locations for AHIMS #45-3-3446/45-3-3537, #45-3-3538, #45-3-3454 and #45-3-3678 (RPS Mand 2016_1) is to be appended to Centennial Coal's Northern Region ACHMP (Attachment 3 [Mandalong Mine]).
- All relevant Centennial Mandalong staff and contractors should be made aware of their statutory obligations for heritage under the NSW *NPW Act (1974)* and the NSW *Heritage Act (1977)*.
- In the event that skeletal remains are uncovered, work must cease immediately in that area and the proponent will need to follow the protocols detailed in Centennial Coal's Northern Region ACHMP.
- If, during the course of development works, significant European cultural heritage material is identified, works should cease in that area immediately. The NSW Heritage Branch should be notified and works recommence only when an appropriate and approved management strategy is implemented.

9.5 Land and Agricultural Resources

9.5.1 Introduction

Land and agricultural resources were assessed in the technical report *Soil and Land Resource Assessment Mandalong Mine LW22 – LW23 Modification* (SLR 2016a) (**Appendix 8**). The study area

was the limit of measurable subsidence defined by the 26.5^0 angle of draw from the LW22 – LW23 voids. The proposed modification does not require any additional surface infrastructure. The Study Area encloses a total area of approximately 172 hectares, comprising both native vegetation and cleared grassland. A field survey and desktop study were undertaken to assess the distribution of soil resources within the study area.

The key objectives of the assessments were:

Objective 1 Classify and determine the soil profile types within the Study Area using the *Australian Soil Classification* (ASC) system, including a description and figure showing the distribution of each soil type.

Objective 2 Provide a description of, and figures showing, the land capability within the Study Area using *The Land and Soil Capability Assessment Scheme: Second Approximation* (Office of Environment and Heritage (OEH), 2013).

Objective 3 Provide recommendations to mitigate soil erosion and sedimentation associated with the works and soil stockpiles using *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Volume 2E Mines and Quarries* (Department of Environment and Climate Change, 2008).

9.5.2 Existing Environment

Vegetation and Land Use

Assessment of recent aerial images shows that the majority of the Study Area remains under native vegetation (approximately 74%). The remainder is land that has been previously cleared and may be suitable for agricultural enterprises. A site inspection in June 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 (*Poalabillardierei*) and red grass (*Bothriochloa* spp.) is the dominant agricultural enterprise. In addition, there are isolated areas where cattle grazing improved pasture, with the pasture dominated by kikuyu grass (*Pennisetum clandestinum*). No intensive cropping activities were observed at the time of the assessment.

Grazing within the Study Area appears to be 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 44 hectares of potential grazing land is currently available for agricultural use.

The Study Area includes a small portion of the Olney State Forest in the north-east.

Soil Landscape Units

Soil Landscapes Units are described as "*areas of land that have recognisable and specific topographies and soils that can be presented on maps and described by concise statements"*.

The Soil Landscape 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* shown in **Figure 13**. Four soil landscapes occur in the Study Area and are summarised in **Table 15**.

Table 15: Soil Landscape Units

Soil Landscape	Study Area		Agricultural Limitation Rating	
Unit	Hectares	%	Grazing	Cultivation

Soil Landscape	Study Area		Agricultural Limitation Rating	
Mandalong	68	40	High – Severe	High – Severe
Gorokan	49	28	Low	High – Severe
Yarramalong	49	28	Low	Low (high – severe*)
Wyong	6	4	Low – Moderate	Low (high – severe*)
Total	**172**	**100**	*** for localised waterlogged and floodplain areas**	

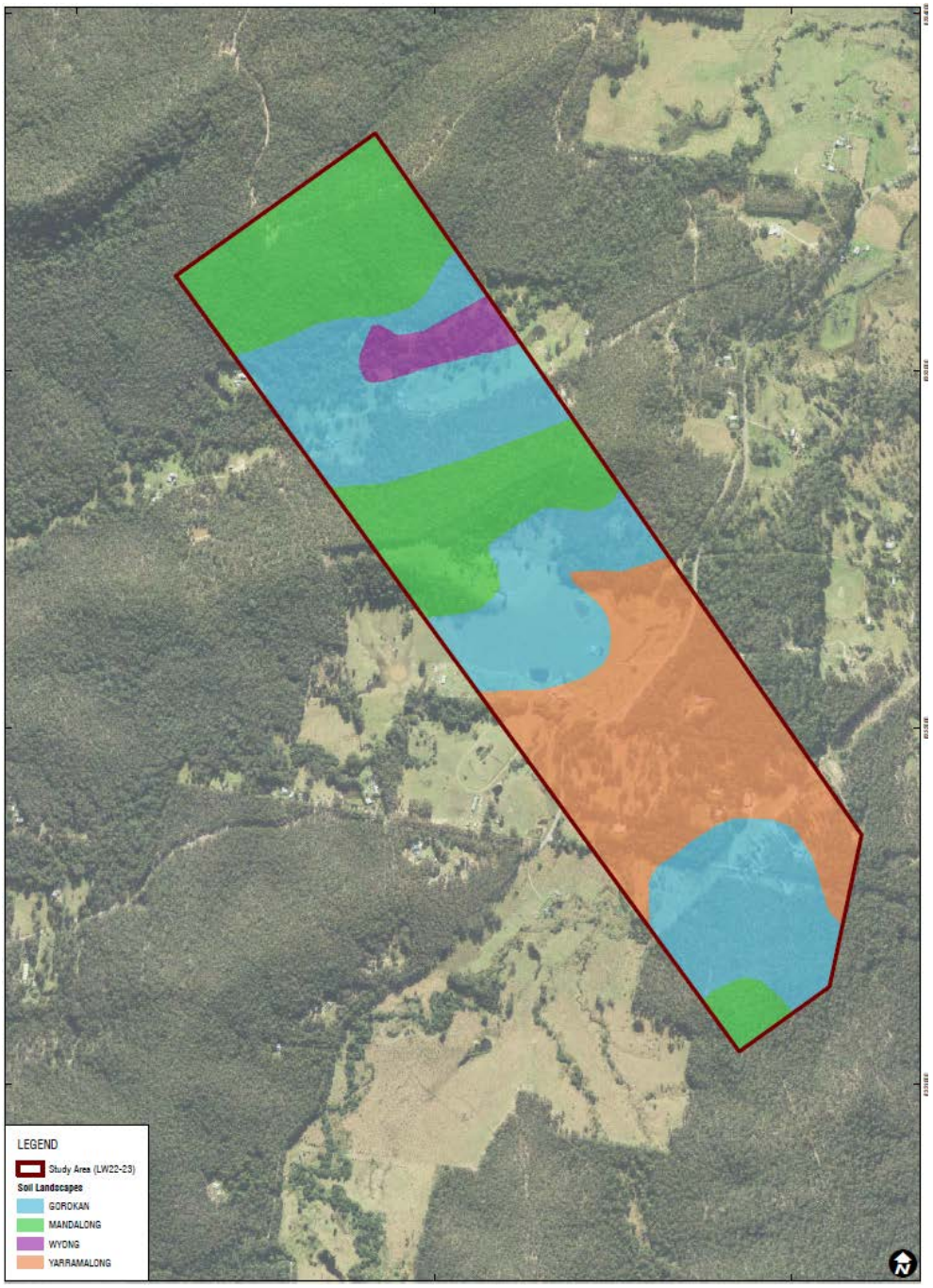


Figure 13 – Soil Landscape Units

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

- The majority of the Study Area (68%) is highly to severely constrained for cultivation (cropping) enterprises.

- The Mandalong Soil Landscape Unit is highly to severely constrained for any agricultural enterprises, which covers 40% of the Study Area.

- Agricultural land best suited to grazing enterprises includes the Gorokan, Yarramalong and Wyong Soil Landscape Units, which covers 60% 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 32% of the Study Area. It should be noted that localised areas within Yarramalong and Wyong Soil Landscape Units have high to severe limitations for cultivation due to waterlogging.

9.5.3 Soil Survey and Assessment

A field survey and a desktop study were undertaken to assess the distribution of soil resources within the Study Area. The field survey undertaken was an integrated and qualitative survey. An integrated survey assumes that many land characteristics are interdependent and tend to occur in correlated sets. Background reference information was used to predict the distribution of soil attributes in the field. The characteristics were evaluated to generate the correlated sets, including vegetation type, landform and geology.

Soil samples from thirteen of the soil assessment sites were utilised in the laboratory testing program. Samples were analysed in order to:

- Classify soil taxonomic classes;

- Determine Land and Soil Capability and Agricultural Suitability classes, and

- Determine suitability of soil as topdressing material in future rehabilitation works.

The dominant soil types within the Study Area were ground-truthed by SLR at the scale of approximately 1:15,000 and determined using the Australian Soil Classification (ASC) System. This assessment consists of 12 detailed laboratory assessed soil profiles. The main assessment points are listed below.

- Three major soil orders are present in the Study Area, Kurosols, Sodosols and Dermosols (**Table 16**).

- 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 5% 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 72% 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 23% of the Study Area.

- Kurosols range from moderately low to moderate inherent fertility, depending on ASC Great Group classification, with both Mesotrophic Kurosols (moderate) and Magnesic (moderately low) occurring in the Study Area. The Dermosol is classed as having moderately high inherent fertility whilst the Sodosol has moderately low inherent fertility.

Table 16: Soil Landscape Units

Soil Landscape	Inherent Fertility	Hectares	%
Mandalong	Moderately Low – Moderate	9	5
Gorokan	Moderately Low	124	72
Yarramalong	Moderately High	39	23
	Total	**172**	**100**

9.5.4 Land and Soil Capability

The LSC classification applied to the Study Area was in accordance with the OEH guideline *The Land and Soil Capability Assessment Scheme; Second approximation* (OEH, 2013) (referred to as the LSC Guideline). This scheme uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes, which classify the land based on the severity of long-term limitations. Their definition has been based on two considerations:

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

The Study Area has been classified into three dominant LSC being LSC Classes 5, 6 and 7 comprising 75 hectares, 47 hectares and 50 hectares respectively.

LSC Class 5 Land

Class 5 land is represented by a Brown Sodosol with a small area of Brown Kurosol. 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 (44%).

LSC Class 6 Land

Class 6 land is represented by a Brown Dermosol with a small area of Brown Kurosol. This classification indicates Low capability land with very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation, it is considered capable for a limited set of 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 27% 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 11% of LSC Class 7 within the Study Area is shallow soil, whilst steep slope is the limiting factor for 18% of the Study Area. Overall LSC Class 7 covers 29% of the Study Area.

Within the Study Area, 56% 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, 2013), whilst the remainder has a moderately low agricultural capability.

9.5.5 Agricultural Suitability

The Agricultural Suitability system was applied to the Study Area in accordance with the DPI guideline *Agricultural Suitability Maps – uses and limitations*. The system consists of five classes providing a ranking of rural lands according to their productivity for a wide range of agricultural activities with the objective of determining the potential for crop growth within certain limits. Agricultural Suitability has been assessed and classified into Classes 3, 4 and 5 for the Study Area. The limitations associated with each Agricultural Suitability Class are shown in **Table 17**.

Table 17: Agricultural Suitability Class Areas

Agricultural Suitability	Study Area		Agricultural Capability Rating
Class	Hectares	%	
3	75	44	Moderately Low
4	47	27	Low
5	50	29	Very Low
Total	172	100	

Biophysical Strategic Agricultural Land Assessment

In April 2013, the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (Interim Protocol) was released by the NSW Government. The Interim Protocol outlines the process for seeking verification of whether or not land mapped as Biophysical Strategic Agricultural Land (BSAL) meets the Interim Protocol's BSAL criteria. The *State Environment Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment 2013* (the 2013 Mining SEPP amendment) requires State Significant Developments to verify whether the proposed site is on BSAL.

The purpose of the Interim Protocol is to assist proponents and landholders to understand what is required to identify the existence of BSAL and outlines the technical requirements for the on-site identification and mapping of BSAL. SLR Consulting completed the BSAL assessment in accordance with the Interim Protocol which appears as **Appendix 9**. An Agricultural Impact Statement was also prepared by SLR Consulting and appears as **Appendix 10**.

The Modification'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*.

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).
- Eleven of thirteen sites which underwent laboratory analysis failed **BSAL Criteria 12**, with either pH in CaCl2 being less than 4.5, ESP > 15 and/or having a calcium to magnesium ratio of less than 0.1.

9.5.6 Disturbance Management

The need for disturbance management of soil resources may be required during and shortly after subsidence remediation. Given the predicted levels of 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)

Remnant ponding as a result of subsidence may require engineered channel earthworks to remediate drainage channels and drain paddocks. Should remnant ponding require remediation, soils that are subject to surface disturbance should be managed in order to minimise impact and ensure appropriate rehabilitation of the disturbed areas can be undertaken. The soil resources that are likely to be impacted by subsidence remediation are Kurosols, Sodosols and Dermosols.

Gypsum will be applied for any remediation earthworks where sodic subsoils (where exchangeable sodium is greater than 5) are exposed. The application of gypsum will minimise the potential for tunnel erosion to occur on disturbed subsoil.

9.5.7 Conclusion

The Soil and Land Resource Assessment was conducted based on the findings of a field investigation and a desktop review of reference information. The findings of the assessment include:

- Soils types within the Study Area are dominated by texture contrast soils which commonly occur with acid and sodic characteristics. ASC soil types are Brown Kurosols (5%) defined by a strongly acidic nature and Brown Sodosols (72%) defined by subsoil sodicity. The remaining soil type is a Brown Dermosol comprising 23% of the Study Area.

- LSC classes range from Class 5 (moderately low capability land) to Class 7 (very low capability land) with approximately 56% of the Study Area classified as having low to very low agricultural capability.

- Agricultural Suitability ranges from Class 3 (land suitable for occasional but not continual cultivation) to Class 5 (land best managed by the presence of light green timber due to its highly erodible soils and steep slopes), with approximately 44% of the Study Area having moderately low agricultural capability.

- No soil stripping within the Study Area is anticipated as a result of the Project.

Disturbance management techniques have been presented to mitigate the negligible soil and land resource impacts associated with the proposed Modification.

9.6 Greenhouse Gas

9.6.1 Introduction

Greenhouse Gas (GHG) impacts were assessed in the technical letter report *SSD-5144 Mod 4 Longwall Panel 22-23 Extension Modification Greenhouse Gas Assessment (*SLR 2016d) (**Appendix 11**).

A GHG assessment for the Mandalong Southern Extension Project (SSD-5144) was completed by BDM Resources in 2012. The same Project boundaries as the previous GHG assessment (BDM 2012) have been adopted for this assessment. For comprehensiveness, this report includes an assessment of scope 3 emissions, including combustion of the product coal by the end user. The GHG assessment predominately aims to present the additional GHG emissions due to secondary extraction of extended longwall panels 22 and 23. The methodology, results and conclusions of the GHG assessment are presented below.

9.6.2 Emission Sources and Factors

The GHG emissions associated with the Modification have been assessed in terms of direct (Scope 1) emission potential, indirect (Scope 2) emission potential and significant upstream/downstream (Scope 3) emission potential. A summary of the potential Project as modified GHG emission sources considered in this assessment is provided in **Table 18**.

Table 18: Summary of Potential Project GHG Emissions

Project Component	Direct Emissions	Indirect Emissions	
	Scope 1	**Scope 2**	**Scope 3**
Fugitive Emissions	Emissions from the release of coal seam methane and carbon dioxide as a result of extraction activities.	N/A	N/A
Diesel	Emissions from the combustion of diesel at the Project in both mobile and fixed plant and equipment.	N/A	N/A
Electricity	N/A	Emissions associated with the consumption of generated and purchased electricity at the mine.	N/A
Coal Combustion	N/A	N/A	Emissions from the combustion of coal from the Project.

It is noted that a number of scope 1 emission sources have not been included in the GHG emission calculations due to their contribution being less than 1% of total Project emissions. Specifically, emissions from Sulphur hexafluoride leakage, oils and grease consumption (not combusted), liquefied petroleum gas consumption and waste to landfill are considered to be negligible compared to the total Scope 1 and Scope 2 GHG emissions from the Project.

The Longwall 22 and 23 extensions will result in an additional 1.4 Mt of coal being extracted from Mandalong Mine over the life of the mine. The GHG emissions associated with extracting this additional resource have therefore been compared to the total life of mine GHG emissions, rather than the Mine's annual GHG emissions. The proposed extraction of this additional 1.4 Mt is proposed to be achieved within the existing approved mine life and annual extraction rate. The estimated incremental GHG emissions associated with the Longwall 22 and 23 extensions is therefore regarded as a component of the total life of mine GHG emissions based on 6.5 Mtpa being extracted over 25 years.

The emission factors for the Scope 1, 2 and 3 emissions are sourced from the *National Greenhouse Accounts Factors* published by the Australian Government's Department of the Environment.

9.6.3 GHG Emissions

Scope 1 Emissions

Scope 1 emissions refer to the "direct emissions" that occur as a result of the Project. The Scope 1 emissions from this Project are:

- Fugitive emissions from drainage gas

The annual pre-drainage gas emission rate will not increase as a result of the proposed extensions to longwall panels 22 and 23 as the in-situ seam gas pressures will remain unchanged and the gas generation rate is independent of production rates. The pre-drainage maximum gas flow rate used in the calculations of 833 L/s (96% CH_4 and 4% CO_2) is therefore unchanged from the previous assessment (BDM 2013). The calculated annual and life of mine (LOM) Scope 1 fugitive emissions in addition to the contributions from longwalls 22 and 23 as extended regarding drainage gas are shown in **Table 19**.

Table 19: Scope 1 Calculated Fugitive Emissions from Drainage Gas

Source	Emissions Presented for Mod 3 (6.5 Mtpa)		LW22-23 Extension
	Annual GHG Emissions (t CO_2-e/yr)	LOM GHG Emissions (t CO_2-e)	(t CO_2-e)
Gas drainage	429,837	10,745,925	93,721

- Fugitive emissions from Ventilation Air Methane (VAM)

For a production rate of 6 Mtpa (Extension Project), the maximum ventilation air flow rate was reported to be 500 m^3/sec (0.46% CH_4 and 0.019% CO_2) for Mandalong Mine and 75 m^3/sec for Cooranbong (0.09% CH_4 and 0.05% CO_2). To provide a conservative estimate of the GHG emissions due to Longwall 22 and 23 extensions, these air flow rates have been scaled accordingly. The GHG emissions due to the Mandalong Tonnage Increase Modification 3 (6.5 Mtpa) are sourced from the SEE prepared for Mod 3 (Centennial 2016). The resulting calculated annual and LOM Scope 1 fugitive emissions in addition to the contributions from longwalls 22 and 23 as extended regarding mine ventilation air are shown in **Table 20**.

Table 20: Scope 1 Calculated Fugitive Emissions from Ventilation Air

Source	Emissions Presented for Mod 3 (6.5 Mtpa)		LW22-23 Extension
	Annual GHG Emissions (t CO_2-e/yr)	LOM GHG Emissions (t CO_2-e)	(t CO_2-e)
Mine Ventilation	1,385,486	34,367,150	300,951

- Emissions from combustion of diesel.

Diesel consumption is linked to production. To assess the incremental contribution of the proposed Project, the maximum diesel consumption rate for the production of 6 Mtpa (984 kL) was scaled accordingly to give 1,066 kL for 6.5 Mtpa and 252 kL for the extension of longwall panels 22 and 23 (1.4 Mtpa). The resulting calculated annual and LOM Scope 1 emissions in addition to the contributions from longwalls 22 and 23 as extended regarding diesel consumption are shown in **Table 21**.

Table 21: Scope 1 Calculated Fugitive Emissions from Diesel Combustion

Source	Emissions Presented for Mod 3 (6.5 Mtpa)		LW22-23 Extension
	Annual GHG Emissions (t CO_2-e/yr)	LOM GHG Emissions (t CO_2-e)	(t CO_2-e)
Diesel Combustion	2,889*	72,214*	630

*Adjusted to account for the updated NGA Emission Factor.

Scope 2 Emissions

Electricity consumption at Centennial Mandalong is associated with conveyors and current ventilation requirements, as well as bath house operations etc. It has therefore been assumed that the contribution of the proposed longwall panels 22 and 23 extensions to the total LOM emissions will be proportional to the 1.4 Mt extracted. The annual and LOM Scope 2 emissions in addition to the contribution from the Longwall 22 and 23 extensions regarding electricity consumption are shown in **Table 22**.

Table 22: Scope 2 Calculated Fugitive Emissions from Electricity Consumption

Source	Emissions Presented for Mod 3 (6.5 Mtpa)		LW22-23 Extension
	Annual GHG Emissions (t CO_2-e/yr)	LOM GHG Emissions (t CO_2-e)	(t CO_2-e)
Electricity consumption	110,805*	2,770,131*	24,161

*Adjusted to account for the updated NGA Emission Factor.

Scope 3 Emissions

The annual and LOM Scope 3 emissions in addition to the contribution from the Longwall 22 and 23 extensions regarding the combustion of bituminous coal are shown in **Table 23**.

Table 23: Scope 3 Calculated Fugitive Emissions from Coal Combustion

Source	Emissions Presented for Mod 3 (6.5 Mtpa)		LW22-23 Extension
	Annual GHG Emissions (t CO_2-e/yr)	LOM GHG Emissions (t CO_2-e)	(t CO_2-e)
Coal combustion	15,835,365*	395,884,125*	3,452,875

*Adjusted to account for the updated NGA Emission Factor.

Emissions Summary

A summary of the estimated annual and LOM Scope 1, 2 and 3 emissions are shown in **Table 24**. It is noted that the emissions associated with the Longwall 22 and 23 extensions represent the contribution of the extraction of this additional resource to the LOM emissions which are based on the maximum production rate of 6.5 Mtpa and the full 25 year life of the mine. The 1.4 Mt coal proposed to be extracted as part of the Longwall 22 and 23 extensions will be achieved within this current approved annual extraction rate and mine life.

Table 24: Summary of Scope 1, 2 and 3 Emissions

Source	Emissions Presented for Mod 3 (6.5 Mtpa)		LW22-23 Extension
	Annual GHG Emissions (t CO_2-e/yr)	LOM GHG Emissions (t CO_2-e)	(t CO_2-e)
Scope 1			
Drainage Gas	429,837	10,745,925	93,721
Mine Ventilation	1,385,486	34,637,150	300,951
Diesel Combustion	2,889	72,214	630
Scope 2			
Electricity Consumption	110,805	2,770,131	24,161

Source	Emissions Presented for Mod 3 (6.5 Mtpa)		LW22-23 Extension
	Annual GHG Emissions (t CO_2-e/yr)	LOM GHG Emissions (t CO_2-e)	(t CO_2-e)
Scope 3			
Coal Combustion	15,835,365	395,884,125	3,452,875
Total – Scope 1	**1,818,212**	**45,455,289**	**395,302**
Total – Scope 1 and 2	**1,929,071**	**48,225,420**	**419,463**

9.6.4 Comparison with National and State GHG Emissions

Emissions of GHG in NSW were reported to be 130.1 Mt in 2014 which was approximately 25% of the total Australian GHG emissions of 523.1 Mt. A comparison of the emissions estimated for Mandalong Mine with NSW and Australia emission totals is presented in **Table 25**. As shown in **Table 25**, the contribution of Longwall 22 and 23 extensions to the total LOM emissions is minimal, at less than 1%.

Table 25: Comparison of Emissions with State and National Totals 2014

Emission Scope	Estimated Emissions (tCO_2-e/yr)	Percentage of NSW 2014 GHG Emissions	Percentage of Australian 2014 GHG Emissions
Scope 1	1,818,212	0.001%	0.0003%
Scope 1 and 2	1,929,017	0.001%	0.0004%

9.6.5 Conclusion

The additional 1.4 Mt coal proposed to be extracted as part of the extension to longwall panels 22 and 23 will be achieved within this current approved annual extraction rate and mine life. The estimated incremental GHG emissions are therefore regarded as a component of the total life of mine GHG emissions based on 6.5 Mtpa being extracted over 25 years. Centennial Mandalong will continue to support research into suitable abatement technologies regarding ventilation air methane.

10.0 JUSTIFICATION AND CONCLUSION

A description of the need and justification for the Modification is provided in this chapter with regard to environmental, social and economic factors. This includes consideration of alternatives, the principles of Ecologically Sustainable Development (ESD) and the consistency of the Modification with the objectives of the EP&A Act.

10.1 Modification Justification and Alternatives

The extension of existing longwall panels 22 and 23 is required due to the mine optimising production within the existing SSD-5144 Project Application Area and associated mining tenements. The extended panels will yield a greater quantity of thermal coal using existing infrastructure. Ultimately the benefits associated with the extended longwall panels are in the form of the greater financial returns. Overall, the Modification is estimated to increase beneficial economic and related social effects by approximately $5 million.

Continuation of the Project as approved equates to the 'do nothing' or 'business as usual' base case. The base Mandalong Southern Extension Project case was presented in detail and approved in 2015. It was based on historic uncertainty associated with the extent of an igneous sill affecting the seams, as a consequence of which, longwall panels 22 to 24 were shortened, as a conservative measure to mitigate the sill's impact on the mine's production.

The proposed Modification is based on the findings of subsequent geological exploration in relation to the extent of the sill, and the successful extraction of adjacent longwall panels below the sill. These have allowed a clearer understanding of conditions, which indicate that the resource below the sill can be successfully mined.

As detailed in the SEE, the Modification will have limited environmental, social and economic impacts beyond those approved in SSD-5144. The Modification will enable continued safe and efficient operations at Mandalong Mine.

10.2 Modification Impacts

This SEE, which includes relevant technical specialist assessments, documents the various studies that have been undertaken to examine potential impacts that may occur as a result of the Modification.

The assessment of environmental issues has been multi-disciplinary and involved consultation with key stakeholders. The Modification is anticipated to pose minimal environmental impacts beyond those previously assessed and approved under SSD-5144.

10.3 Modification Benefits

The socio-economic assessment prepared in relation to the Modification has considered the findings from the relevant technical specialist assessments which have assumed a worst case scenario, meaning that potential impacts may be less than predicted.

Overall the Modification results in no long term socio-economic impacts with the Modification being undertaken to sustain the ongoing operation of Mandalong Mine.

Approval of the Modification will result in greater economic and related social returns for the state. This will also have a positive social impact over the life of the mine.

10.4 Ecologically Sustainable Development

Ecologically Sustainable Development (ESD) is a primary objective of environmental protection in NSW. The objects of the EP&A Act adopt the principles of ESD and it is defined under section 6(2) of the *Protection of the Environment Administration Act 1991* as:

> *6(2) For the purposes of subsection (1)(a), ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:*
>
> *(a)* ***the precautionary principle*** *- namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:*
>
> *(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*
>
> *(ii) an assessment of the risk-weighted consequences of various options,*
>
> *(b)* ***inter-generational equity*** *- namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,*
>
> *(c)* ***conservation of biological diversity and ecological integrity*** *- namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,*
>
> *(d)* ***improved valuation, pricing and incentive mechanisms*** *- namely, that environmental factors should be included in the valuation of assets and services, such as:*
>
> *(i) polluter pays - that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*
>
> *(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*
>
> *(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*

The overall objectives of ESD are to use, conserve and enhance natural resources. This ensures that ecological processes are maintained facilitating improved quality of life, now and into the future.

Mandalong Mine is committed to the principles of ESD and understands that social, economic and environmental objectives are interdependent. The company acknowledges that a well-designed and effectively managed operation will avoid significant and/or costly environmental impacts or degradation. Consideration has been given to appropriately identifying, avoiding, mitigating and managing environmental risks. This demonstrates environmental due diligence and will provide for on-going and adaptive monitoring and management of the operation in line with the ESD principles outlined in the below sub-sections.

10.4.1 The Precautionary Principle

The precautionary principle, in summary, holds that where there are threats of serious or irreversible environmental damage, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent the degradation.

The SEE has enabled an understanding of the potential impacts of the Modification on environmental, social and economic factors. Existing management controls and mitigation strategies are already in place to effectively monitor, mitigate and/or manage the potential environmental and socio-economic impacts of the Modification should it be approved.

10.4.2 Intergenerational Equity

Intergenerational equity is centered on the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. There is a moral obligation to ensure that today's economic progress, which will benefit both current and future generations, is not offset by environmental deterioration.

Mandalong Mine undertakes on-going environmental monitoring with mitigation measures to provide effective environmental management across its operations. This management is provided through planning, communication, documentation, review and feedback. These environmental management measures ensure that the health, diversity and productivity of the environment is maintained or enhanced for future generations.

10.4.3 Conservation of Biological Diversity and Ecological Integrity

The principle of "conservation of biological diversity and ecological integrity" holds that the conservation of biological diversity and ecological integrity should be a fundamental consideration for development proposals.

The potential environmental impacts of the Modification and existing measures to ameliorate these potential impacts are detailed in this report. The Modification poses no significant impacts to biodiversity or ecological matters beyond those approved under SSD-5144.

10.4.4 Improved Valuation, Pricing and Incentive Mechanisms

The principle of "improved valuation, pricing and incentive mechanisms" deems that environmental factors should be included in the valuation of assets and services. The cost associated with using or impacting upon an environmental resource is seen as a cost incurred to protect that resource. Mandalong Mine will optimise the valuation and pricing of the coal resource by efficiently achieving the extraction of additional coal resources by utilising existing approved infrastructure.

10.5 Conclusion

The Modification has been assessed using a risk-based and consultative approach to identify and assess potential environmental, social and economic impacts. The assessment has been multi-disciplinary and has involved consultation with DP&E in addition to other stakeholders. Emphasis has been placed on ensuring minimal impacts to the environment and affected landowners whilst enabling Centennial Mandalong's operations to proceed in accordance with the mine's business plan.

A range of potential impacts have been assessed in this report in addition to the appended technical specialist assessments. Conclusions indicate that the Modification will have minimal environmental, social and economic consequences. In addition to the Longwall 22 – 23 Extraction Plan being developed, existing management controls and mitigation strategies are in place for Mandalong Mine to effectively

monitor, mitigate and/or manage the potential environmental and socio-economic impacts of the Modification should it be approved.

The Modification is considered to be consistent with relevant objectives of the EP&A Act, including the principles of ESD, and will not change the nature of the development as originally approved. On considering the balance of environmental, social and economic impacts, it is considered reasonable to conclude that the benefits of the Modification outweigh the impacts. Based on the findings of this report, it is recommended that the Modification be approved.

11.0 REFERENCES

AIGIS Group (2016) *Mandalong Mine Longwall Panels 22 to 23 Modification, Economic Impact Assessment.*

BDM Resources (2013) *Mandalong Southern Extension Project, Greenhouse Gas Report for EIS*.

Centennial Coal (2011) *Environmental Management System Framework.*

Centennial Coal (2016) *LW 22 and 23 Social Impact Assessment*.

Department of Planning (2006) *Lower Hunter Regional Strategy 2006-31.* Sydney.

Department of Planning and Environment (2014), *Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals.* Sydney.

GHD (2013) *Mandalong Southern Extension Project, Water Management Impact Assessment.*

GHD (2016a) *Mandalong Longwall Panel 22 to 23 Modification Water Resources Impact Assessment.*

GHD (2016b) *Mandalong Mine Production Tonnage Project, Groundwater and Water Balance Modelling Report.*

Lake Macquarie City Council (2013) *Lifestyle 2030 Strategy.*

Lake Macquarie Development Control Plan 2014.

Lake Macquarie Local Environmental Plan 2014.

Landcom (2004) *Managing Urban Stormwater: Soils and Construction Volume 1.* Sydney.

Office of Environment and Heritage (2013) *The land and soil capability assessment scheme: second approximation.* Sydney.

RPS (2016a) *Mandalong Mine Longwalls 22-23 Ecological Impact Assessment*.

RPS (2016b) *Mandalong Mine Heritage Impact Assessment Longwall 22 and 23 Modification*.

Seedsman Geotechnics (2016) *Centennial Mandalong Pty Ltd Prediction of Subsidence Impacts for LW22-LW23*

SLR (2016a) *Soil and Land Resource Assessment Mandalong Mine LW22 – LW23 Modification.*

SLR (2016b) *Biophysical Strategic Agricultural Land Assessment Mandalong Mine LW22 – LW23 Modification.*

SLR (2016c) *Agricultural Impact Statement Mandalong Mine LW22 – LW23 Modification.*

SLR (2016d) *SSD-5144 Mod 4 Longwall Panel 22-23 Extension Modification Greenhouse Gas Assessment.*

Umwelt (2016) *Centennial Mandalong Flood Assessment Longwalls 22 to 23.*

Wyong Local Environmental Plan 2013.

12.0 ABBREVIATIONS

ACHCR	Aboriginal Cultural Heritage Consultation Requirements for Proponents
ACHMP	Aboriginal Cultural Heritage Management Plan
AHD	Australian Height Datum
AIP	Aquifer Interference Policy
ANZECC	Australian and New Zealand Environment Conservation Council
ASC	Australian Soil Classification
BCR	Benefit-Cost Ratio
BDM	BDM Resources Pty. Ltd.
BoM	Bureau of Meteorology
BSAL	Biophysical Strategic Agricultural Land
CO2-e	Carbon Dioxide Equivalent
DA	Development Application
DEC	Former NSW Department of Environment and Conservation
DECC	Former NSW Department of Environment, Climate Change
DECCW	Former NSW Department of Environment, Climate Change and Water
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
DRE	NSW Division of Resources and Energy
CBA	Cost-Benefit Analysis
CCC	Community Consultative Committee
CCL	Consolidated Coal Lease
CH_4	Methane
CO	Carbon Monoxide
c/t	Cut-through
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EL	Exploration Licence
EMS	Environmental Management Strategy
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EP&A Reg	NSW Environmental Planning and Assessment Regulation 2000
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FCNSW	Forestry Corporation of NSW
GHD	GHD Pty. Ltd.
GIS	Geographical Information System
ha	Hectares
ILUA	Indigenous Land Use Agreements
ISO	International Standards Organisation
kL	Kilolitre

km	Kilometres
LEA	Local Effects Analysis
LEP	Local Environmental Plan
LGA	Local Government Area
LMCC	Lake Macquarie City Council
LOM	Life of Mine
LS2030	Lake Macquarie City Council's Lifestyle 2030 Strategy
LW	Longwall
m	Metres
mm/m	Millimetres per metre
MG	Maingate
ML	Mining Lease
ML/yr	Megalitres per year
MMAS	Mandalong Mine Access Site
MNES	Matter of National Environmental Significance
MOD	Modification
MOP	Mining Operations Plan
MPL	Mining Purposes Lease
MSSS	Mandalong South Surface Site
Mtpa	Million tonnes per annum
MU	Mapping Unit
NGER Act	National Greenhouse and Energy Reporting Act 2007
NPV	Net Present Value
NPW Act	NSW National Parks and Wildlife Act 1974
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PAA	Project Application Area
PAC	NSW Planning Assessment Commission
POEO Act	NSW Protection of the Environment Operations Act 1997
RAP	Registered Aboriginal Party
ROM	Run of Mine
RPS	RPS Australia East Pty. Ltd.
SEE	Statement of Environmental Effects
SEP	Stakeholder Engagement Plan
SEPP	State Environmental Planning Policy
SILO	Scientific Information for Land Owners
SLR	SLR Consulting Australia Pty. Ltd.
SMP	Subsidence Management Plan
SSD	State Significant Development
SSR	Safe, Serviceable and Repairable
t	Tonnes
TARP	Trigger Action Response Plan
TEC	Threatened Ecological Community
TSC Act	NSW Threatened Species Conservation Act 1995
TSP	Total Suspended Particulates

VAM	Ventilation Air Methane
WAL	Water Access Licence
WM Act	NSW Water Management Act 2000
WSP	Water Sharing Plan
µg	Microns
µs/cm	Microsiemens per Centimetre

Centennial Coal

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