Centennial Coal

CENTENNIAL MANDALONG PTY LTD

Mandalong Mine

ANNUAL REVIEW

March 2018

Centennial Coal
Environment Matters

Annual Review Title Block

Name of Operation	Mandalong Mine
Name of Operator	Centennial Mandalong Pty Ltd
Development Consent/ Project Approval #	SSD-5144, SSD-5145, DA97/800, DA 35-2-2004.
Mining Lease #	Mining Lease 1431 Mining Lease 1443 Mining Lease 1543 Mining Lease 1553 Mining Lease 1722 Mining Lease 1744
Name of Holder of Mining Lease	Centennial Mandalong Pty Ltd
Water License #	WAL39767
Name of Holder of Water License	Centennial Mandalong Pty Ltd
MOP/RMP Start Date	1 December 2016
MOP/RMP End Date	30 November 2023
Annual Review Start Date	1 January 2017
Annual Review End Date	31 December 2017

I, M. CAIRNEY certify that this audit report is a true and accurate record of the compliance status of Centennial Mandalong for the period 1 January to 31 December 2017 and that I am authorized to make this statement on behalf of Centennial Mandalong Pty Ltd.

Note:

a) *The Annual Review is an 'environmental audit' for the purposes of s122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion) in an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.*

b) *The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (intention to defraud by false or misleading statement – maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents –maximum penalty 2 years imprisonment or $22,000,or both).*

Name of Authorised Reporting Officer	M. CAIRNEY
Title of Authorised Reporting Officer	MD + CEO
Signature of Authorised Reporting Officer	M Cairney
Date	23.3.18

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1 STATEMENT OF COMPLIANCE

Table 1: Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
DA97/800 (MOD10)	Yes
DA97/800 MOD 4 Statement of Commitments	Yes
DA97/800 MOD 7 Statement of Commitments	Yes
SSD-5144 (MOD5)	**No**
SSD-5144 Mandalong Southern Extension Project Statement of Commitments	Yes
SSD-5144 MOD 1 Statement of Commitments	Yes
SSD-5145 (MOD 1)	Yes
DA35-2-2004 (MOD 1)	Yes
EPL 365	Yes
Mining Lease 1431	Yes
Mining Lease 1443	Yes
Mining Lease 1543	Yes
Mining Lease 1553	Yes
Mining Lease 1722	Yes
Mining Lease 1744	Yes
WAL39767	Yes
EPBC Approval 2013/6906	Yes

Table 2: 2017 Non-Compliances

Relevant Approval	Condition #	Condition summary	Compliance Status	Comment	Table # Addressed in Annual Review
SSD-5144 (MOD 5)	Schedule 3, Condition 24(a)	Centennial Mandalong must design and construct the Mandalong South Surface Site (MSSS) access road to avoid impacting *Melaleuca biconvexa* trees.	**Low**	An incident occurred on Monday 3 April 2017 at the MSSS access road construction site. A Daracon excavator inadvertently struck and broke a branch of an individual *Melaleuca biconvexa* specimen whilst installing ballast on the existing access track.	**Table 44**

Note: Compliance Status Key for Table 2

Risk Level	Colour Code	Description
High		Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium		Non-compliance with: • Potential for serious environmental consequences, but is unlikely to occur; or • Potential for moderate environmental consequences, but is likely to occur
Low		Non-compliance with: • Potential for moderate environmental consequences, but is unlikely to occur; or Potential for low environmental consequences, but is likely to occur
Administrative		Only to be applied where the non-compliance does not result in any risk of environmental harm (eg submitting a report to government later than required under approval conditions)

2 INTRODUCTION

Mandalong Mine is owned and operated by Centennial Mandalong Pty Ltd (Centennial Mandalong), a subsidiary of Centennial Coal Company Limited ('Centennial'). Centennial completed the purchase Mandalong Mine in August 2002. Centennial was subsequently purchased by Banpu Public Company Limited ("Banpu") in October 2010.

Mandalong Mine is a modern underground longwall operation located on the western side of Lake Macquarie near Morisset and west of the M1 Motorway. The Mine is situated approximately 130 km north of Sydney and 50 km from the Port of Newcastle, supplying up to 6.5 million tonnes of coal to the domestic power and export markets (**Figure 1**).

Figure 1: Regional Context

2.1 OVERVIEW

Mandalong Mine comprises the underground workings and surface infrastructure of:

- The Mandalong Mine underground workings including longwall panels, development units and surface infrastructure located near Morisset;
- The Cooranbong Entry Site, consisting of the Cooranbong Colliery underground workings and surface infrastructure located near Dora Creek;
- The Mandalong South Surface Site located off Mandalong Road; and
- The Delta Entry Site, which encompasses an entry and coal delivery system, located near Wyee at the Vales Point Rail Unloader Facility.

An Environmental Impact Statement (EIS) was submitted in 1997 and a Commission of Inquiry held in 1998. The Mine was granted development consent DA 97/800, in October 1998. After obtaining development consent, Centennial constructed the Mandalong Mine site and decline tunnel to access the Mandalong mining area. Longwall mining operations at Mandalong commenced in January 2005. The Mine has approval to extract up to 6.5 million tonnes per annum of coal from the West Wallarah Seam using the longwall mining method.

Development consent DA 35/2/2004 granted in July 2004 by the then NSW Department of Planning & Infrastructure approved the construction and operation of the coal handling and clearance system at the Delta Entry Site. Construction of the Delta Coal Clearance System was completed in 2006. The Cooranbong Entry Site and the Delta Entry Site contain coal handling infrastructure, enabling the Mandalong Mine to process and convey as permitted by their respective development consents up to 10 million tonnes of coal per annum. These sites are maintained under current mine leases as detailed in **Table 4**.

Development consent SSD-5144 was granted by the Planning & Assessment Commission (PAC) on 12 October 2015. As per Condition 13 of Schedule 2 of SSD-5144 and agreed with the Secretary of the Department of Planning & Environment on 16 September 2016 in accordance with Section 104A of the Environmental Planning and Assessment Act 1979 (EP&A Act) Centennial Mandalong shall surrender DA97/800 by 30 April 2018.

2.2 SCOPE

This Annual Review details the progress of environmental management covering Mandalong Mine, Mandalong South Surface Site, Cooranbong Entry Site and Delta Entry Site collectively, for the period 1 January 2017 to 31 December 2017.

The Annual Review has been prepared in accordance with the Mandalong Mine conditions of consent as detailed in SSD-5144 and DA 97/800. The Annual Review has also been prepared in accordance with the requirements of Schedule 3, Condition 4 of DA35-2-2004 (Mandalong Coal Delivery System – Delta Link Project).

Development Consent SSD-5145 (Northern Coal Logistic Project) was approved by the DPE on 29 September 2015. The approval consolidates the receipt, handling, processing and transport of run-of-mine coal from Centennial Coal's underground operations at Mandalong Mine, Newstan Colliery and Awaba Colliery.

This Annual Review document also addresses the requirements of Schedule 5, Condition 11 of SSD-5145 for the Cooranbong Entry Site (CES). The others operations covered by SSD-5145 are described in the Newstan Annual Review required by SSD-5145.

Table 3: Centennial Mandalong Environmental Contact Details

Name	Position	Email	Phone
John Turner	Mine Manager	john.turner@centennialcoal.com.au	02 49730911
Jeffrey Dunwoodie	Environment & Community Coordinator	jeffrey.dunwoodie@centennialcoal.com.au	02 49730947
Phil Enright	Mining Approvals Coordinator	phil.enright@centennialcoal.com.au	02 49730948

3 APPROVALS

Table 4: Environmental Approvals held by Centennial Mandalong.

Name	Description	Issued By	Expiry Date	Renewal Procedure
Consolidated Coal Lease 762	Title to Cooranbong Workings includes some surface land, some environmental conditions	Dept. Primary Industry (Mineral Resources)	13/10/2022	Group Manager Property, Titles and Survey
Consolidated Coal Lease 746 (sublease)	Title for Cooranbong Workings includes some surface land – some environmental conditions	Dept. Primary Industry (Mineral Resources)	31/12/2028	Group Manager Property, Titles and Survey This lease is managed by Centennial Newstan
Mining Purposes Lease 191	Title to surface land for water tanks at Cooranbong – requires annual environmental management report on anniversary	Dept. Primary Industry (Mineral Resources)	24/2/2023	Group Manager Property, Titles and Survey
Mining Lease 1431	Title to surface land for proposed shaft at the back of Morisset	Dept. Primary Industry (Mineral Resources)	27/5/2019	Group Manager Property, Titles and Survey
Mining Lease 1443	Mandalong Project Mining Lease – includes some surface land	Dept. Primary Industry (Minerals Resources)	01/03/2020	Group Manager Property, Titles and Survey
Mining Lease 1543	Mining Lease – Mandalong Mine Project	Dept. Primary Industry (Mineral Resources)	25/11/2024	Group Manager Property, Titles and Survey
Mining Lease 1553	Mining Lease Delta Link Project – includes surface land	Dept. Primary Industry (Mineral Resources)	07/09/2025	Group Manager Property, Titles and Survey

Name	Description	Issued By	Expiry Date	Renewal Procedure
Mining Lease 1722	Mining Lease – Southern Extension Area	Dept. Industry Resources & Energy	17/12/2036	Group Manager Property, Titles and Survey
Mining Lease 1744	Mining lease associated with proposed mining operations in the Olney State Forest areas within the Southern Extension Area	Dept. Industry Resources & Energy	6/10/2037	Group Manager Property, Titles and Survey
Exploration Licence 4443	Exploration Licence	Dept. Primary Industry (Mineral Resources)	23/10/2017#	Group Manager Property, Titles and Survey
Exploration Licence 4969	Exploration Licence	Dept. Primary Industry (Mineral Resources)	31/07/2017#	Group Manager Property, Titles and Survey
Exploration Licence 5892	Exploration Licence	Dept. Primary Industry (Mineral Resources)	31/07/2017#	Group Manager Property, Titles and Survey
Exploration Licence 6317	Exploration Licence	Dept. Primary Industry (Mineral Resources)	08/08/2019#	Group Manager Property, Titles and Survey
Authorisation 404	Exploration Licence	Dept. Primary Industry (Mineral Resources)	31/07/2017#	Group Manager Property, Titles and Survey
Mine Operations Plan (MOP) – Amendment A	Summary of Mining Activities – Mandalong	Department of Planning & Environment – Division of Resources & Geoscience.	30/11/2023	MOP approved for the period 1 December 2016 to 30 November 2023.

Name	Description	Issued By	Expiry Date	Renewal Procedure
Environmental Protection Licence 365	Permits scheduled activity “coal mining” and discharge of water from licensed discharge points.	Environment Protection Authority	Perpetual	Requires payment and Annual Return February each year
Mandalong Mine Development Consent No.97/800	Permits development and works to occur as described in the EIS.	NSW Department of Planning & Environment	October 2020	To be surrendered by 30 April 2018.
Mandalong Mine Development Consent No. DA 35-2-2004	Permits construction and operation of the Delta Coal Handling Facility	NSW Department of Planning & Environment	31/12/2040	Requires new development consent after expiry date.
Mandalong Mine Development Consent SSD-5144	Extension of underground operations into the Mandalong Southern Extension Area.	NSW Department of Planning & Environment	31/12/2040	Requires new development consent after expiry date.
Centennial Northern Coal Services Development Consent SSD-5145	Receipt, handling, processing and transport of run-of-mine coal from Centennial Coal’s underground operations at Mandalong Mine, Newstan Colliery and Awaba Colliery.	NSW Department of Planning & Environment	31/12/2045	Requires new development consent after expiry date.
Northern Coal Logistics EPBC Approval 2013/6906	To upgrade coal preparation, handling infrastructure, transport and water management activities at the existing Northern Coal Services Site	Department of the Environment & Energy	31/12/2055	Requires new EPBC approval after expiry date.

Name	Description	Issued By	Expiry Date	Renewal Procedure
Cooranbong Borehole WAL39767	Dewatering of Mine Workings	Department of Industry – Crown Lands & Water	This water access licence continues to be in force until it is cancelled.	Submit renewal application
Radiation Licence 5064217	Radiation management	Environment Protection Authority	26/6/2018	Submit renewal application.

Note # Renewal applications have been lodged and acknowledged for these titles however, no renewal offers have been received at the time of writing of this Annual Review.

3.1 DEVELOPMENT CONSENTS

The Mandalong Mine, which is an extension of the old Cooranbong Colliery, was originally granted Development Consent DA 97/800 by the then Minister for Urban Affairs and Planning on 14 October 1998 under Part 4 of the EP&A Act following the submission of the *Cooranbong Colliery Life Extension Project Environmental Impact Statement* (Umwelt, 1997) and a Commission of Inquiry. The currently approved Mandalong Mine comprises the underground workings and surface infrastructure of the:

- Mandalong Mine, including the Mandalong Mine Access Site, encompassing underground workings and associated surface infrastructure near Morisset;
- Cooranbong Entry Site encompassing a coal delivery system and surface infrastructure (coal handling and processing) near Dora Creek; and
- The new surface facilities site currently under construction, referred to as the Mandalong South Surface Site located off Mandalong Road.

The other operations directly related to the currently approved Mandalong Mine are the two components which comprise the Delta Link Project, namely:

- The construction and use of the Mandalong Coal Delivery System for the underground transportation of coal from the Mandalong Mine to the Delta Entry Site; and
- The receipt and handling of coal at the Wyee Coal Handling Plant at the Delta Entry Site.

The approved Mandalong Mine, and the other operations which directly relate to it, are currently regulated by four planning approvals.

3.1.1 Development Consent SSD-5144 for the Mandalong Southern Extension Project

Development Consent SSD-5144 was granted by the Planning & Assessment Commission (PAC) on 12 October 2015 for the Mandalong Southern Extension Project.

The primary components of the Project are:

- Continue the currently approved operations at the Mandalong Mine, with the exception of the surface infrastructure and operations at the Cooranbong Entry Site

(i.e. the continued use of the coal delivery system, the ventilation shaft and the extent of workings at Cooranbong Entry Site for water management.) Note: The surface infrastructure and operations at the Cooranbong Entry Site are part of the Northern Coal Logistics Project SSD-5145, however continue to be managed by Centennial Mandalong;

- Extend the Mandalong Mine's underground mining operations into the Southern Extension Area using a combination of continuous miner and longwall mining methods;
- Extract up to 6.5 Mtpa of 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, and upgrade where required, the existing surface infrastructure of the Mandalong Mine Access Site and Delta Entry Site;
- Install and operate surface infrastructure at the proposed Mandalong South Surface Site 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;
- Increase the life of mine to 25 years from the granting of a mining lease(s); and
- Continue to operate 24 hours per day, seven days per week.

Approval to modify SSD-5144 (**MOD 1**) to allow for the relocation of Transgrid's 330 kV Transmission Line TL24 was granted by the DPE on 14 June 2016.

In August 2016, Centennial Mandalong submitted a second application to modify Development Consent SSD-5144 (**MOD 2**) to the DPE. The modification sought to extend development of first workings associated with maingates for longwall panels 22 and 23. This modification was approved on 22 September 2016.

A further modification (**MOD 3**) to increase the annual production limit for the Mandalong Mine from 6 million tonnes per annum to 6.5 million tonnes per annum of ROM coal was approved by DPE on 16 November 2016. This increase is required due to the mine optimising the production process, both in terms of mechanical improvements and through the continuing development and training of underground operators.

An igneous sill exists to the north 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 production. Through ongoing geological exploration and the successful extraction of adjacent Longwall panels 19, 20 and 21 below the igneous sill, its extent and condition had become better understood. This resulted in the proposed extension of Longwall panels 22 to 24 and the addition of Longwall panel 24A within the existing development consent boundary.

This extension of Longwall mining however existed beyond the development layout. To address this, a Statement of Environmental Effects was prepared titled the Mandalong Longwall Panel 22-23 Extension Modification (**MOD 4**) which was approved by the Department of Planning & Environment on 24 March 2017.

The Mandalong Longwall 24-24A modification (**MOD 5**) was approved by the Department of Planning and Environment on 1 August 2017 following public exhibition of the Statement of Environmental Effects. This modification approves the extension of Longwall 24 and the addition of Longwall 24A.

3.1.2 Development Consent DA 97/800 for the Mandalong Mine

Development application DA 97/800 was lodged with LMCC on 27 November 1997 and described in the *Cooranbong Colliery Life Extension Project Environmental Impact Assessment* (Umwelt, 1997), including the Applicants submissions to the Commission of Inquiry, and as modified on nine occasions as follows:

- **MOD 1 (August 2001) -** minor changes to the conditions of consent relating to the preparation of subsidence management plans and notification of landholder requirements, as described in the modification application dated 29 March 2001.
- **MOD 2 (February 2005) -** installation of methane drainage plant and the transport of 1,000 tonnes of mined coal by road, as described in *Mandalong Mine Methane Drainage Plant and Coal Haulage, Statement of Environmental Effects*, dated 28 October 2004 and prepared by Sinclair Knight Merz.
- **MOD 3 (March 2006) -** installation and operation of enclosed methane gas flare units for high purity methane drainage gas. This was undertaken in response to condition 60a(iii) imposed as part of MOD 2, which required Centennial Mandalong to submit a report on the progress towards implementing greenhouse gas abatement measures. This modification is as described in the *Statement of Environmental Effects for the Installation and Operation of Enclosed Methane Gas Flare Units*, dated February 2006 and prepared by Umwelt.
- **MOD 4 (July 2009) -** installation and operation of gas engines (yet to be constructed) to produce up to 12 megawatts of electricity using high purity methane drainage gas, increase the coal production rate from 4 Mtpa to 6 Mtpa, relocate a ballast borehole and update subsidence conditions. This modification is as described in the Environmental Assessment entitled *Mandalong Mine Modification to Development Consent Environmental Assessment*, dated September 2008.
- **MOD 5 (November 2009) -** coal from Mandalong Mine (Cooranbong Entry Site) permitted to be washed at Newstan Colliery and a temporary increase in the volume of coal transported by conveyor from the Cooranbong Entry Site to the Eraring Power Station stockpiles for subsequent road haulage to Newstan Colliery (until construction of the Cooranbong Private Haul Road was complete). This modification is as described in the Statement of Environmental Effects entitled *Washing of Mandalong Coal at Newstan Section 96(A) Application Statement of Environmental Effects*, dated October 2009.
- **MOD 6 (November 2009) -** changes to the locations and heights of approved (but not previously constructed) coal handling infrastructure at the Cooranbong Entry Site. This modification is as described in the Statement of Environmental Effects entitled *Relocation of Infrastructure within the Mandalong Services Site Section 96(1A) Application Statement of Environmental Effects*, dated November 2009.
- **MOD 7 (October 2011) -** installation and operation of a new technology known as a ventilation air methane regenerative after burner (VAM-RAB) as a trial unit to demonstrate the ability of the technology to capture and abate ventilation air methane from the underground mine. This modification is as described in the *Environmental Assessment: Ventilation Air Methane Abatement Demonstration Project, Mandalong Mine – Section 75W Modification*, dated June 2011 and additional information provided in the document entitled *Mandalong Mine Ventilation Air Methane Abatement Demonstration Project – Response to Submissions* dated September 2011.

- **MOD 8 (August 2012) -** increase in the volume of coal permitted to be transported from the Cooranbong Entry Site to both Newstan Colliery and the Eraring Power Station from 2 Mtpa to up to 4 Mtpa and back haulage of middlings (middle quality coal product) from Newstan Colliery to the Cooranbong Entry Site for subsequent supply to the Eraring Power Station. This modification is as described in the *Environmental Assessment: Mandalong Mine – Cooranbong Entry Site – Cooranbong Distribution Project – Section 75W Modification to Development Consent DA 97/800*, (GSS Environmental, 2012) and additional *Noise Mitigation Assessment*, dated 31 May 2012.
- **MOD 9 (February 2013) -** administrative amendment to conditions 1A(c) and (d) to allow the coal delivery limits approved as part of MOD 8 (i.e. up to 4 Mtpa from Cooranbong Entry Site to both Newstan Colliery and the Eraring Power Station).
- **MOD 10 (November 2014) -** a minor modification to conditions 1A(b) and 1A (c) for a small increase in the amount of coal allowed to be delivered from the underground workings to the Cooranbong Entry Site from 4 Mtpa to 4.1 Mtpa in 2014 only.

3.1.3 Development Consent DA 35-2-2004 for the Delta Entry Site

Development Consent for the transportation of coal to the Delta Entry Site via the underground Mandalong Coal Delivery System, as approved by development consent DA 35-2-2004 and described in the *Delta Link Project – Statement of Environmental Effects* (Umwelt, 2004). This development consent is held by Centennial Mandalong.

Centennial Mandalong sought to modify Development Consent DA 35-2-2004 (**MOD 1**) in September 2017 in order to increase the life of the Mandalong Coal Delivery System from 2021 to 2040. There was no change proposed to the volume of coal permitted to be transported via the Mandalong Coal Delivery System (4 Mtpa), nor any other proposed changes.

The modification would make the life of the Mandalong Coal Delivery System consistent with the life of Mandalong Mine as currently approved under Development Consent SSD-5144 and, as a result, enable continuation of the transportation of coal from Mandalong Mine to the Vales Point Power Station.

This was essentially an administrative amendment. The modification application was submitted to the NSW Department of Planning and Environment in September 2017 and was supported by an Environmental Assessment. Approval was granted by the Department of Planning & Environment on 17 October 2017.

3.1.4 Development Consent SSD-5145 for Northern Coal Logistics Project

Development Consent SSD-5145 for the Northern Coal Logistic Project was approved by the DPE on 29 September 2015. The approval consolidates the receipt, handling, processing and transport of run-of-mine coal from Centennial Coal's underground operations at Mandalong Mine, Newstan Colliery and Awaba Colliery.

The surface infrastructure and operations at the Cooranbong Entry Site are part of the Northern Coal Logistics Project SSD-5145, however continue to be managed by Centennial Mandalong.

3.2 MINING AUTHORITIES

The Mandalong Mine holding comprises a number of leases as shown in **Table 4**.

3.3 ENVIRONMENT PROTECTION LICENCE

Centennial Mandalong holds Environment Protection Licence (EPL) 365 under the Protection of the Environment Operations Act 1997 for the Mandalong Mine, Cooranbong Entry Site and the Delta Entry Site.

3.4 AUTHORISATIONS & EXPLORATION LICENCES

The Mandalong Mine holding comprises a number of leases as shown in **Table 4**. There were no renewals completed for the Mandalong Mine Exploration Licences during 2017.

The approved Mining Operations Plan for the period 1 December 2016 to 30 November 2023 was amended in 2017 (Amendment A). The MOP Amendment A was approved by the DPE Division of Resources and Geoscience (DRG) on 12 April 2017 and by DPE on 23 June 2017.

3.5 CONSENT CONDITIONS – ANNUAL REVIEW REQUIREMENTS

The Annual Review has been developed to satisfy the reporting requirements of the approvals listed in **Table 5**. Condition 12 of Schedule 6 of SSD-5144 and Condition 11 of Schedule 5 of SSD-5145 include the requirements for the Annual Review. Conditions 105-107 of DA97/800 (MOD 10) also detail requirements for an Annual Environmental Management Report (AEMR) (now referred to as an Annual Review). Schedule 3 condition 4 of the Delta Entry Site Development Consent (DA 35-2-2004) requires an Annual Report to be submitted as part of the Mandalong Mine AEMR.

Table 5 Annual Review Requirements

Approval	Condition No	Requirement	Where addressed in Annual Review
SSD-5144	Schedule 6 Condition12	By the end of March each year, or as otherwise agreed by the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development, to the satisfaction of the Secretary. This review must:	
		a) describe the development (including any rehabilitation) that was carried out in the last calendar year, and the development that is proposed to be carried out over the current calendar year;	**Section 2**, **Section 3**, **Section 8** & **Section 12**.
		b) include a comprehensive review of the monitoring results and complaints records of the development over the past calendar year, which includes a comparison of these results against the: • relevant statutory requirements, limits or	**Section 6, Section 7** & **Section 9.**

Approval	Condition No	Requirement	Where addressed in Annual Review
		performance measures/criteria; • requirements of any plan or program required under this consent; • monitoring results of previous years; and • relevant predictions in the documents identified in condition 2(a) and (b) of Schedule 2;	
		c) Identify any non-compliance over the past calendar year, and describe what actions were (or are being) taken to ensure compliance;	**Table 1**, **Table 2** & **Table 44**.
		d) identify any trends in the monitoring data over the life of the development;	**Section 6, Section 7** & **Section 9.**
		e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies;	**Section 6, Section 7** & **Section 9.**
		f) describe what measures will be implemented over the current calendar year to improve the environmental performance of the development.	**Table 45**
SSD-5145	Schedule 5 Condition 11	By the end of March each year, or as otherwise agreed by the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development to the satisfaction of the Secretary. This review must:	
		a) describe the development (including any rehabilitation) that was carried out in the past calendar year, and the development that is proposed to be carried out over the current calendar year;	**Section 2**, **Section 3**, **Section 8** & **Section 12**.
		b) include a comprehensive review of the monitoring results and complaints records of the development over the past calendar year, which includes a comparison of these results against the: • relevant statutory requirements, limits or performance measures/criteria; • requirements of any plan or program required under this consent; • monitoring results of previous years; and • relevant predictions in the documents	**Section 6, Section 7** & **Section 9.**

Approval	Condition No	Requirement	Where addressed in Annual Review
		identified in condition 2(a) of Schedule 2;	
		c) identify any non-compliance over the past calendar year, and describe what actions were (or are being) taken to ensure compliance;	**Table 1**, **Table 2** & **Table 44**.
		d) identify any trends in the monitoring data over the life of the development;	**Section 6, Section 7** & **Section 9.**
		e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and	**Section 6, Section 7** & **Section 9.**
		f) describe what measures will be implemented over the current calendar year to improve the environmental performance of the development.	**Table 45**
DA97/800	Condition 105	The Applicant shall through out the life of the mine and for a period of at least five years after the completion of mining, prepare and submit an Annual Environmental Management Report (AEMR) to the satisfaction of the Director General. The AEMR shall review the performance of the mine against the Environmental Strategy and the relevant Mining Operations Plans, the conditions of consent, and other licences and approvals relating to the mine. To enable ready comparison with the EIS predictions, diagrams and tables the report shall include, but not be limited to, the following matters:	
		i. An annual compliance audit of the performance of the project against the conditions of this consent and statutory approvals;	**Table 1**
		ii. A review of the effectiveness of the environmental management of the mine in terms of EPA, OEH, NOW, DRE and council requirements;	**Table 1**
		iii. Results of all environmental monitoring required under this consent or other approvals, including interpretations and discussion by a suitably qualified person;	**Section 6, Section 7** & **Section 9.**
		iv. An assessment of any changes to agricultural land suitability resulting from the mining operations, including	**Section 6.8**

Approval	Condition No	Requirement	Where addressed in Annual Review
		cumulative changes;	
		v. A listing of any variations obtained to approvals applicable to the subject area during the previous year;	**Section 3.1**
		vi. The outcome of the water budget for the year, the quantity of water used from water storages and details of discharge of any water from the site;	**Section 7.2**
		vii. Rehabilitation report; and	**Section 8**
		viii. Environmental management targets and strategies for the next year.	**Section 12**
	Condition 106	In preparing the AEMR the applicant shall:	
		I. Consult with the Director General during the preparation of each report for any additional requirements;	**Section 5**
		II. Comply with any requirements of the Director General or other relevant Government Agency; and	**Section 5**
		III. Ensure that the first report is completed and submitted within twelve months of this consent, or at a date determined by the Director General in consultation with the DRE, EPA and OEH.	N/A
	Condition 107	The applicant shall ensure that copies of each AEMR are submitted at the same time to the Department, EPA, OEH, NOW, Council and the Community consultative Committee, and made available for public information at Council within fourteen days of submission to these authorities.	**Section 3.5**
DA 35-2-2004	Schedule 3 Condition 1	The Applicant may incorporate any plan, audit or Annual Review required by this consent with the plans, audits or Annual Review required for the Mandalong Mine or any other adjoining operation in common ownership or under common management.	Noted.
	Schedule 3 Condition 4	By the end of March each year, or other timing as may be agreed by the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development, to the satisfaction of the Secretary. This review must:	
		a) provide monthly records of the amount of coal transported on the MCDS;	**Table 8**
		b) include a comprehensive review of the groundwater monitoring results of the development over the previous calendar year, which includes a comparison of	**Section 7.2.2.2**

Approval	Condition No	Requirement	Where addressed in Annual Review
		these results against the: • relevant statutory requirements, limits or performance measures/criteria; • requirements of any plan or program required under this consent; • monitoring results of years prior; and • relevant predictions in the documents listed in condition 2(a) of Schedule 2;	
		c) evaluate and report on the compliance with the performance measures, criteria and operating conditions in this consent;	**Section 6, Section 7** & **Section 9.**
		d) detail any non-compliance over the past calendar year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence;	**Table 1**, **Table 2** & **Table 44**.
		e) identify any trends in the monitoring data over the life of the development;	**Section 6, Section 7** & **Section 9.**
		f) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies;	**Section 6, Section 7** & **Section 9.**
		g) describe the measures to be implemented over the current calendar year to improve the environmental performance of the development; and	**Section 12**
		h) be prepared in accordance with the Department's *Annual Review Guideline (2015)*.	Noted.

The 2016 Annual Review (Centennial Mandalong, 2017b) was provided to DPE, DRE, LMCC, WSC, DPI-Water, EPA, OEH and the Mandalong Mine CCC consistent with DA97/800 condition 106(i).

As required by DA97/800 consent condition 105(v) a listing of any variations to approvals during the reporting period are provided in **Table 4**. DA97/800 Consent Condition 24 requires a Land Access, Management and Compensation Security in the form of a Bank Guarantee and that evidence of the Guarantee shall be provided in the Annual Review. A copy of the current Bank Guarantee is included in **Appendix 1**.

4 OPERATIONS SUMMARY

Table 6: Production Summary & Forecast

Material	Approved Limit (and source)	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
Waste Rock/ Overburden	N/A			
ROM Coal	6.5 MTPA	5,699,777	5,509,194	5,637,026
Coarse reject	N/A			
Fine reject (Tailings)	N/A			
Saleable product	6.5 MTPA	5,670,086	5,452,443	5,600,263

4.1 OTHER OPERATIONS

Table 7: Operations Summary

	Approved Limit (and source)	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Comment
Hours of operation	24/7	24/7	24/7	
Transport (rail)	N/A			
Product to Vales Point PS	4 MTPA	1,633,383	1,180,340	
Mandalong to Cooranbong	6 MTPA	4,066,394	4,328,854	
Product to Eraring PS	6 MTPA	3,167,467	2,742,197	
Cooranbong to Newstan for Washing	6 MTPA	889,077	1,747,127	

Table 8: Mandalong Coal Delivery System (Delta Entry Site) Monthly Tonnages

Month	Product to Vales Point PS (4 Mtpa limit)
January 2017	255,919
February 2017	71,655
March 2017	31,314
April 2017	39,191
May 2017	140,818
June 2017	89,251
July 2017	103,927
August 2017	56,024
September 2017	11,334
October 2017	99,697
November 2017	162,081
December 2017	119,129
Total 2017 CY	1,180,340

4.2 EXPLORATION

Centennial Mandalong drilled four exploration boreholes in 2017.

Drilling commenced on 20 February 2017 and was completed on 23 October 2017. All boreholes have been successfully rehabilitated.

Applications for additional boreholes will be ongoing as potential sites are identified.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

Mandalong Mine Access Site, Mandalong South Surface Site, Cooranbong Entry Site and Delta Entry Sites

DRG in their letter dated 23 October 2017 found that the 2016 Annual Review was acceptable for the reporting period and completed a site inspection on 12 September 2017. DRG noted several issues which were required to be addressed as detailed in **Table 9**.

DPE completed a site inspection on 6 September 2017 and did not provide any specific written requirements for inclusion in the 2017 Annual Review.

Table 9: Actions from Previous Annual Review

Action Required	Requested By	Action Taken	Where addressed in Annual Review
Provide ponding monitoring map to DRG.	DRG	Provided to DRG on 29/11/17.	N/A
Provide land management program to DRG.	DRG	Provided to DRG on 29/11/17.	N/A
General housekeeping required adjacent to the Mandalong Mine store and at the gross pollutant trap.	DRG	Housekeeping was completed at the two locations as requested by DRG. 	N/A

Action Required	Requested By	Action Taken	Where addressed in Annual Review
			
Management of weeds behind the Mandalong Mine workshop.	DRG	Weed spraying has been completed behind the Mandalong Mine workshop. 	N/A
Removal of unnecessary sediment controls on ventilation fan access road.	DRG	Redundant sediment controls have been removed. 	N/A
Removal of used ventilation tubes found close to the	DRG	Used ventilation tubes have been removed from the area adjacent to the helipad.	N/A

Action Required	Requested By	Action Taken	Where addressed in Annual Review
helipad.			
Removal of the container next to the water treatment station (gross pollutant trap).	DRG	The shipping container adjacent to the Gross Pollutant Trap has been removed. 	N/A

5.1 MINE WATER REDUCTION TARGETS

DA97/800 Condition 66 requires the mine to investigate opportunities to reduce mine water discharge at Mandalong and report on such in the Annual Review. The water balance model (GHD, 2018a) estimated 702.8 ML of water from the underground mine and surface water was discharged via LDP001 in 2017 which is lower than the water volume discharged in 2016 (802 ML).

Investigations into reducing the mine water discharge by recycling underground mine water were undertaken in 2009 and 2010. These included a water treatment options study and engineering design and feasibility assessments. The preferred option, recycling the underground mine water by treatment in a Reverse Osmosis (RO) plant, was assessed as not feasible for the Mine. The feasibility of the RO plant was limited due to the inability to discharge waste brine generated by the RO plant to receiving waters. Disposal methods, other than the discharge of waste brine, were cost prohibitive and not feasible at this stage. In addition the RO treatment plant was not capable of supplying mining equipment with potable water for 100% of the time as required by operations, due to equipment malfunction

and routine maintenance requirements. Given the currently limited options for waste brine disposal and RO treatment plant availability the investigations conclude recycling of underground mine water by an RO treatment, does not at this time, provide a feasible business option to reduce mine water discharges from the Mine.

5.2 WASTE MANAGEMENT

All opportunities for waste avoidance and minimisation are considered by all staff and contractors across all areas including; contracts, purchasing, equipment procurement and waste generation processes.

Waste oil and greases are stored in tanks and drums within bunded areas for removal by a licenced waste management contractor for recycling or disposal. Oil water separation is achieved by the use of hydro-cyclone oil water separators at Mandalong and at the Cooranbong Entry Site on flows from vehicle work and storage areas and the wash down bays.

Hydrocarbon spill kits are inspected weekly by a licenced waste management contractor and re-stocked as required. Oily rag bins and oil filter bins are also serviced on a weekly basis.

Office paper and cardboard is collected and recycled by a licenced waste management contractor on a weekly basis. Metals are collected and stored in steel bins at Mandalong and the Cooranbong Entry Site. In 2017, a total of 271.83 tonnes of scrap steel was recycled. This is a decrease compared to 2016 during which a total of 357.75 tonnes of scrap steel was recycled.

General refuse and non-recyclable materials are sorted and stored in 30m^3 steel bins at Mandalong and the Cooranbong Entry Site. The material was collected by a licenced waste management contractor for disposal in 2017. In 2017, 584.84 tonnes of refuse material was taken off-site for disposal which is an increase compared with 535.63 tonnes of refuse material in 2016.

Of the total waste collected at Mandalong in 2017, 61.37% was recycled including steel, timber, liquid waste, oils, paper and cardboard, filters grease, oily rags and oil filters. This compares with a recycling result of 64.4% in 2016.

6 ENVIRONMENTAL PERFORMANCE

Condition 12 of Schedule 6 of SSD-5144, Condition 11 of Schedule 5 of SSD-5145, Condition 4 of Schedule 3 of DA35-2-2004 and Condition 105(iii) of DA97/800 require the presentation and discussion on all monitoring required under the Development Consents and other approvals. **Table 10** includes a summary of the monitoring required by the Development Consents, current status and report section in the Annual Review

Table 10: Summary of Monitoring Requirements

Monitoring Type	Status	Report Section
Noise Monitoring	Annual survey	**Section 6.1**
Blast Monitoring	As required	**Section 6.2**
Air Quality Monitoring	Ongoing	**Section 6.3**
Independent Noise and Dust Monitoring	Not Requested	**N/A**
Greenhouse Gas reporting and abatement measures	Ongoing	**Section 6.3.7**
Biodiversity Monitoring	Ongoing	**Section 6.4**
Wetland Monitoring	Ongoing	**Section 6.4.3**
Rehabilitation Monitoring	Off-set area annual survey for first five years (commenced 2012).	**Section 6.4.4**
Cultural Heritage Monitoring	Ongoing	**Section 6.5**
Meteorological Monitoring	Ongoing	**Section 6.6**
Groundwater Monitoring Surface Water Monitoring	Ongoing Ongoing	**Section 7.3** **Section 7.1**

6.1 NOISE MONITORING

Annual noise monitoring was conducted to assess operational noise levels compared to the noise limits specified by SSD-5144, SSD-5145 and EPL 365 in accordance with the requirements of the Northern Region Noise Management Plan. The Mandalong Mine Noise Monitoring Program requires Centennial Mandalong to survey noise from the operation annually. The noise monitoring network locations at the Mandalong Mine and the Cooranbong Entry Site are shown in **Figure 2** and **Figure 3**.

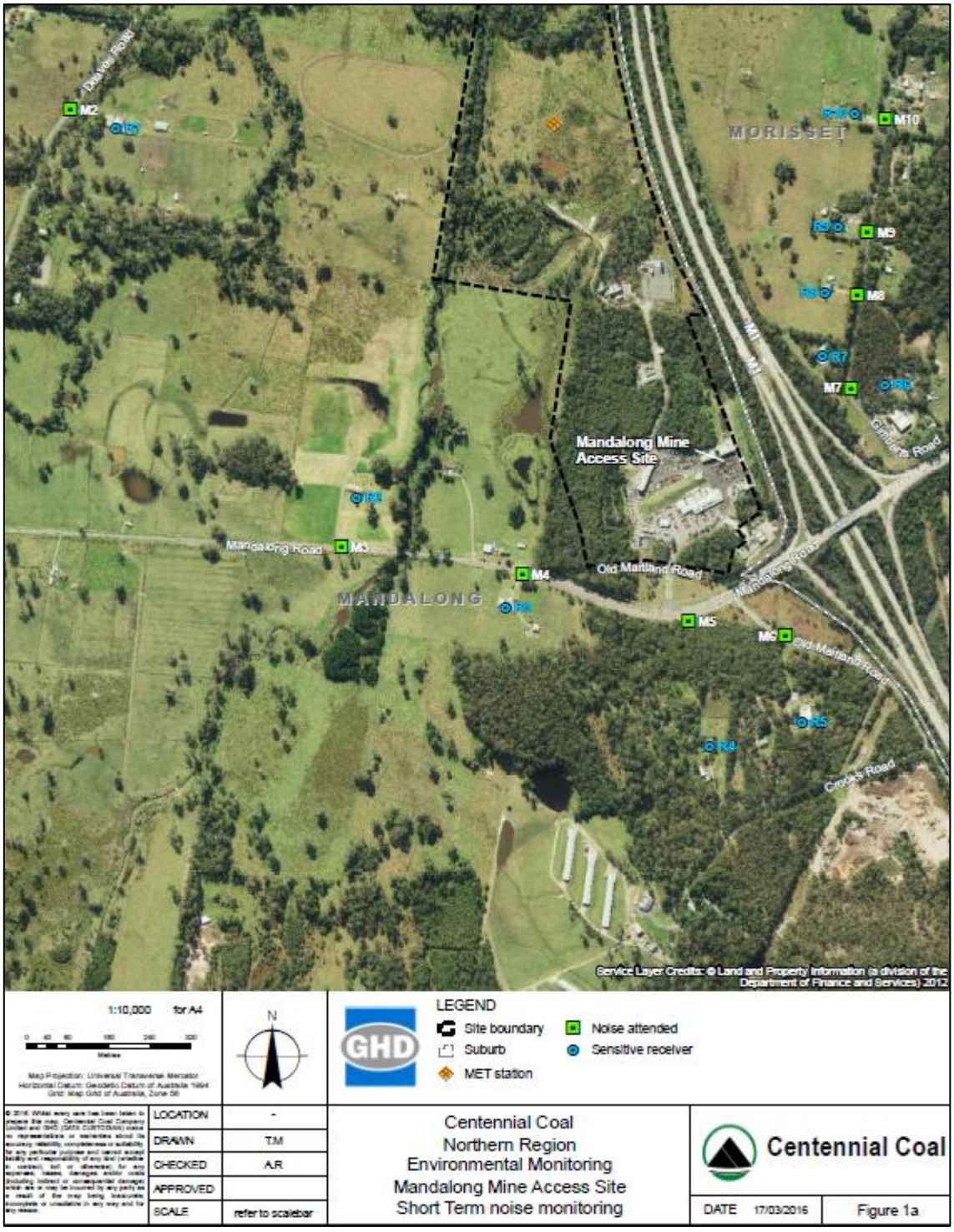


Figure 2: Mandalong Mine Noise Monitoring Locations

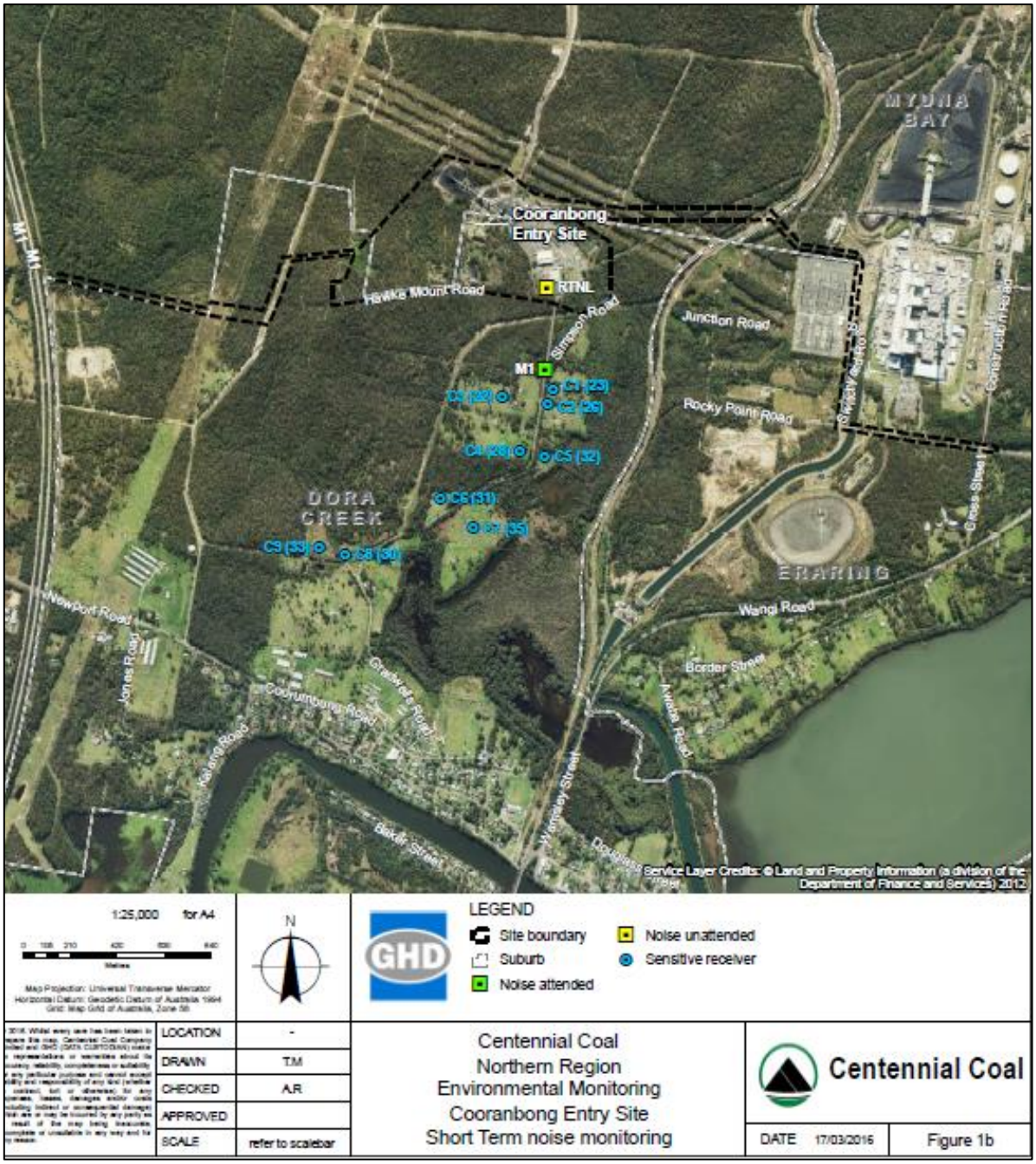


Figure 3: Cooranbong Entry Site Noise Monitoring Locations

Operator attended noise surveys were conducted during August 2017 at each of the 10 locations for a minimum of 1.5 hours during the day, 30 minutes during the evening and 1 hour during the night, to determine the character and relative contribution of ambient noise sources and mine contributions.

Measurements were conducted during typical worst case operational conditions for both Mandalong and Cooranbong Entry Sites in order to capture associated typical worst case noise emission levels.

Noise monitoring during the construction of the Mandalong South Surface Site (MSSS) commenced in March 2017 on a quarterly basis in accordance with the Northern Region Noise Management Plan.

The Mandalong Southern Extension Project Environmental Impact Statement (SLR, 2013) described the results of operational noise modelling for the Mandalong Mine Access Site and indicated that the relevant intrusive and amenity noise criteria will be achieved at all the nearest sensitive receivers. The noise impact assessment completed as part of the Northern Coal Logistics Project Environmental Impact Statement (SLR, 2014) predicted that operational noise levels at the Cooranbong Entry Site will meet the project-specific noise criteria at all nominated residential locations.

6.1.1 Summary of Noise Monitoring Results

GHD was engaged by Centennial Mandalong to conduct an annual noise compliance assessment for the Mandalong Mine and Cooranbong Entry Site in accordance with the Northern Region Noise Management Plan.

Operator-attended noise measurements were conducted at the 10 focus locations surrounding the operations from Monday 28 to Thursday 31 August 2017 during the day, evening and night-time periods.

The operator attended operational noise monitoring results showed that the noise contributions from Mandalong Mine and Cooranbong Entry Site comply with the EPL 365, Development Consent SSD-5144 and SSD-5145 noise criteria at all monitoring locations and during all time periods. However, exceedances of SSD-5145 were measured at location M1 during the evening, and exceedances of EPL 365 were measured at location M1 during the evening, and at location M5 and M6 during the night-time.

The operator attended sleep disturbance noise monitoring results showed that the noise contributions from Mandalong Mine and Cooranbong Entry Site comply with the EPL 365, Development Consent SSD-5144 and SSD-5145 relevant sleep disturbance noise criteria at all monitoring locations. However, an exceedance of SSD-5144 was measured at location M3 and exceedances of EPL 365 sleep disturbance criterion of LA1 (1 minute) 45 dBA was measured at M3, M7, M8 and M9. The cause of the exceedance was due to an onsite banging. Given the external noise level was below 65 dBA, the measured exceedance is unlikely to cause any awakening reaction.

It should be noted that all of the meteorological conditions during all exceeded operation and sleep disturbance noise levels in August 2017 were either at times when the wind speed was greater than 3m/s or during a stability category G class temperature inversion. As specified in condition L5.3 of EPL 365, Appendix 3 of SSD-5144 and Appendix 3 of SSD-5145 the noise limits do not apply under these conditions. Based on past monitoring results at these locations, GHD have concluded that it is unlikely that the noise levels would exceed the noise criterion under normal meteorological conditions.

Following the August 2017 monitoring, further additional noise monitoring was recommended by GHD to be undertaken under normal meteorological conditions at seven (7) locations, R1 during the evening, and at R3, R5, R6, R7, R8, R9 during the night. Monitoring was undertaken for 30 minutes during the evening on 12 December 2017 and 1 hour during the night-time on 12, 13, 18 and 19 December 2017.

The operator attended operational noise monitoring results showed that the noise contributions from Mandalong Mine and Cooranbong Entry Site comply with the EPL 365, Development Consent SSD-5144 and SSD-5145 noise criteria at all monitoring locations and during all time periods.

The operator attended sleep disturbance noise monitoring results showed that the noise contributions from Mandalong Mine comply with the EPL 365, Development Consent SSD-5144 and SSD-5145 relevant sleep disturbance noise criteria at all monitoring locations.

6.1.1.1 Mandalong South Surface Site

GHD was engaged by Centennial Mandalong to conduct quarterly noise compliance assessment for the construction activities which commenced in February 2017 at the Mandalong South Surface Site in accordance with the Northern Region Noise Management Plan. The Noise Management Plan – Northern Region (June 2017) specifies the project-specific noise goals for construction activity (excluding shaft sinking). They have been established with reference to the Interim Construction Noise Guideline (ICNG) (DECC, 2009). The noise monitoring network locations at the Mandalong South Surface Site are shown in **Figure 4**.

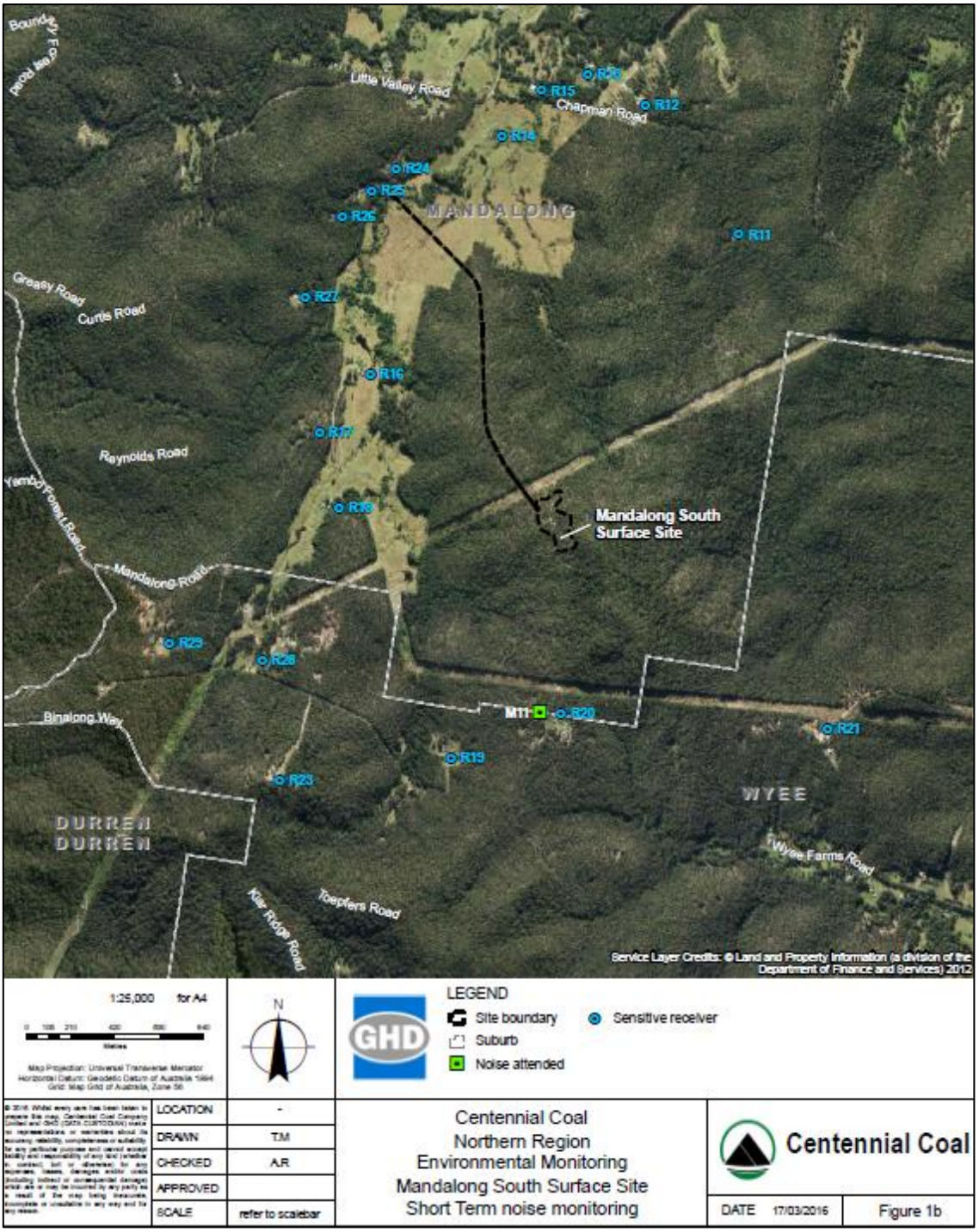


Figure 4: MSSS Noise Monitoring Locations

Operator attended noise measurements were conducted during the day period on Wednesday 22 March 2017, Monday 26 June 2017, Thursday 28 September 2017 and Thursday 7 December 2017. The noise assessment consisted of attended monitoring to quantify construction noise levels at three noise sensitive receivers (R12, R16 and R20) near the Mandalong South Surface Site.

The results of the 2017 quarterly noise surveys indicate that construction noise levels were below the relevant construction criteria at the closest residential receivers and therefore additional noise mitigation was not required.

6.2 BLAST MONITORING

Mandalong

There was no blasting carried out at the Mandalong Mine in 2017.

Delta and Cooranbong Entry Sites

There was no blasting carried out at the Delta and Cooranbong Entry sites during 2017.

6.3 AIR QUALITY MONITORING

6.3.1 Mandalong

Depositional dust monitoring results are shown in **Table 12**.The results are presented as:

- Long-term average (all data since the commencement of monitoring at its present location - Sept 1999 to present);
- Average during the report period (January 2017 to December 2017); and
- Pre-construction average (September 1999 to August 2000).

Table 11: Description of Depositional Dust Gauges

Dust Gauge No.	Locality
D1	Cooranbong Entry Site (western boundary)
D4	41 Gradwells Road Dora Creek (near Cooranbong Entry Site)
D5	Northern end Mandalong Mine Site (Adjoining Property)
D6	Mandalong Mine Site Eastern Boundary (Near Sediment Basin)
D7	Rear of the former Project Office (Mandalong Site)
D8	West of main front entrance (Mandalong Site)
D9	184 Mandalong Road
D10	202 Mandalong Road West of Mandalong Mine
D11	North Western Boundary fence on Mandalong Mine
D12	Mandalong South Surface Site
D13	Power Easement North of Mandalong South Surface Site
D14	North of Mandalong South entrance road (near wetland)

Table 12: Summary of depositional dust results between January 2017 and December 2017 surrounding Mandalong Mine.

	Insoluble Solids (Combustible Matter + Ash) g/m^2/month						
	DG5	**DG6**	**DG7**	**DG8**	**DG9**	**DG10**	**DG11**
Long Term Average	0.8	1.2	1.2	0.7	1.1	1.5	1.1
Average 2017 (Reporting Period)	0.5	0.8	1.3	0.6	1.1	2.1	1.1
Pre-Construction Average	0.7	0.8	3.4	0.8	0.9	*	*
EPA Dust Deposition Goal	4.0	4.0	4.0	4.0	4.0	4.0	4.0

* not available. Dust gauges installed after commencing construction.

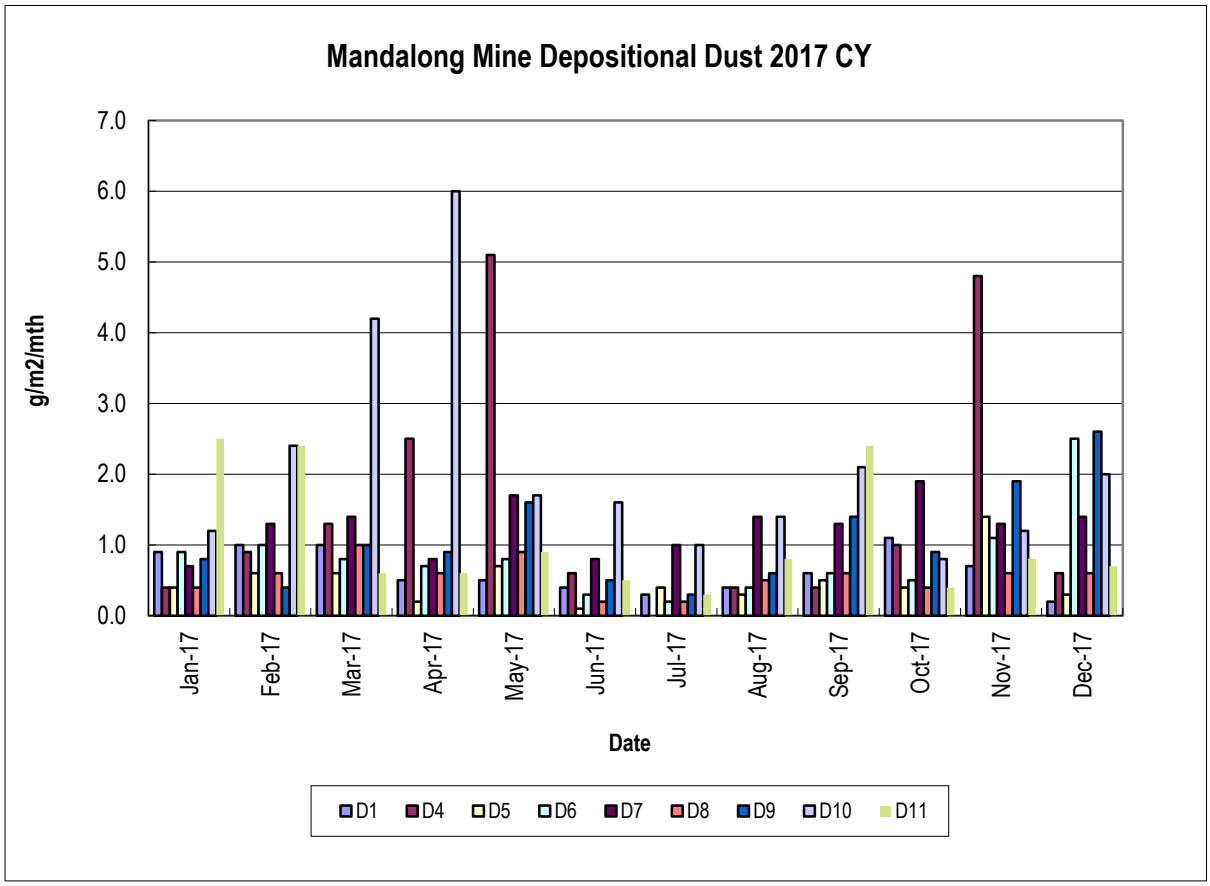


Figure 5: Depositional dust results surrounding Mandalong Mine for 2017

6.3.2 Delta Entry Site

Three dust deposition gauges were installed at the Delta Entry Site in July 2004. **Table 13** details the location of the dust gauges and their localities are shown on plan **MG10722C**. These gauges were positioned to monitor depositional dust around the Delta Entry Site.

Table 13: Location of Delta Entry Site Depositional Dust Gauges

Dust Gauge No	Locality
DG1	North east side of settling ponds on decline site.
DG2	Main gates to decline off Rutley's Road.
DG3	Delta clearing left hand side Rutley's Road.

Depositional dust monitoring results are provided in **Table 14**. The monthly dust monitoring data for the Delta Entry Site for 2017 is included in **Figure 6**.

Table 14: Summary of Depositional Dust Results between January 2017 and December 2017 surrounding Delta Entry Site

	Insoluble Solids (Combustible Matter + Ash) g/m^2/month		
	DG1	DG2	DG3
Long Term Average	0.4	0.9	0.4
Average 2017 (Reporting Period)	0.6	0.7	0.7
EPA Dust Deposition Goal	4.0	4.0	4.0

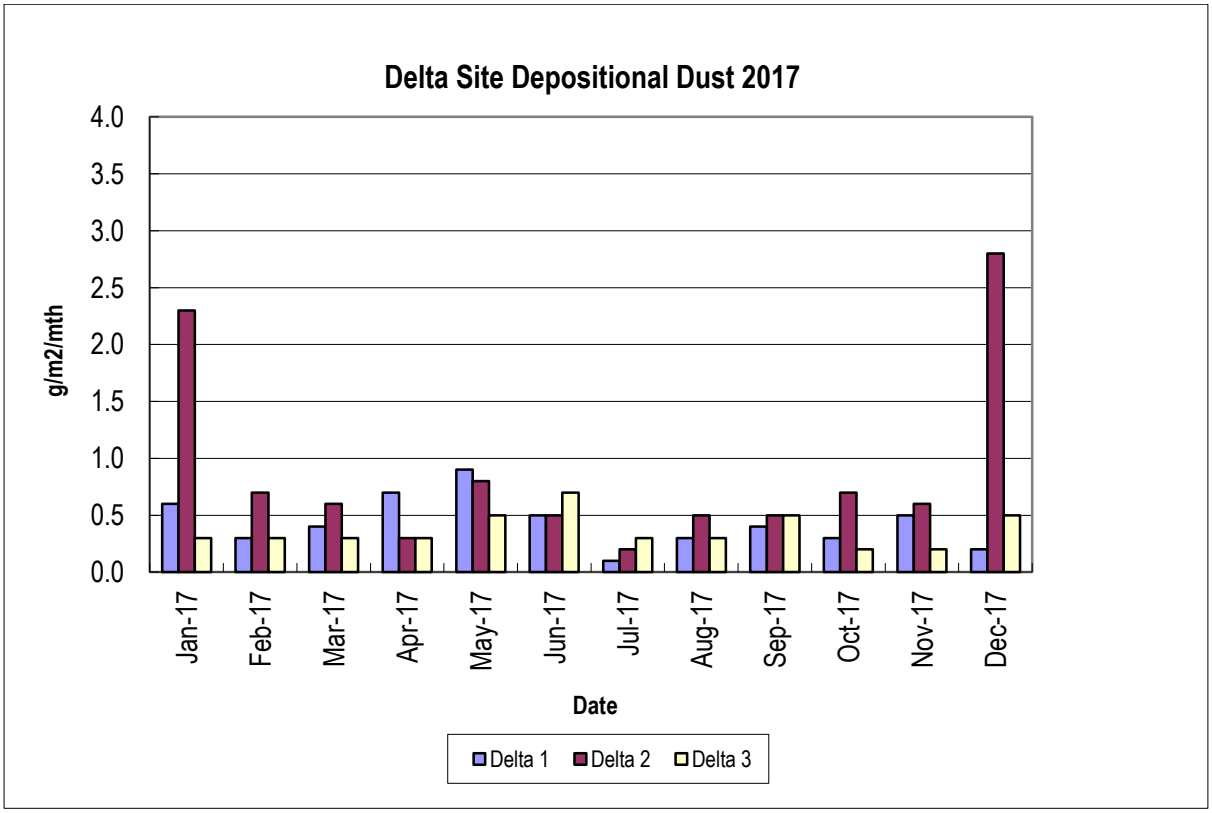


Figure 6: 2017 Depositional Dust Results for Delta Entry Site

6.3.3 Cooranbong Entry Site

The Cooranbong Colliery Life Extension Project EIS predicted that dust emissions from the operational phase of the Cooranbong Preparation Plant were unlikely to cause a dust nuisance due to the distance to sensitive receptors (Umwelt, 1997). The Cooranbong Distribution Project EA (GSS Environmental, 2012) and the Northern Coal Logistics Project EIS (March 2014) modelling predictions for dust deposition also show that incremental and cumulative annual average dust deposition rates are predicted to be well below the impact criteria of 2g/m^2/month and 4g/m^2/month (assuming a background rate of 1.2 g/m^2/month) at the nearest surrounding residences.

Annual average depositional dust results for 2017 and the EPA goal are provided in **Table 15**. The complete monthly dust monitoring data is provided in **Figure 5.**

Table 15: Summary of Depositional Dust Results between January 2017 and December 2017 surrounding the Cooranbong Entry Site.

	Insoluble Solids (Combustible Matter + Ash) g/m^2/month	
	DG1	**DG4**
Long Term Average	1.4	1.3
Average 2017 (Reporting Period)	0.6	1.3
EPA Dust Deposition Goal	4.0	4.0

6.3.4 Mandalong South Surface Site

Depositional dust gauges were installed at the Mandalong South Services Site in June 2014 for the purpose of pre-construction air quality monitoring. Construction of the Mandalong South Surface Site access road commenced in February 2017 and construction of the Surface Site commenced in July 2017. Annual average depositional dust results for 2017 and the EPA goal are provided in **Table 16** and **Figure 7**.

Table 16: Summary of Depositional Dust Results between January 2017 and December 2017 surrounding the Mandalong South Surface Site.

	Insoluble Solids (Combustible Matter + Ash) g/m^2/month		
	DG12	**DG13**	**DG14**
Long Term Average	0.5	0.7	1.8
Average 2017 (Reporting Period)	0.4	1.1	2.4
EPA Dust Deposition Goal	4.0	4.0	4.0

6.3.5 Air Quality Monitoring Data Interpretation

6.3.5.1 Mandalong Mine & Cooranbong Entry Site

SSD-5144 requires that the Mine does not increase the dust deposition rate by more than 2g/m^2/month, averaged over any 12 month period, as shown in **Table 12**, **Table 14**, **Table 15** and **Table 16**. All dust gauges recorded depositional dust levels that averaged an increase of less than 2 g/m^2/month in the 12 month period.

All dust gauges recorded results as shown in **Table 12**, **Table 14, Table 15** and **Table 16** are well below the EPA air quality goal of annual dust deposition of 4 g/m^2/month. Dust

levels at DG 8, 10 & 11 located at the nearest sensitive receivers at the Mandalong Mine Access Site boundary were well below the EPA air goals, confirming that the activities had minimal impact on surrounding air quality in 2017 as predicted in the Cooranbong Colliery Life Extension Project EIS (Umwelt, 1997) and the Mandalong Southern Extension Project EIS (SLR, 2013).

Dust levels at DG4 located at the nearest sensitive receivers and on the operational boundary at Cooranbong were well below the EPA air goals, confirming that the Cooranbong operation had minimal impact on surrounding air quality in 2017 as predicted in the Cooranbong Colliery Life Extension Project EIS (Umwelt, 1997), the Cooranbong Distribution Project EA (GSS Environmental, 2012) and the Northern Coal Logistics Project EIS (SLR, 2014).

Dust gauges 1, 5, 6, and 8 recorded 2017 annual averages lower than their respective long term averages. Dust gauges 7 and 10 recorded annual averages slightly above the long-term average however; these increases were well below the EPA Air Quality Goals of 4 g/m^2/month. All dust results for 2017 were well below the EPA annual dust deposition air quality goal of 4 g/m^2/month.

Table 17: Detailed Dust Monitoring and Analysis showing the Annual Rolling Average and Change in Deposition from the Pre-construction Average (PCA) for Dust Gauges DG6, DG8 and DG9.

	DG6			DG8			DG9		
Date	Monitored Dust	Rolling Average (since 2012)	Change from PCA	Monitored Dust	Rolling Average (since 2012)	Change from PCA	Monitored Dust	Rolling Average (since 2012)	Change from PCA
23/01/2017	0.9	1.2	-0.3	0.4	0.7	-0.3	0.8	1.1	-0.3
22/02/2017	1.0	1.2	-0.2	0.6	0.7	-0.1	0.4	1.1	-0.7
24/03/2017	0.8	1.2	-0.4	1.0	0.7	0.3	1.0	1.1	-0.1
24/04/2017	0.7	1.2	-0.5	0.6	0.7	-0.1	0.9	1.1	-0.2
23/05/2017	0.8	1.2	-0.4	0.9	0.7	0.2	1.6	1.1	0.5
23/06/2017	0.3	1.2	-0.9	0.2	0.7	-0.5	0.5	1.1	-0.6
24/07/2017	0.2	1.2	-1.0	0.2	0.7	-0.5	0.3	1.1	-0.8
22/08/2017	0.4	1.2	-0.9	0.5	0.7	-0.5	0.6	1.1	-0.5
21/09/2017	0.6	1.2	-0.8	0.6	0.7	-0.1	1.4	1.1	0.3
20/10/2017	0.5	1.2	-0.7	0.4	0.7	-0.3	0.9	1.1	-0.2
20/11/2017	1.1	1.2	-0.2	0.6	0.7	-0.1	1.9	1.1	0.8
20/12/2017	2.5	1.2	1.3	0.6	0.7	-0.1	2.6	1.1	1.5

6.3.5.2 Delta Entry

Average annual depositional dust results for dust gauges DG1, DG2 and DG3 are relatively low. The highest average depositional dust rate for the period was 0.7 g/m^2/month for DG2

and DG3. All results are well below the EPA air quality goal of 4 g/m^2/month and are provided in **Table 14** and **Figure 6**.

6.3.5.3 Mandalong South Surface Site

All dust gauges recorded results below the EPA air quality goal of annual dust deposition of 4 g/m^2/month (**Figure 7**). DG12 was removed in August 2017 due to construction work directly at the dust gauge location. DG12 was re-installed in January 2018. There are no results for DG12 from September to December 2017.

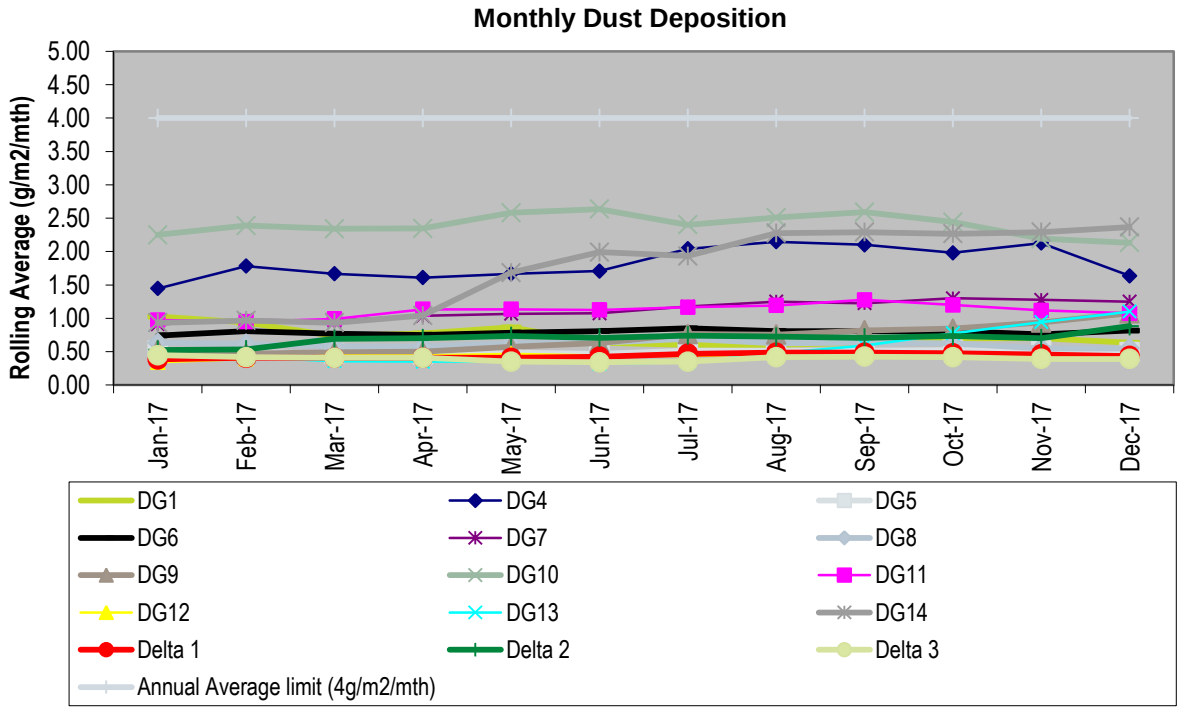


Figure 7: Monthly Rolling Annual Average Dust Deposition for 2017.

6.3.6 Particulate Matter

The Cooranbong Distribution Project EA (GSS Environmental, 2012) and the Northern Coal Logistics Project EIS (SLR, 2014) both concluded that incremental and cumulative annual average TSP concentrations were predicted to be well below the impact criterion of 90 ug/m^3 at the nearest sensitive residences. The EA and the EIS also predicted that incremental and cumulative annual average PM10 concentrations will be below the impact criterion of 30 ug/m^3 at the nearest surrounding residences.

Continuous dust monitoring was installed in June 2013 at the Cooranbong Entry Site to monitor total suspended particles (TSP) and particulate matter (PM10) as per the condition M2.2 of EPL365. SSD-5144 and SSD-5145 require that air quality impacts at the Cooranbong Entry Site do not exceed the limit criteria of:

- 90ug/m^3 annual average for TSP;
- 30ug/m^3 annual average for PM10; and
- 50ug/m^3 24 hour average for PM10.

TSP and PM10 monitoring results are shown in **Figure 8.** The results are presented as annual average for the monitoring period (July 2013 to December 2017). TSP and PM10 monitoring results to date since installation in June 2013 are in accordance with the

predictions from the air quality impact assessment for the Cooranbong Distribution Project EA (GSS Environmental, 2012). TSP and PM10 monitoring results to date since October 2015 are in accordance with the predictions from the air quality impact assessment for the Northern Coal Logistics Project EIS (SLR, 2014).

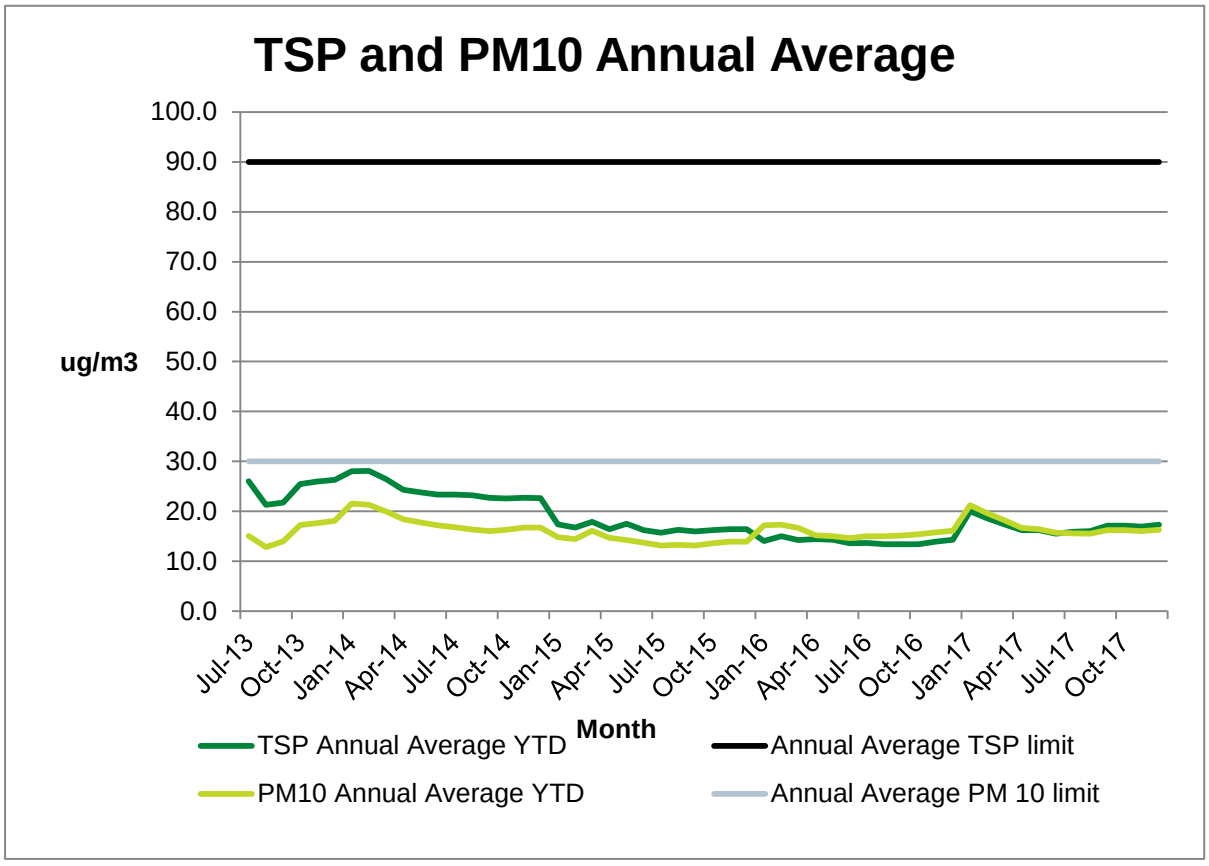


Figure 8: TSP and PM10 2017 Annual Rolling Average

6.3.7 Greenhouse Gas Monitoring

DA97/800 conditions 60A (i) & (iv) require Mandalong Mine to monitor greenhouse gas (GHG) emissions and report these in the Annual Review. In accordance with Centennial Coal's standard for GHG reporting the 2017 financial year (FY 1 July 2016 to 30 June 2017), emissions in CO2 equivalent tonnes (Co2-eT) as defined in the *National Greenhouse and Energy Reporting Act 2007* are provided in **Table 18**. Total GHG emissions for the 2017 FY period were 1,626,678 Co2-eT, which is higher than the 2016 FY emissions of 1,248,483 Co2-eT.

The majority of GHG emissions in 2017 were caused by fugitive methane contributing to 88% of all GHG emissions. Mandalong Mine as discussed below is currently working towards GHG reduction measures to abate fugitive methane emissions.

Table 18: Total GHG Emissions from Mandalong Mine in 2017 Financial Year

Emissions Summary (Co2-eT) July 2016 to June 2017	Total
Electricity	65,917
Diesel	3,770
Petroleum Based Oils and Greases (PBOG)	95
SF6	5
Fugitives - CH4	1,426,134
Fugitives - CO2	35,746
Fugitives – N_20	14
Surface Fugitive - Post Mining	94,996
TOTAL	**1,626,678**

6.3.8 Greenhouse Gas Abatement Investigations Measures

As reported in previous Annual Reviews, Centennial Coal has invested in technologies to reduce fugitive methane GHG emissions from the Mandalong Mine. A three stage process is planned to address this Greenhouse Abatement. Construction of Stage 1 and Stage 2 were completed in November 2013.

Stage 1 Gas Flares - A consent modification approval was obtained in 2005 to construct multiple enclosed flares planned to be used to reduce fugitive methane GHG emissions from the Mine's surface gas drainage plant. Civil works for construction of the gas flares commenced in October 2012, with final commissioning completed and automated operations commencing in November 2013. The construction of the enclosed gas flare will assist with abating drainage gas emissions of up to 1,500 litre/sec flow rate.

Stage 2 Ventilation Air Methane Regenerative After Burner (VAM RAB ®) - Approval for a modification to DA97/800 was sought in 2011, to allow for the installation and ongoing operation of a single VAM RAB® unit as a demonstration project to examine the performance capability. Approval was granted by the Planning Assessment Commission (PAC) on behalf of the Minister for the then Department of Planning and Infrastructure on 11 November 2011.

The VAM RAB® technology initially proposed for Mandalong includes installation and operation of a single VAM RAB® unit as part of a demonstration project to demonstrate capture and abatement of approximately 10 cubic metres per second (m^3/s) of the mine's total Ventilation Air Methane (VAM). The VAM is a low concentration methane in the mine ventilation stream and the VAM RAB® system overcomes this technical difficulty by directing the mine ventilation air into a large oxidation vessel, oxidising the methane into carbon dioxide. This technology is based on well tested coke-oven principles, utilised in the steel industry.

Civil construction works on the surface pad for the VAM RAB® unit commenced in December 2011 and were completed in November 2013. The VAM RAB® demonstration plant has been heated up on a number of occasions during the last six months of 2014, with some minor configuration changes made in 2015 and 2016.

The VAM RAB® plant is currently impacted by technical issues. From a technical perspective, refinements are required for the VAM RAB® to reach a suitable temperature profile to allow trial abatement of methane. Over the project life, a number of test procedures have been conducted resulting in significant changes to the design and structure of the plant. These have included a rebuild of the VAM RAB® core.

The current status of the Project is that it is on hold in its commissioning phase. It has not progressed to, or completed, the formal experiment Stage 1 (6 week VAM simulation) or Stage 2 (12 months on VAM).

Stage 3 Gas Engines - In July 2009 Mandalong Mine received approval from the then DP&I to construct and operate multiple methane gas engines to generate electricity. If the generation facility is implemented, power will be supplied to the site and excess power sold to the grid. The flare units will remain available as back-up or for peak gas flows.

In 2017, Centennial Mandalong commenced planning and design works for the Gas Engines project. This project will continue to be progressed in 2018.

6.4 BIODIVERSITY MONITORING

6.4.1 LW22-24A Extraction Plan Areas

The monitoring of sensitive environments subject to potential subsidence impacts is a requirement as per Schedule 4 Condition 6 of SSD-5144 and Condition 72 of DA97/800. The aim of the 2017 monitoring conducted by RPS was to establish baseline data for sensitive ecological communities to compare against control locations of the same vegetation type over time (RPS, 2018). Additionally, the program aims to evaluate the conditions of known populations of threatened flora against reference and baseline population conditions. Repeated sampling will allow for the detection and quantification of change over time (RPS, 2018). The study area consists of the proposed subsidence extent of Longwalls LW22-24A covering approximately 279.90 hectares. The northern boundary of the study area extends into the Olney State Forest. The southern boundary area extends into heavily vegetated areas whilst the majority of the western and eastern boundaries are situated within rural agricultural lands with remnant patches of vegetation. The location of biometric plots with the LW22-24A area is shown in **Figure 9**.

The monitoring is to be performed on an annual basis in accordance with the relevant approved Extraction Plan and associated Biodiversity Management Plan. Study methods include biometric plots and condition assessment for threatened species. Monitoring was conducted by RPS in September 2017, with further monitoring scheduled for 2018.

Vegetation and habitat condition baseline data has been collected from the impact area for vegetation that is predicted and not predicted to be impacted. This data will be used for year on year comparisons following future monitoring events to evaluate for change in predicted impact areas.

Threatened flora baseline data has been collected from the impact area for threatened flora (i.e. *Melaleuca biconvexa* and *Maundia triglochinoides*). This data will be used for year on year comparisons following data collections from future monitoring events to evaluate for any change. The absence of *Maudia triglochinoides* from the 2017 monitoring plots is likely attributed to the dry conditions and associated grazing pressures (RPS, 2018).

6.4.1.1 Aquatic Ecology Monitoring

The objectives of the monitoring conducted by RPS in the Spring of 2017 were to gain an understanding of the macroinvertebrate communities within the downstream receiving environment of the LW22-24A Extraction Plan areas; identify spatial and temporal changes in macroinvertebrate community structure; identify any potential key impacting processes resulting in changes to aquatic ecosystems health; identify the likely spatial and temporal scale of any potential impacts to aquatic communities; and provide recommendations for the improvement of future monitoring rounds (RPS, 2018).

RPS was responsible for conducting a spring 2017 sampling event at multiple sites (**Figure 10**) in accordance with the Biodiversity Management Plan (BMP).

The study completed by RPS characterised the aquatic ecological health upstream and within the vicinity of the LW22-2A Extraction Plan Area. From the study there has been found to be no impacts to water quality and macroinvertebrate community composition. All survey sites recorded nutrient composition above the ANZECC (2000) guideline range for TP, TN and Ammonia. Physico-chemical water quality results such as DO and PH for all sites were lower than the guideline range. The high nutrient values are expected, given that the sampling event occurred during the drying phase of the normal ephemeral hydrological cycle (RPS, 2018).

The macroinvertebrate taxa found composed of both pollution tolerant and pollution sensitive taxa. The composition of macroinvertebrates and observation of the physical condition of sample site MA-TO1T (refer to **Figure 10**) suggest that the test site has been subject to water and/or environmental degradation, although this is not supported by the water quality

results. Site MA-TO1T during the time of inspection had the smallest body of water and was more advanced in the drying phase compared to other sites. The limited edge habitat available during sampling is a likely contributor to the difference in the macroinvertebrate community between MA-TO1T and other test sites.

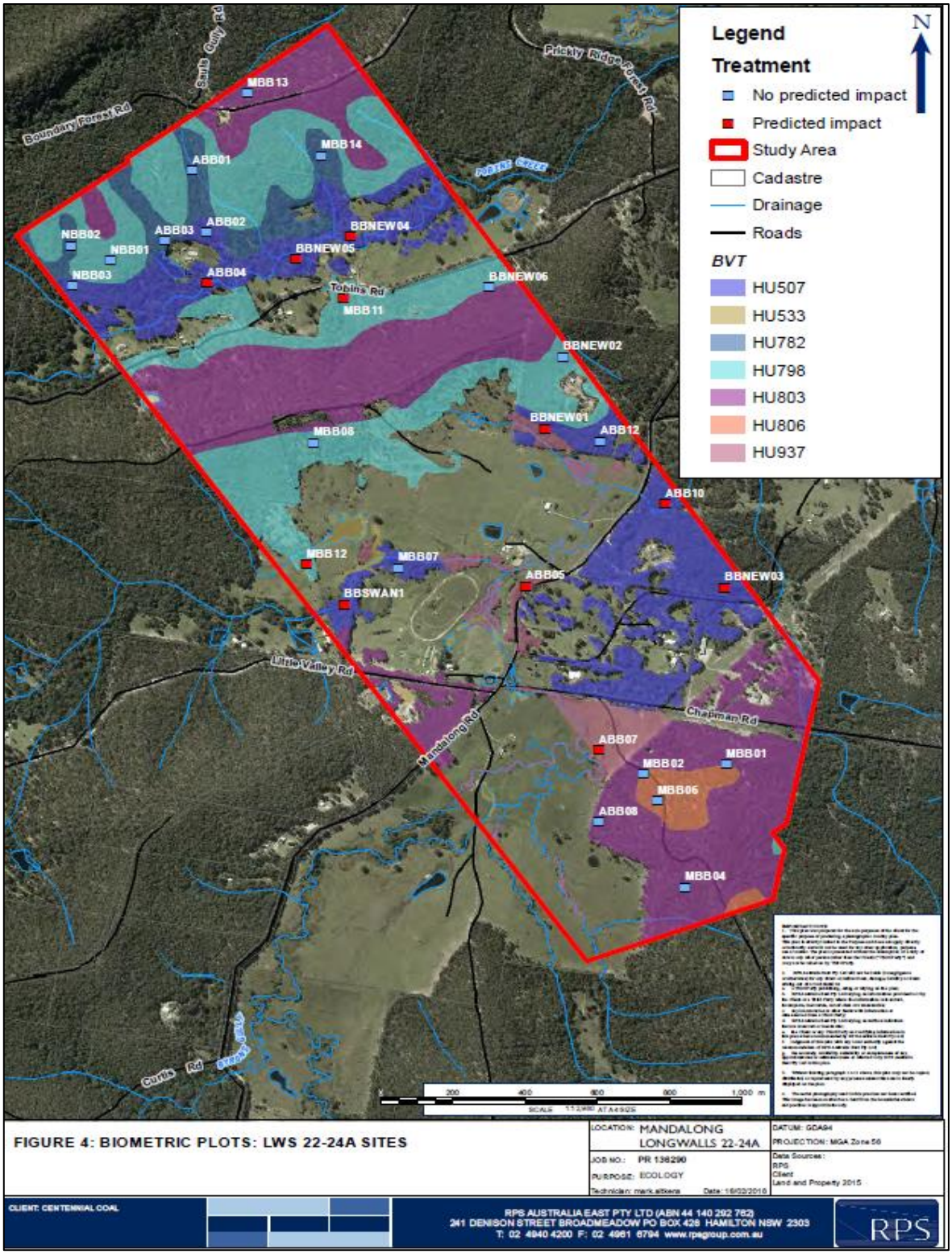


Figure 9: Biometric Plots LW22-24A Sites

Source: (RPS, 2018).

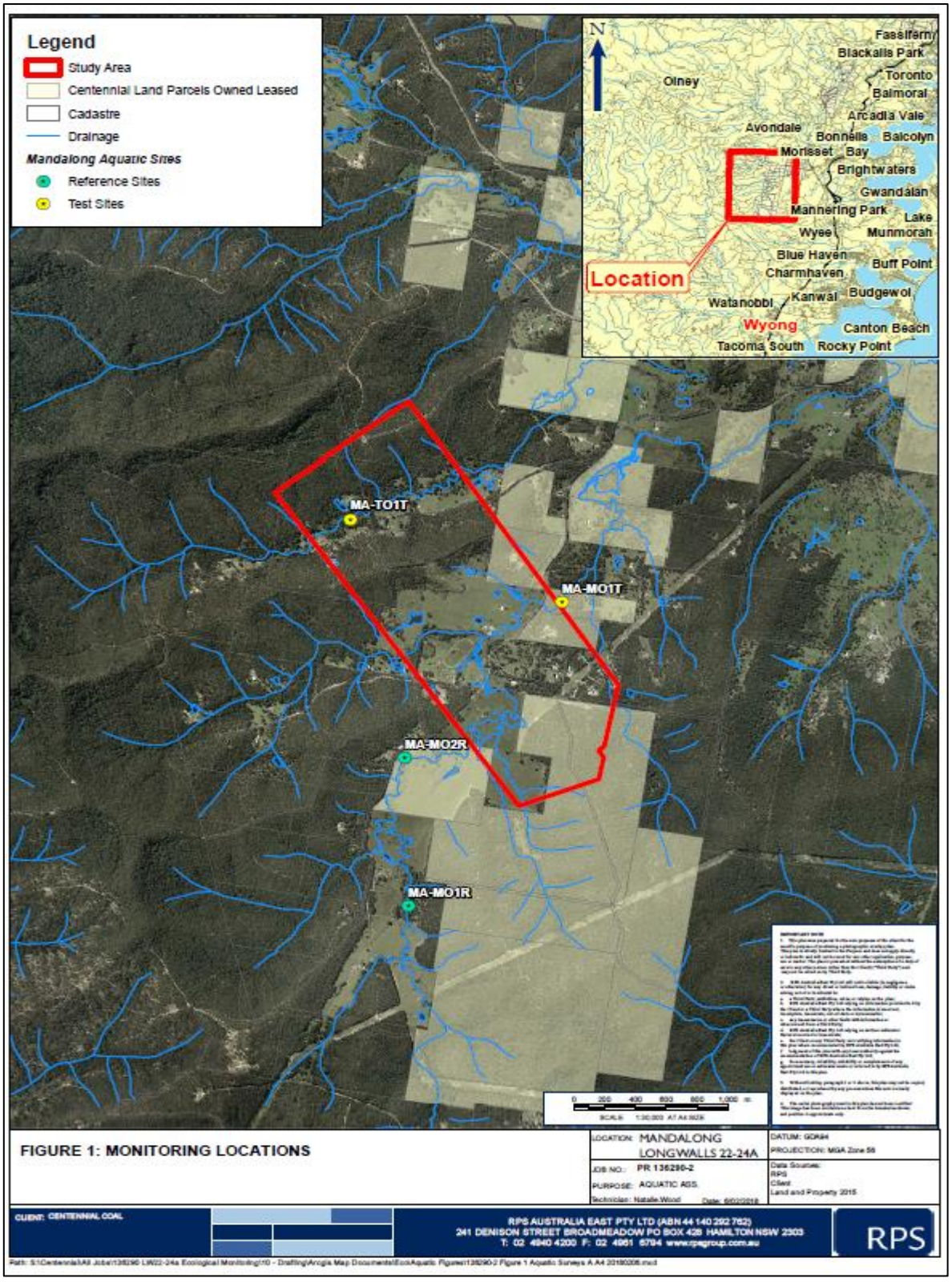


Figure 10: Aquatic Ecological Monitoring Locations

Source: (RPS, 2018).

6.4.2 Land Management Strategy for the MSSS and TL24 Offset Areas

The proposed construction of the MSSS and access road which commenced in 2017 will result in the clearing of approximately 15.6 ha of MU 15: Coastal Foothills Spotted Gum – Ironbark Forest, which is not commensurate with any threatened ecological community listed under the Threatened Species Conservation Act (TSC Act 1995) or Environmental Protection and Biodiversity Conservation Act (EPBC Act 1999) (SLR, 2013a).

MU 15 is very common and widespread in the locality, occupying approximately 2,502 hectares within the Study Area and approximately 21,094 hectares between Ourimbah and Beresfield (NPWS 2003, cited in (SLR, 2013a). The proposed clearing, therefore, amounts to approximately 0.6 percent of the total available vegetation community within the immediate area and approximately 0.07 percent of the total available vegetation community within the region. None of the land proposed to be cleared contains threatened flora species or endangered ecological communities.

For these reasons, Centennial Mandalong is not proposing to provide a direct offset strategy. Rather, as a substantial landholder in the Mandalong Valley, Centennial Mandalong has developed a Land Management Strategy for land owned by Centennial in the Valley.

In addition, the relocation of TL24 will also result in 8.5 ha of vegetation clearing for the establishment of the new easement. Centennial Mandalong has also included in the Land Management Strategy an additional area of 73.6 ha in order to compensate for the loss of vegetation communities.

The Land Management Strategy provides for four lots identified in **Table 19**. The four lots form two sites referred to as Mandalong Road and Chapman Road. The two sites have been placed under a Conservation Property Vegetation Plan (PVP) under Native Vegetation Regulation 2013 (Clause 9(1)) in 2017.

Table 19: Land Management Strategy Site Locations

Approval Reference	LMS Site Reference	Lot	DP	Ownership	LGA	Area (ha)
SSD-5144	Mandalong Road Northern Lot	580	733227	Centennial Fassifern Pty Ltd	LMCC	18.37
	Mandalong Road Southern Lots	Lot A	110119	Centennial Fassifern Pty Ltd	LMCC	106.52
		902	541065	Centennial Fassifern Pty Ltd	LMCC	
SSD-5144 (MOD 1)	Chapman Road	152	755238	Centennial Fassifern Pty Ltd	LMCC	72.3

The objective of land management at Mandalong Road and Chapman Road as as follows -
Mandalong Road Objective - coexistence of conservation and agricultural practices that retain or improve habitat.

Chapman Road Objective - retain/maintain or improve ecological diversity of land to a self-sustaining system/environment.

Centennial Mandalong will report on the progress of works associated with the Land Management Strategy commencing in the 2018 Annual Review. Annual ecological monitoring of the land management sites will commence in 2018.

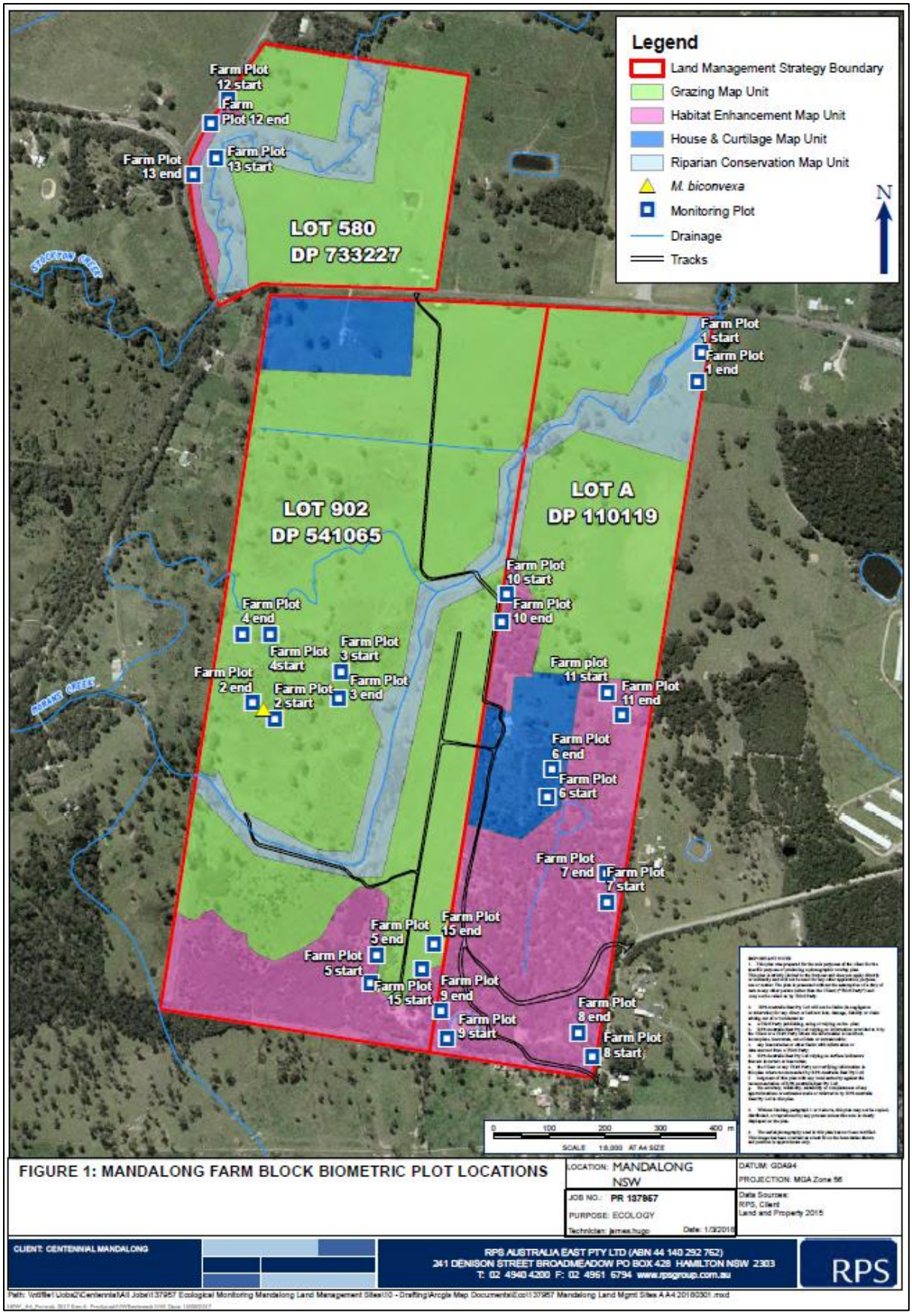


Figure 11: Mandalong Farm Offset Area

Source: (RPS, 2018).

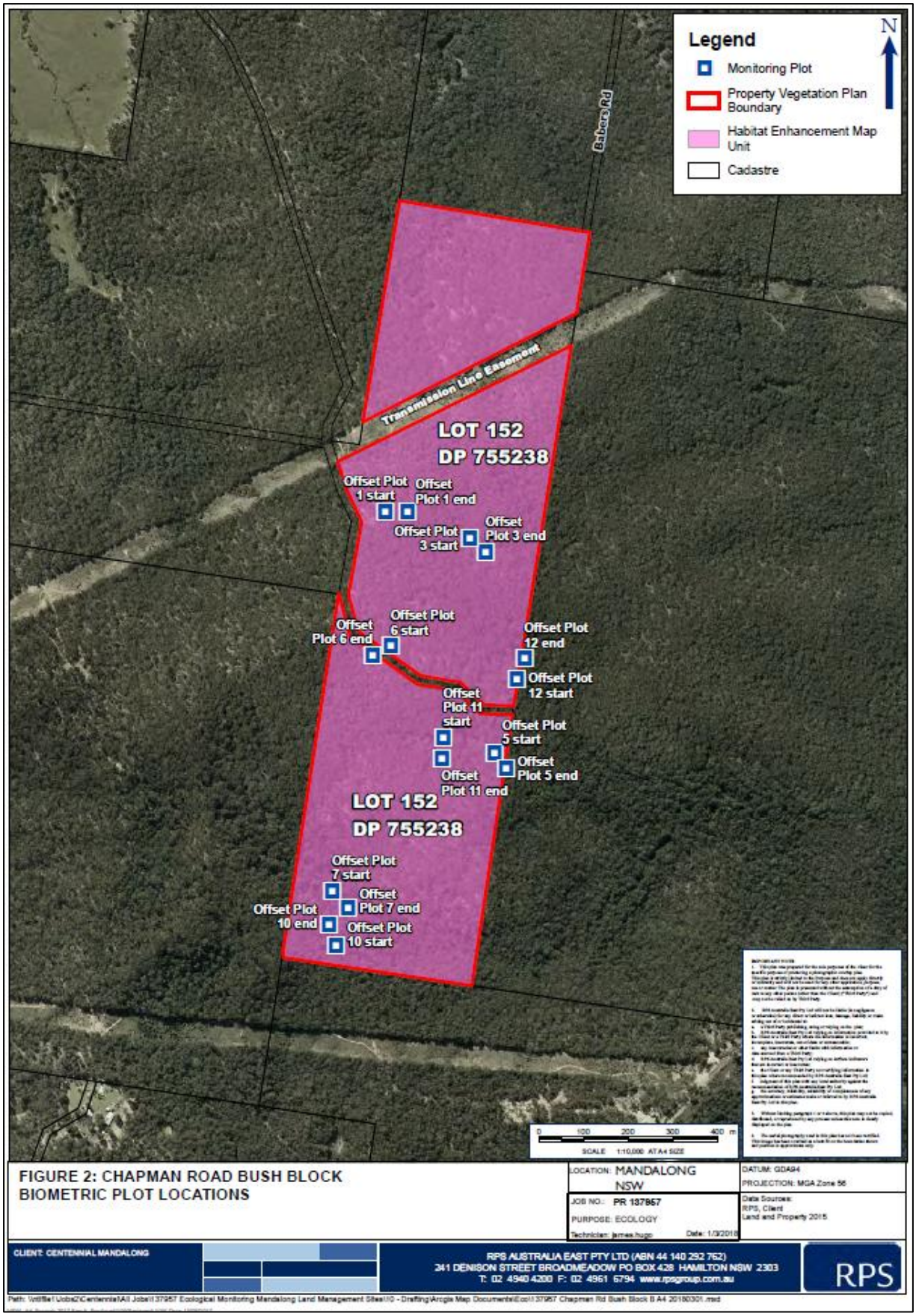


Figure 12 : Chapman Road Bush Block Offset Area

Source: (RPS, 2018).

6.4.3 Wetland Monitoring

The Cooranbong Colliery Life Extension Project EIS predicted that the preferred longwall design (250 metre wide longwall panels) would result in some substantial changes to the existing wetlands within the Mandalong Valley, and as a result the extent of the wetlands may increase if drainage mitigation works were not undertaken (Umwelt, 1997). The EIS also predicted alteration to contours over the area which "…*may result in some of the current wetlands drying out or changing in shape or extent, other areas are likely to become inundated, with new wetland areas forming adjacent to or interconnected with the original wetlands*" (Umwelt, 1997).

The current longwall mining width at the Mandalong Mine is 160 metres which significantly reduces maximum subsidence levels to around 20% of those predicted in the EIS. This reduction in longwall mining width has reduced the impacts on wetlands within the Mandalong valley to below the levels that were predicted in the EIS.

Condition 74 of DA97/800 requires monitoring and management of wetlands in the mining area. The Wetlands Management and Monitoring Plan (WMP) approved by LMCC was prepared by Hunter Eco (2016a), identifying seven wetlands for monitoring (

Figure 13**).** Wetlands 1, 2, and 3 are located outside of the subsidence zone and are control sites while the remaining five wetlands are within the mining area.

In April 2009 a baseline report was prepared by Hunter Eco which described the status of the wetlands prior to any subsidence having occurred. Two monitoring rounds occurred in May 2017 (Hunter Eco, 2017a) and November 2017 (Hunter Eco, 2017b). The following is a summary monitoring results from the current report *"Mandalong Wetlands Monitoring Report"* by Hunter Eco (2017b).

The purpose of the monitoring program, as prescribed in DA97/800, is to determine what, if any, changes in the monitored wetlands in the Mandalong floodplain can be attributed to subsidence.

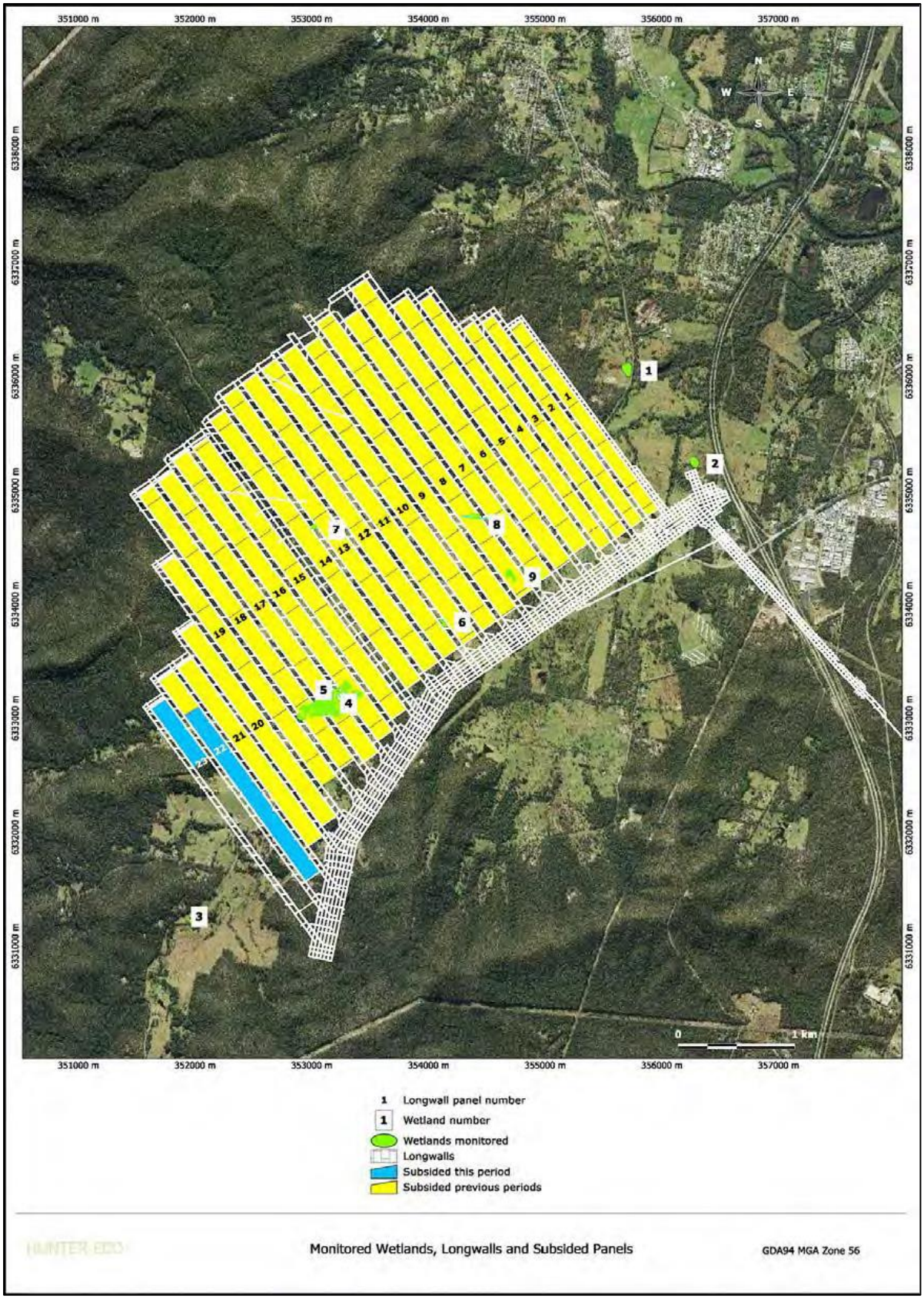


Figure 13: Wetland Monitoring Locations and underground workings.

Monitoring of eight wetlands commenced in April 2009 with two (W1 and W6) dropped from the program in May 2015 due to detrimental landholder actions. The property holding Wetland 9 was sold in 2017 and monitoring this wetland has been discontinued.

As at May 2017 the total monitoring period has been eight and one half years, 17 monitoring occasions, for the remaining six wetlands; now 18 monitoring occasions for the remaining five wetlands (November 2017). All wetlands started out with water then began to dry until May 2010 when only Wetlands 1 and 3 had water.

Hunter Eco (2017b) has identified an increasing rainfall trend over the entire monitoring program with short-term fluctuations. Prior to and including May 2015 there has been higher than average rainfall resulting in elevated water levels; in fact there had been some flooding that refreshed the wetland water; rainfall then dropped up to November 2015. There was high rainfall in January 2016 but less than average up to May 2016 when water levels were low or dry. Subsequently 198 mm was recorded in June 2016 with an average of 50 mm monthly thereafter and while this is good rain it is not sufficient to create significant runoff. Consequently water levels were reduced at the November 2016 monitoring. Subsequent to November 2016 a period of exceptionally hot and dry weather resulted in all wetlands drying. In late March 2017, 256 mm of rainfall was recorded filling all wetlands.

Hunter Eco (2017b) have determined that the wetlands are dynamic ecosystems with species composition and diversity varying with the amount of available water and seasonal conditions. Variable land-use activities also have an influence on the state of the wetlands. Water analysis results continue to be highly variable, showing no trends over time or within or among wetlands.

Wetland 6 is located over a pillar between panels 11 and 12, both panels having been subsided. The most noticeable change at this wetland is the change at the beginning of the transect from dry to margin habitat. This change appears to now be a feature of this transect. This wetland will no longer be monitored as a result of landholder slashing activity and cattle introduction.

Wetland 8 has been subject to subsidence for over four years and there is no change in the wetland vegetation and water levels that can clearly be assigned to being an impact of subsidence.

Wetland 7 which is located over a pillar between panels 13 and 14, both of which have been subsided. There is no subsidence monitoring through this wetland, however this wetland was again in a healthy condition in November 2017. Wetlands 4 and 5 are part of a larger wetland that had drained in late 2014 and early 2015 as a consequence of subsidence in panel 16 which temporarily lowered the wetland overflow point. The wetland capacity has mostly been restored following the subsidence of panels 18 and 19. There has been considerable change in the floristic composition of these transects over time reflecting the changes in water levels caused by rainfall variation and subsidence. However, the essential characteristics of a freshwater wetland remain. As of May 2017 water levels had returned to an approximately pre-subsidence state with a slight reduction in November 2017 due to low rainfall in the preceding three months.

Species composition across all wetlands is relatively consistent over time. Few new species were added in 2017 suggesting that the majority of likely species has been recorded. Weeds are primarily confined to the surrounding dry grassland with no invasion into the aquatic ecosystem (except *Isolepis prolifera* in Wetland 5). The proportion of weeds to native species over time has reduced significantly for Wetlands 7 and 8 but has remained unchanged for the others.

Changes in the amount of the threatened *Maundia triglochinoides* have been interesting with whole local populations disappearing by April 2011 (Wetlands 2 & 6) or substantially reducing in numbers (Wetlands 1 & 4). Since then the species has not been present in Wetlands 1, 2, and 4 until its reappearance in Wetland 4 in November 2015, then absence in May 2016. Since November 2011 a large area of the species at the south eastern end of Wetland 6 had recovered by November 2012 but had declined in April 2013, was longer present in April 2014 and had recovered in January 2015. The species was found in Wetland 8 since May 2015 having not been recorded there previously and had become the dominant aquatic species across the wetland as of November 2016. The species was no longer present in Wetland 8 in May 2017.

Wetlands 4 and 5 had been fenced from stock since November 2012, however the property tenant has reported seeing deer inside the fence and deer droppings are regularly seen along Wetland 4 transects.

Herbivory and environmental degradation caused by feral deer is listed as a Key Threatening Process in the NSW Threatened Species Conservation Act 1955. The impact of deer on wetlands could arise from direct grazing of wetland plants and indirectly by destroying underwater regrowth with continual trampling. Depending on severity, this type of disturbance will add a confounding factor to comparison between wetlands.

While there have been some significant reductions in diversity and oxygen saturation none can be directly attributed to mining subsidence. During May 2015 the flush of water raised oxygen saturation levels substantially, a factor that would likely explain the change in aquatic vegetation in Wetland 8. Subsequently oxygen has returned to pre-flood levels. There have also been significant increases in diversity along with changes from downward trends to neutral.

Hunter Eco (2017b) have concluded that it is evident anthropogenic factors other than subsidence influence these wetlands over time along with natural responses to variation in environmental conditions. The exception being the temporary draining of the large wetland monitored at W4 and W5 which has since recovered.

Table 20: Wetland Trigger Action Response Plan and Assessment

Trigger	Result at November 2017	Response
A steady trend in the decline of water level observed in more than one round for monitoring at monitored wetlands that cannot be explained by rainfall data or upstream agricultural activity.	All wetlands were at optimum water levels as a result of recent rainfall	No further action needed.
A significant increase in the trend of EC levels observed over greater than one monitoring round. AGEC (2008) describe the alluvial aquifer as having substantially elevated EC levels. Any increase in EC in a wetland could be the result of the alluvial aquifer coming into contact with surface water.	EC levels were all within an acceptable range.	No further action needed.
Substantial physical erosion or damage to the wetland soil that cannot be explained by natural or man-made erosion process and is caused subsidence cracking (>200 mm in width).	No erosion or cracking was found.	No further action needed.
A significant increase in water nutrient levels, particularly N and P that cannot be explained by natural variations in nutrient levels or manmade influences.	Nutrient levels were acceptable.	No further action needed.
A steady trend in declining biodiversity observed over a period greater than one monitoring round.	Two wetlands have shown statistically significant declining diversity indices.	Not related to subsidence.
A landholder submits a complaint that a wetland has changed as a result of subsidence.	No landholder reports had been received.	No further action needed.

Source: (Hunter Eco, 2017b)

6.4.4 VAM-RAB Rehabilitation Off-Set Monitoring

Centennial Mandalong received approval in 2011 (DA97/800 Modification 7) for the trial installation of a ventilation air methane regenerative afterburner unit (VAM-RAB) that would remove and breakdown the exhaust methane.

Installation of the VAM-RAB unit necessitated clearing of some native vegetation. Two endangered ecological communities (EEC) listed in Schedule 3 of the NSW Threatened Species Conservation Act 1995 were included in the areas to be cleared. These were: Swamp Sclerophyll Forest (SSF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; and River-Flat Eucalypt Forest (RFEF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

DA97/800 Condition 76A included a requirement for a 1.25 hectare rehabilitation off-set area to be established on cleared land adjoining the VAM-RAB construction site. These EEC were represented by communities described in the regional vegetation mapping and classification (NPWS 2000) as: MU37 Swamp Mahogany Paperbark Forest (SSF); and MU38 Redgum – Rough-barked Apple Swamp Forest (RFEF).

An ecology survey (Hunter Eco, 2011) prepared for the VAM-RAB project application described the area to be rehabilitated as mostly dominated by weeds. This being the case, active regeneration was required and this was commenced in January 2012 and completed in March 2012.

Further to the requirement to rehabilitate, DA97/800 Condition 76A also requires that the progress of the rehabilitation be monitored annually for five years. Hunter Eco commenced baseline monitoring in October and November of 2012, with the first annual monitoring completed in October 2013, the second annual round of monitoring completed in December 2014, the third annual round of monitoring completed in December 2015, the fourth annual round of monitoring completed in October 2016 and the fifth round of monitoring completed in December 2017 (Hunter Eco, 2017c).

The aim of the monitoring program conducted by Hunter Eco was to collect data that would enable a quantitative comparison between the relatively undisturbed communities and the areas being rehabilitated. This is achieved through the collection of floristic data from 400 m^2 permanently established plots. The normal plot size is 20 m x 20 m but the dimension can vary depending on the configuration of the available space. Two plots were established in each of the two undisturbed communities and two in each of the two areas being rehabilitated to these communities; eight plots in all.

All plots were permanently established with star pickets at each corner in 2012, and floristic data was collected on 15 December 2017. Hunter Eco have found that rehabilitation areas remain substantially different to that in the reference areas. However, as time goes by the cover contribution of the planted species will increase and should contribute to improved similarity.

Hunter Eco (2017c) have recommended that well advanced trees (around 1 metre tall) be sourced and planted for Plot 4 and Plot 5. *Eucalyptus robusta* and *Melaleuca nodosa* would be appropriate for Plot 4 and *Eucalyptus amplifolia* and *Angophora floribunda* for Plot 5. This planting will be completed in 2018. Blackberry had recently been sprayed, mostly with success, but there are still several plants that appear to have been missed. Further weed spraying will also be completed in 2018.

Hunter Eco (2017c) has described the results of what is effectively four years of rehabilitation given the initial year lost to herbivory prior to fencing. Overall the results to date

are encouraging suggesting that the measures taken should result in successful rehabilitation, although over a longer period than the required five year monitoring program.

Source: (Hunter Eco, 2017c)

Figure 14: Location of Floristic Sample Plots

6.4.5 Green & Golden Bell Frog Research Program

In 2016 Centennial Mandalong commenced the preparation and implementation of a research and monitoring program for the Green and Golden Bell Frog (GGBF) in accordance with EPBC approval (2013/6906) conditions of the Northern Coal Logistics Project.

As part of current operations at the Cooranbong Entry Site, underground mine water is pumped from the existing Mandalong Mine underground workings at an average rate of 0.6 to 2.5 ML/day and is discharged into an unnamed creek from Licensed Discharge Point 001 (LDP001) at the Cooranbong Entry Site. The unnamed creek flows into Muddy Lake which is also connected to Lake Macquarie via Lake Eraring.

Ecological surveys were first undertaken at Muddy Lake in October 2015. During these surveys, approximately five Green and Golden Bell Frog *Litoria aurea* (GGBF) individuals were identified. The Green and Golden Bell Frog is listed as an endangered species under the NSW *Threatened Species Conservation Act* 1995 (TSC Act) and as a vulnerable species under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

The GGBFs identified at Muddy Lake are the only known records of the species within a 10 km radius of the Cooranbong Entry Site.

The research project will monitor GGBF populations and habitat quality within Muddy Lake in conjunction with reference populations to fulfil the relevant EPBC approval conditions. Monitoring commenced in late 2016, with approval received from the Department of Environment & Energy on 30 November 2016 for Professor Michael Mahoney to act as an independent peer reviewer for the purpose of reviewing the Green and Golden Bell Frog Research Program's methodology and final report.

Surveys were conducted by GHD within the study area over a two-week period in January - February 2017 and also in Spring 2017 and Summer 2017 / 18. Adult males, adult females and juvenile Green and Golden Bell Frogs were captured during the surveys. The size of the juveniles indicated that breeding has occurred either within the study area or within adjacent habitat in the past twelve months. At this stage, this suggests that the population is viable, although further surveys will be required to examine trends in population structure. The presence of a viable population on the Central Coast, a large distance from the two known key populations, is likely to be important for the conservation of the species in the region.

6.5 CULTURAL HERITAGE & ARCHAEOLOGY

6.5.1 Aboriginal Archaeology –LW22-23 & LW24-24A Extraction Plan Areas

In 2016, RPS prepared a Heritage Management Plan (RPS, 2016a) to support an Extraction Plan for the extraction of coal from Mandalong Mine Longwall panels 22 and 23. The Study Area for the Heritage Management Plan encompassed the 26.5 degree angle of draw around the secondary extraction areas of Longwalls 22 and 23.

A survey of the Longwall 22-23 Study Area was undertaken by RPS archaeologists Cheng Yen Loo and Jo Nelson on 14 and 15 June 2016 accompanied by Phil Enright (Centennial Mandalong Mining Approvals Coordinator). Based on the areas surveyed and ground truthing of existing sites, a total of four Aboriginal sites were located inside the Study Area: three that were previously identified in 2011 and one newly recorded scarred tree site named #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) located in the angle of draw for Longwall 21 which would not be directly undermined as a result of the extraction of Longwalls 22 or 23, and the fourth was a scarred tree site (#45-3-3678 - RPS Mand 2016_1).

Based on the predicted subsidence there was no impact predicted for the four Aboriginal sites as a result of the extraction of Longwalls 22 and 23 (RPS, 2016a).

Table 21: Subsidence on Aboriginal Cultural Heritage Sites

AHIMS Number	Artefact No.	Aboriginal Cultural Heritage Site	Mining Location	Predicted Subsidence	Actual Subsidence	Comment
45-3-3454	RPS MAND Nth 5	Grinding Groove	Angle of Draw Longwall 21	<20mm		Not undermined
45-3-3453	RPS MAND Nth 6	Artefact Scatter	Outside influence of mining.	100mm		Not mined – LW20 shortened due to seam intruded by igneous sill.
45-3-3446 45-3-3537		Artefact Scatter	Longwall 22 abutment pillar	40mm	<20mm	Based on nearest monitoring point.
45-3-3538		Isolated Find	Longwall 23	60mm		Not mined in 2017
45-3-3678	RPS Mand 2016_1	Scarred Tree	Longwall 24	700mm		Not mined in 2017

A pre-mining baseline recording of Aboriginal grinding groove site AHIMS #45-3-3454-RPS (Mand North 5) was undertaken on 1 November 2016 by Tessa Boer-Mah (RPS), Arthur Fletcher (Wonn1), Mark Harrower (Centennial), Jeffrey Dunwoodie (Centennial) and Tim Gayner (Centennial). The baseline recording located the grinding grooves to survey control standard, included a detailed archaeological recording and archival photography, as well as a 3D scan.

The baseline pre-mining recording was undertaken in accordance with Phase 1 of the ACHMP (RPS 2016). The post mining initial condition inspection (Phase 2) was undertaken on 1 March 2017 and the post mining secondary condition inspection (Phase 3) was undertaken on 23 October 2017. All recording and inspections were undertaken with Aboriginal community participation. No mining induced changes were noted for each of the grinding grooves as the site (RPS, 2017a).

The artefact scatter (#45-3-3446/45-3-3537) located above the Longwall 22 abutment pillar and the isolated find (#45-3-3538) above Longwall 23 were also monitored in 2017. The baseline pre-mining recording was undertaken for both sites in accordance with Phase 1 of the ACHMP (RPS 2016) on 1 March 2017. The post mining initial condition inspection (Phase 2) was undertaken on 1 March 2017 at the artefact scatter ((#45-3-3446/45-3-3537). All recording and inspections were undertaken with Aboriginal community participation.

AHIMS # 45-3-3678 scarred tree was originally recorded by RPS archaeologists. A detailed baseline recording was undertaken on 23 October 2017 by Tessa Boer-Mah (RPS), Tracey Howie (Guringai Tribal Link), Jackson Walker (Awabakal Traditional Owners Aboriginal Corporation), Kane Leven (Awabakal Descendants Traditional Aboriginal Owners Corporation), Mark Harrower (Centennial) and Jeffrey Dunwoodie (Centennial).

Once mining has been completed for Longwall 24 in 2018, a Phase 2 recording will be undertaken of AHIMS #45-3-3678 in accordance with Centennial's Northern Region Aboriginal Cultural Heritage Management Plan (RPS, 2016a).

6.5.2 European Heritage

A Historic Heritage Management Plan was developed for Mandalong in 2016 to address European Heritage items located within the Mandalong lease boundary. The archival recording of the Landing Skid 2 which is located within the Mandalong South Surface Site disturbance boundary was completed by RPS in 2016 (RPS, 2017b). Landing Skid 2 was subsequently demolished in 2017 during the construction of the Mandalong South Surface Site.

Subsidence on the section of Convict Road (Brisbane Waters to Wallis Plains Road) above Longwall panels 1 and 2 was last recorded at 320mm in 2012. No observed subsidence damage was identified to the road which is in accordance with the predictions in the EIS (Umwelt, 1997). Subsidence monitoring was completed in 2012 as approved by the DRG.

6.6 RAINFALL MONITORING RESULTS

The total monthly rainfall data is shown below in **Table 22** and in **Figure 15**.

Table 22: Rainfall at Mandalong Mine for the Period January 2017 to December 2017.

2017 Month	Mandalong Mine Total Rainfall (mm)
January	55.6
February	72.0
March	256.4
April	49.4
May	31.0
June	96.8
July	4.4
August	6.4
September	10.0
October	118.8
November	59.2
December	52.4
Total	**812.4**

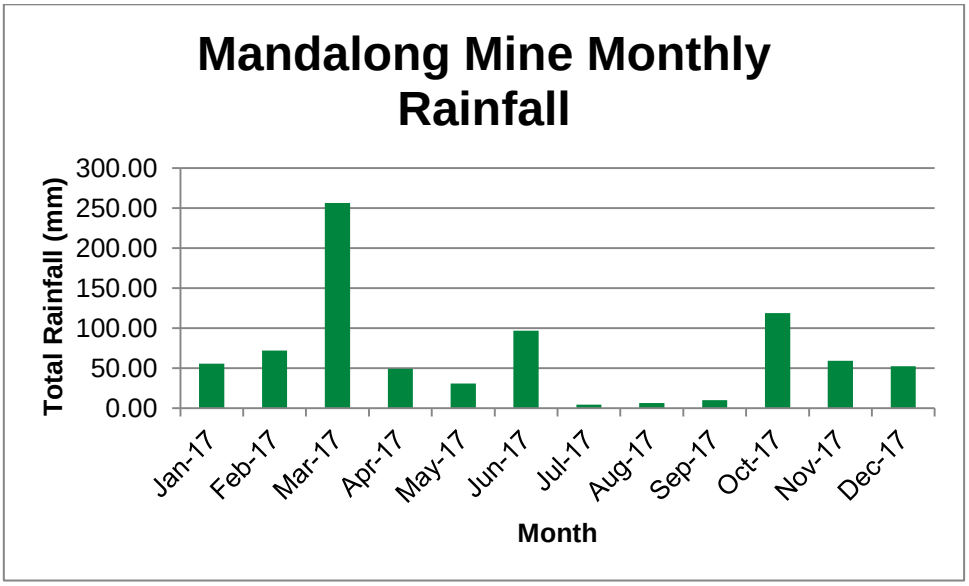


Figure 15: Mandalong Annual Rainfall

A total of 812.4 mm of rainfall was recorded at the Mandalong Mine site during the reporting period. The total annual rainfall for 2017 was lower than the total rainfall (1041.4 mm) recorded in 2016. The wettest period in 2017 was March recording 256.4 mm.

6.7 SUBSIDENCE MONITORING

Subsidence monitoring programs are developed and approved for each Extraction Plan and previously Subsidence Management Plans (SMP). During 2017, both Longwall 21 and Longwall 22 completed extraction, while Longwall 23 had extracted half its planned length. Subsidence effects from Longwall 21 were managed in accordance with SMP LW18-21 requirements and Longwall 22 and 23 were managed by the Extraction Plan LW22-23.

Subsidence monitoring aims to confirm that subsidence predictions and expected subsidence impacts are consistent with the SMP / Extraction Plan. Where subsidence predictions and or impacts are greater than predicted, Trigger Action Response Plans (TARPs) provide the appropriate and agreed management. The subsidence monitoring program includes monitoring for subsidence performance on built features including private dwellings, public roads, Telstra Network, Ausgrid powerlines, TransGrid 330kV towers and natural features including wetlands, creeks, steep slopes and flood path inspections.

6.7.1 Subsidence Performance Measures

Development Consent DA97/800 specifies subsidence performance measures for private properties and natural features up to and including Longwall 21. **Table 23** provides a summary of the performance measures.

The Extraction Plan for Longwall 22 and 23 operates within mining leases ML1443 and ML1543 and is approved under Development Consent SSD-5144 MOD 5. Subsidence Performance Measures are detailed in Schedule 4, Condition 1 Table 6 and Condition 4 Table 7 as shown below in **Table 24** and **Table 25** respectively.

Table 23: Summary of DA97/800 Subsidence Performance Measures

Feature	Subsidence Performance Measures
Private Property	
Privately Owned Dwellings *Other built features and improvements*	Remain Safe, Serviceable and Repairable (SSR) – acquisition and compensation procedure if beyond SSR
Flood	Dwelling floor level to remain above post mining 100 year ARI flood level - acquisition and compensation procedure if floor level is below flood level.
	No increase in flood hazard at dwelling or dwelling access at 100 year ARI flood level - acquisition and compensation procedure if flood hazard is increased.
Landuse	No loss of agricultural productivity or adverse impact to land use including buildings and flooding - acquisition and compensation procedure if land use is impacted.
Infrastructure	
Local Roads and Access	Access to properties and within properties is maintained at no less than existing standard during the period of mining and at least five years thereafter.

Feature	Subsidence Performance Measures
Environmental	
Flora and Fauna	No specific subsidence performance measures. Requirement to develop management plans for each item. Predicted subsidence impacts and subsidence management is documented and approved in Subsidence Management Plans.
Heritage and Archaeology	
Erosion and Sediment Control	
Floodplain	
Wetlands	
Groundwater	

Table 24: SSD-5144 Subsidence Performance Measures – Natural and Heritage Features

Watercourses	
3rd Order and above streams Groundwater-dependent Ecosystems	No connective cracking between the surface, or the base of the alluvium, and the underground workings. No subsidence impact or environmental consequence greater than minor.
1st and 2nd Order streams	No subsidence impact or environmental consequences greater than predicted in the documents listed in condition 2(b) of Schedule 2. No connective cracking between the surface and the underground workings.
Aquatic and riparian ecosystems, including affected sections of Morans Creek, Wyee Creek, Tobins Creek and Mannering Creek	Maintain or improve baseline channel stability. Develop site-specific in-stream water quality objectives in accordance with ANZECC 2000 and *Using the ANZECC Guidelines and Water Quality Objectives in NSW* procedures (DECC 2006), or their latest versions.
Land	
Steep slopes and rock outcrops	No subsidence impact or environmental consequence greater than predicted in the documents listed in condition 2(b) of Schedule 2.
Agriculture	No loss of agricultural productivity greater than minor.
Biodiversity	
Threatened species, threatened populations and endangered ecological communities	Negligible environmental consequences.
Heritage sites	
Stone Arrangement RPS TBM 32	Negligible subsidence impacts or environmental consequences
All other Aboriginal Cultural Heritage sites/items at the site	No subsidence impact or environmental consequence greater than predicted in the documents listed in condition 2(b) of Schedule 2.
Mine workings	
First workings under an approved Extraction Plan beneath any feature where performance measures in this table require negligible subsidence impacts or negligible environmental consequences	To remain long-term stable and non-subsiding.
Second workings	To be carried out only within the approved mine plan, in accordance only with an approved Extraction Plan.

Table 25: SSD-5144 Subsidence Performance Measures – Built Features

Key Public Infrastructure	
M1 Motorway	Always safe and serviceable.
Main Northern Railway	
330 kV power supply infrastructure	Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.
Other Built Infrastructure	
Power lines and power poles	Always safe.
Telecommunications infrastructure	
Privately-owned residences	Serviceability should be maintained wherever practicable.
Local Roads	
Other built features and improvements, (including access roads, farm dams, swimming pools, tracks and fences)	Loss of serviceability must be fully compensated. Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.
Public Safety	
Public Safety	Negligible additional risk.

6.7.2 Subsidence Reporting

The SMP LW18-21 required fortnightly Subsidence Management Status reports to be prepared and made available to the DRE when requested. The preparation of an Annual Report replaced the requirement for the preparation of four monthly status reports and End of Panel Reports in the previous SMPs. The Department of Planning and Environment (DPE) approved the consolidation of End of Panel Reporting as required by DA 97/800 Condition 18 into the Annual Review as required by Condition 12 of Schedule 6 of SSD-5144. All reports were completed at the specified timeframes as detailed in **Table 26**.

The Extraction Plan LW22-23 provides six-monthly reporting in accordance with the Extraction Plan Guidelines.

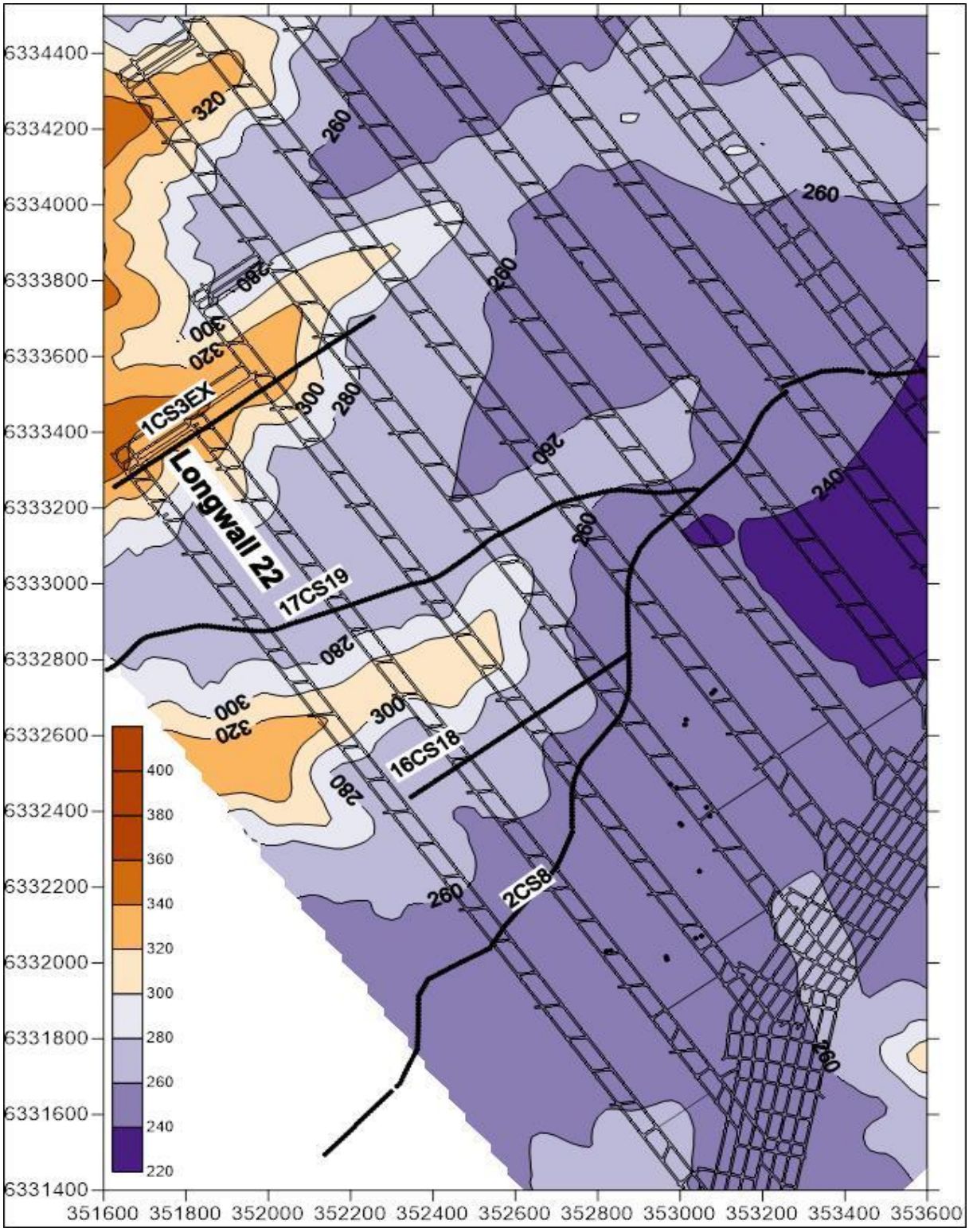
Table 26: Subsidence Reports 2017

Report	Report Period	Date Issued
LW21 Subsidence Management Status Reports	Fortnightly (13 reports)	21 November to 9 May 2017
Six Monthly Report Extraction Plan LW22-23	1 April 2017 to 30 September 2017	October 2017

6.7.3 Subsidence Performance Summary

Subsidence performance was reviewed following the completion of Longwall 21 (Seedsman Geotechnics, 2017) and Longwall 22 (Seedsman Geotechnics, 2018). Subsidence over both longwalls was measured across four crosslines and monitoring installed on properties and dwellings as shown in **Figure 16**.

Figure 17 to **Figure 19** present the subsidence data for Longwalls 19 to 22 and **Table 27** and **Table 28** show the maximum predicted and measures subsidence over Longwall 21 and Longwall 22 respectively.



Source: (Seedsman Geotechnics, 2018)

Figure 16 - Location of Subsidence Monitoring Lines and Depth of Cover to Underground Workings

Table 27: Maximum Vertical Subsidence developed over LW21

Subsidence Line	Depth of Cover (m)	Predicted Maximum Subsidence LW21 (m)	Measured Maximum Subsidence LW21 (m)	Difference Measured less Predicted (m)	Comment
Crossline 3Ex	330	0.40	0.40	0.00	
Crossline 19	280	0.95	1.07	0.12	Tobins Rd
Crossline 18	270	0.75	1.08	0.33	
Crossline 8	260	0.75	1.14	0.39	Mandalong Rd

Table 28: Maximum Vertical Subsidence developed over LW22

Subsidence Line	Depth of Cover (m)	Predicted Maximum Subsidence LW22 (m)	Measured Maximum Subsidence LW22 (m)	Difference Measured less Predicted (m)	Comment
Crossline 3Ex	330	0.40	0.25	-0.15	
Crossline 19	280	0.95	0.95	0.00	Tobins Rd
Crossline 18	260	0.85	0.86	0.01	
Crossline 8	260	0.60	0.84	0.24	Mandalong Rd

Crossline 3Ex is located close to the start line of both panels and such that there would have been little sag of the overburden above the extraction and subsidence would be predominantly the compression of the coal and roof/floor. The associated tilts and strains are correspondingly low (**Figure 17**).

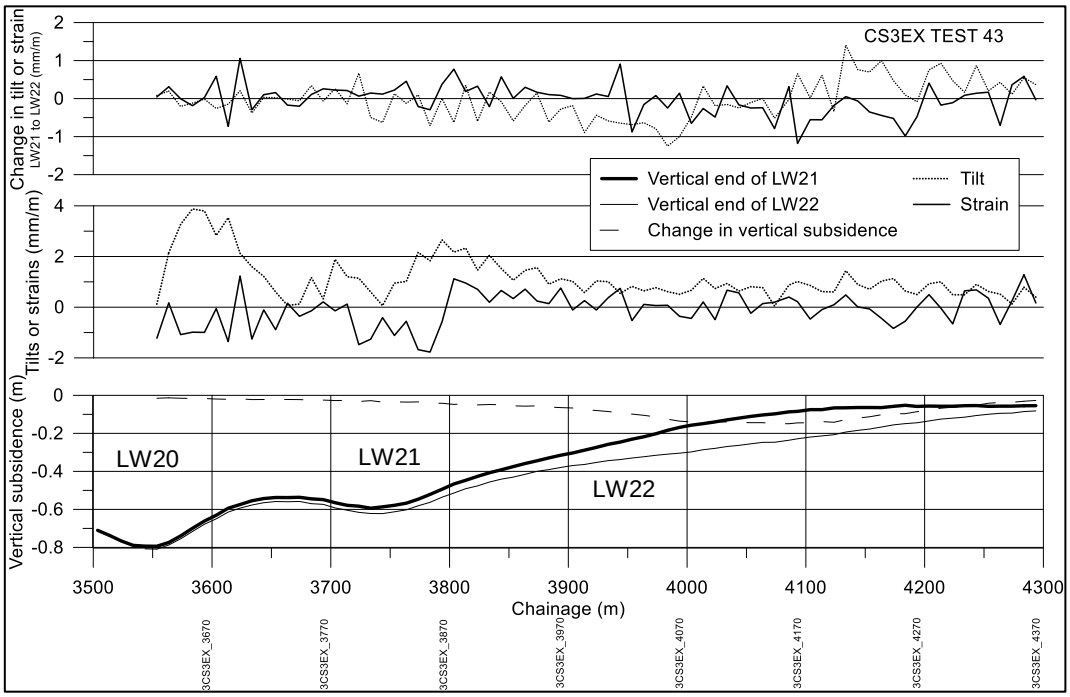


Figure 17 – Subsidence Parameters measured along Crossline 3Ex

Crossline 18 (**Figure 18**) is a straight survey line normal to the longwall centrelines. Similar to Crossline 19 the subsidence associated with the longwalls dominated by the pillar compression with little panel sag.

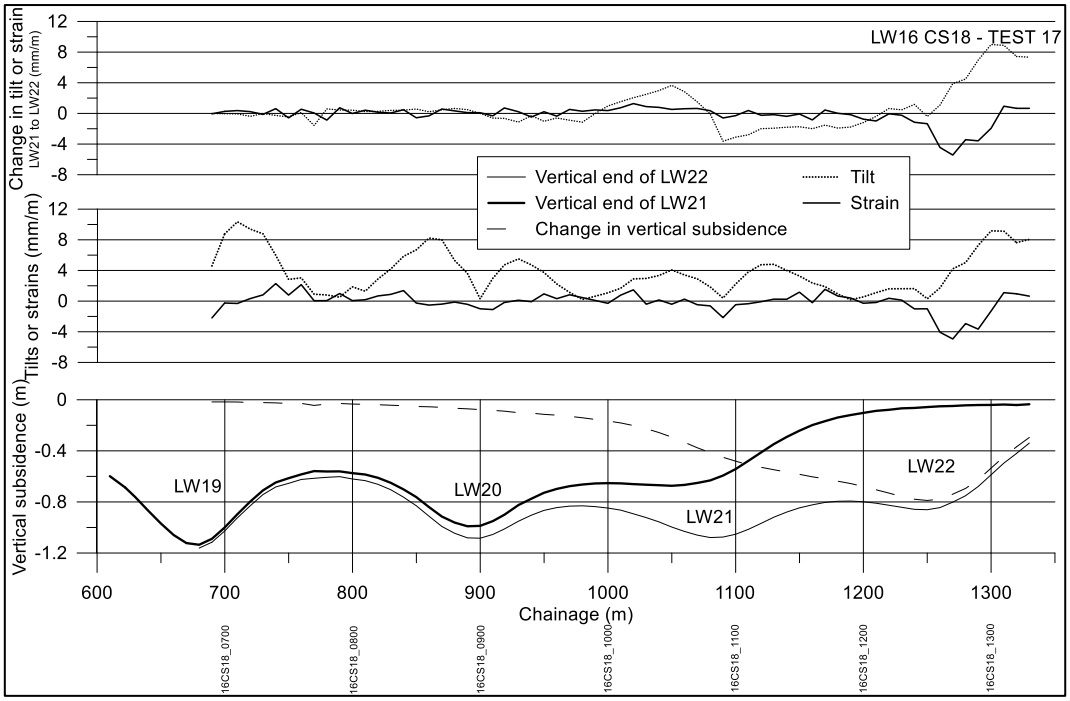


Figure 18: Subsidence parameters measured along Crossline 18

On Crossline 8 (**Figure 19**) the subsidence patterns are similar with a larger amount of panel sag compared to Crosslines 18 and 19 – the pillar compression approximately 0.6m and the sag is 0.5m. The tilt on the western side of LW22 is the result of both the larger sag and the pillar compression.

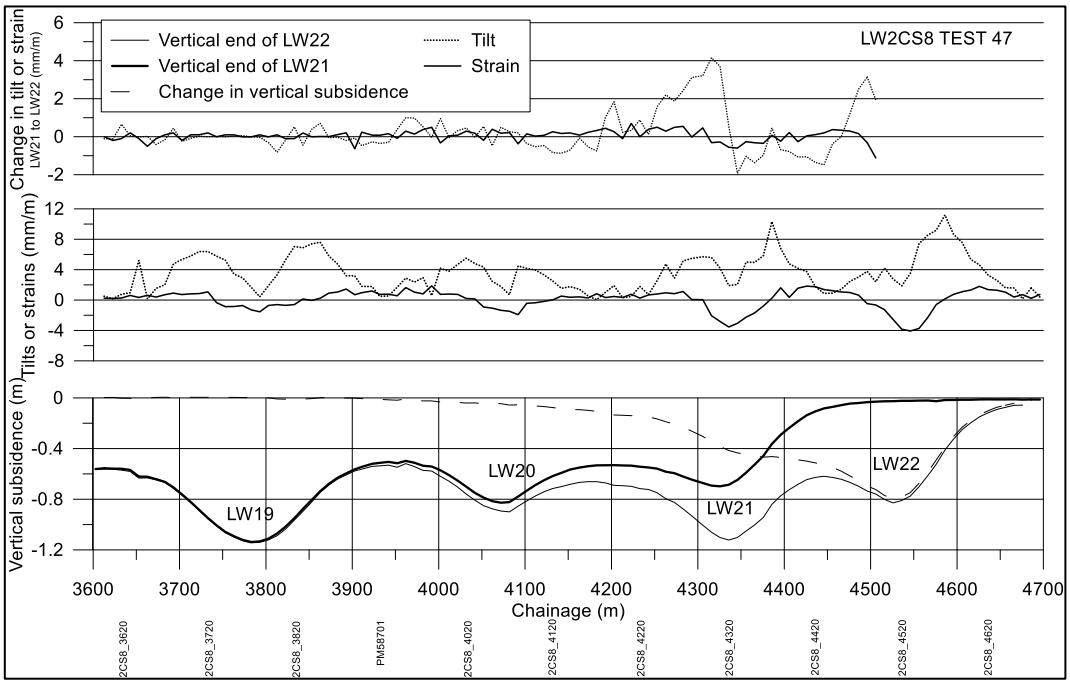


Figure 19: Subsidence parameters measured along Crossline 8 Mandalong Rd

Values for Safe Serviceable and Repairable (SSR) criteria for dwellings have been assessed as being less than 5mm/m for tensile and compressive strains and less than 7mm/m of tilt. To review the range of tilt and strain measurements across both Longwall 21 and Longwall 22, frequency histograms for tilt, tensile strain and compressive strain have been used after the extraction of each panel to assess subsidence performance. The histograms are based on the results of all subsidence monitoring lines located over the longwall panels as shown in **Figure 16**. The histograms compare the subsidence results against the SSR criteria values. **Table 29** provides a summary of the histogram results measured over Longwalls 6 to 22 compared to SSR criteria for dwellings. The results confirm the high level of confidence in the mine design achieving low levels of subsidence and impact on both built and natural features.

Table 29: Measured Subsidence Frequency Histogram Summary Longwalls 6 to 22

Frequency Histogram Summary for Longwalls 6 to 22 Measured Subsidence Compared Against SSR Criteria for Dwellings			
Longwall Panel	**Tilt Less that 7mm/m**	**Tensile Strain Less than 5mm/m**	**Compressive Strain Less than 5mm/m**
LW6	97.7%	99.8%	97.4%
LW7	97.6%	100%	97.8%
LW8	100%	100%	99.4%
LW9	100%	100%	100%
LW10	98.8%	100%	98.5%
LW11	96.5%	100%	100%
LW12	96.4%	100%	93.3%
LW13	95.6%	100%	95.6%
LW14	100%	100%	100%
LW15	96.9%	100%	100%
LW16	90.9%	100%	96.7%
LW17	96.0%	100%	96.3%
LW18	97.9%	100%	95.7%
LW19	95.0%	100%	100%
LW20	100%	100%	100%
LW21	98.2%	100%	100%
LW22	92.2%	100%	98.6%
Average	**97.3%**	**100%**	**98.1%**

Table 30 provides a summary of the assessment of subsidence performance against the specified subsidence performance measures and predicted impacts in SMP LW18-21 and Extraction Plan LW22-23. As shown in the summary table, subsidence impacts were within the predicted levels for private property, surface infrastructure, natural features and heritage items.

Table 30: Assessment of Subsidence Performance against Performance Measures and Predicted Impacts

Feature	Subsidence Performance Measures	Predicted Subsidence Impact SMP LW18-21 Extraction Plan LW22-23	Assessment of Performance against Predicted Impact
Private Property			
Dwellings	Remain Safe, Serviceable and Repairable (SSR) – acquisition and compensation procedure if beyond SSR	Subsidence predictions below SSR criteria, with all dwellings remaining SSR.	***Impact as predicted*** Nine private dwellings impacted by subsidence from LW21, LW22 and LW23. All remained SSR. Only minor repairs required.
Flood – dwelling and access	No increase in flood hazard at dwelling or dwelling access at 100 year ARI flood level - acquisition and compensation procedure if flood hazard is increased (SMP LW18-21).	No predicted increase to the flood hazard category at all dwellings or access at the 1:100 year ARI Storm Event at predicted maximum subsidence and for two times predicted maximum subsidence.	***Impact as predicted*** Maximum subsidence was consistent with prediction at dwelling locations. Drainage works on private property located over LW18-21 completed (refer **Table 32**). No increase in flood hazard along access roads.
	Dwelling floor level to remain above post mining 100 year ARI flood level (0.5m above for EP LW22-23) - acquisition and compensation procedure if subsided floor level is below flood level.	All dwellings freeboard remains above 100 year flood level at the maximum predicted subsidence and two times maximum predicted subsidence.	***Impact as predicted*** Maximum subsidence was consistent with prediction at dwelling locations.
Landuse	No loss of agricultural productivity or adverse impact to landuse including buildings and flooding - acquisition and compensation procedure if landuse is impacted (SMP LW18-21) No loss of agricultural productivity greater than minor (EP LW22-23)	No loss of landuse to State Forest or agricultural productivity to private property (hobby farms) and Centennial properties.	***Impact as predicted*** No reported or observed impact to landuse. An increase in existing ponding slightly greater than expected occurred on one private property (82) following completion of LW21. Remediation works completed (refer **Table 32**).
Infrastructure			
Local Roads and Access	Access to properties and within properties is	Low damage predicted to Tobins Rd, Mandalong Rd	***Impact as predicted*** Subsidence impacts consistent

Feature	Subsidence Performance Measures	Predicted Subsidence Impact SMP LW18-21 Extraction Plan LW22-23	Assessment of Performance against Predicted Impact
	maintained at no less than existing standard during the period of mining and at least five years thereafter (SMP LW18-21). Public Roads Management Plan LW22-23	and Chapman Rd. To remain safe, serviceable and repairable. No change to flood hazard.	with prediction. Minor compression humps developed on Mandalong Rd near centreline of LW21 and Tobins Rd near centreline of LW22, both not requiring immediate repairs. Repairs to pavement to take place during scheduled road maintenance. No impact to road drainage.
Electricity Transmission Lines	Powerline Management Plan Transmission Line Management Plan TL24 Tower 47	No impact to serviceability to powerlines and transmission lines. Cruciform footings installed on TL24 Towers 45, 46 and 47.	***Impact as predicted*** Subsidence within prediction. No observed or reported damage to powerline or transmission line infrastructure.
Communications	Telstra Management Plan	Low impact. No disruption to copper cable network. No impact to inactive fibre optic cable located along Mandalong Rd.	***Impact as predicted*** Subsidence monitoring confirmed subsidence consistent with predicted maximum values (strains). No interruption to service detected or reported.
Natural Features			
Flora and Fauna	No net loss of ecologically significant vegetation communities within DA area.	No net loss of native flora and fauna habitat.	***Impact as predicted*** There has been no observed or reported impact to flora and fauna affected by LW21, LW22 and LW23 subsidence.
Floodplain	Floodplain inspection and monitoring	Minimal changes to creek channel flows or alignment. Predicted no surface cracking on floodplain.	***Impact as predicted*** Minimal changes to creek channel grades resulting in a negligible change to stream flows. No mining induced erosion or deterioration in stream bank condition. No subsidence related soil cracking was observed in report period in areas with higher depth of cover or alluvial flood plain area above LW1 to LW23.
Wetlands	Wetland Monitoring Management Plan	No long-term impact was predicted.	***Impact as predicted*** Subsidence was within prediction. Wetland Monitoring is ongoing as per

Feature	Subsidence Performance Measures	Predicted Subsidence Impact SMP LW18-21 Extraction Plan LW22-23	Assessment of Performance against Predicted Impact
			management plan.
Remnant Ponding	Flood Modelling	Minor increase to existing ponding predicted over LW21 and LW22.	***Impact as predicted*** Increase in ponding to dam over LW21 did not occur. No remnant ponding observed over LW22 and LW23 to date.
Groundwater	Groundwater Monitoring and Management Plan	Predicted no adverse subsidence related impacts on alluvium groundwater levels.	***Impact as predicted*** The monitoring data indicates that there is no adverse impact on groundwater levels in the alluvial aquifers. Notification was provided to DPE on 4/8/17 of a breach of a trigger level assigned to the Mandalong Mine groundwater monitoring location BH26C. Specifically, triggers 1 and 2 as per the LW22-23 Extraction Plan – Water Management Plan Trigger Action Response Plans (Appendix F) were breached in the July 2017 monitoring round. The decline in the groundwater level in BH26C within the Munmorah Conglomerate Formation is consistent with the simulated groundwater model predictions and as predicted given the location of BH26C directly above the extracted longwall. DPE provided a written response to this notification on 9/8/17.
Steep Slopes	Public Safety Management Plan	No cliffs or potential for rock fall hazards exist. Possible opening of rock joints. No additional risk to public safety	***Impact as predicted*** Subsidence within predicted levels. No observed impact to steep slopes or evidence of rock falls or rollout. No opening of rock joints observed.

Feature	Subsidence Performance Measures	Predicted Subsidence Impact SMP LW18-21 Extraction Plan LW22-23	Assessment of Performance against Predicted Impact
Heritage			
Heritage and Archaeology	No specific subsidence performance measures	No impact to the 10 Aboriginal cultural heritage sites identified in the SMP Area for LW18-21 and two within EP LW22-23.	***Impact as predicted*** Subsidence within prediction.

6.8 AGRICULTURAL LAND SUITABILITY

This section details the assessment of changes to agricultural land suitability resulting from the mining operations, including cumulative changes, at the Mandalong Site as required by DA97/800 condition 105(iv).

6.8.1 Agricultural Suitability Classification

The agricultural suitability and land capability of the Mandalong area was classified in the Environmental Impact Statement titled *"Cooranbong Colliery Life Extension Project"* (Umwelt, 1997). As stated in the EIS the land areas range from fairly level country in which the majority of the areas have been cleared, to steep heavily timbered country which is not capable of sustaining economically viable agricultural operations. Agricultural land suitability classification is mapped using the definitions in the Department of Urban Affairs and Planning *"Rural Land Evaluation Manual",* which classifies land into five different classes, based on the potential productivity of the land in the relevant social and economic context. The agricultural suitability system classifies land in terms of suitability for general agricultural use, including both cropping and pastoral purposes.

The Agricultural Suitability of the land in the Mandalong area was assessed in the EIS (Umwelt, 1997) to range from class 3 to 5. The majority of the level land at Mandalong has an Agricultural Suitability of 3, suited to grazing and limited cultivation in rotation pasture. The timbered area on level ground and timbered areas on sloping foothills were classified in the EIS with an Agricultural Suitability of 4 and 5 respectively. Agricultural Suitability with a classification of 4 is not suitable for cultivation but is suitable for grazing. These areas tend to be prone to water logging and production of these areas is constrained by the land size. Timbered land with an Agricultural Suitability of 5 in the Mandalong area is not suitable for agricultural production due to major constraints by native vegetation regulation and the costs associated with improving this land to a productive level.

To update information in the EIS (Umwelt, 1997) 19 agricultural assessments have been completed on properties during the development of Private Property Subsidence Management Plans (PSMP's). In 2009 an additional five agricultural surveys were undertaken on private properties located above longwall panels 11 to 14 for PSMP's. No further agricultural assessments were required in 2017.

The agricultural assessments completed in 2009 concurred with the agricultural suitability classes described in the EIS. Monitoring has confirmed that Longwalls 1 to 19 are stable. Tilts and strains have also remained unchanged over these 19 longwall panels. Agricultural assessments for the properties above these panels are unchanged from previous Annual Reviews and as such are removed from **Table 31**. The properties situated above the current zone of subsidence in 2017 above Longwall 21-22 are highlighted in **Table 31** and have an agricultural classification ranging from three to five as defined above.

Table 31: Agricultural Suitability Classification and Land Use

Property Reference (Number)	Agricultural Suitability Class 3	Agricultural Suitability Class 4	Agricultural Suitability Class 5	Current Agricultural Land use
Centennial 75			**x**	Horses
Centennial 81		**x**		Horses
Centennial 84	**x**	**x**		Horses
Centennial 85		**x**		
89	**x**	**x**		
74		**x**	**x**	Horses & Cattle
73	**x**	**x**	**x**	Biodynamic farming is practiced on the property including a small orchard.
80		**x**	**x**	
86	**x**			Farm - cattle, horses, pigs, emus, goats, lamas, alpacas.
203		**x**	**x**	Farm - cattle, horses, pigs, emus, goats, lamas, alpacas.
87	**x**	**x**		Farm - cattle, horses, pigs, emus, goats, lamas, alpacas.
88	**x**			Farm - cattle, horses, pigs, emus, goats, lamas, alpacas.
90	**x**			Cattle
221	**x**			
220	**x**			Horses

6.8.2 Assessment of Agricultural Suitability

Since commencing longwall mining operations, Mandalong Mine has fully extracted Longwalls 1 to 22. No additional subsidence was recorded above Longwalls 1 to 19. As such the agricultural suitability following mining is as reported in previous Annual Reviews. In 2017, 15 properties were influenced by subsidence movements on Longwalls 21 to 22. Of these 15 as highlighted in **Table 31**, 11 currently use land for agricultural purposes and typically have agricultural land suitability of class 3 or 4. The predominant land use on these properties is recreational/lifestyle, horse breeding and agistment and cattle/horse grazing.

6.8.3 Agricultural Suitability Impact Assessment

Vertical subsidence levels on Longwalls 21 and 22 are generally within predicted maximums. The distribution of subsidence above Longwalls 21 to 22 indicates subsidence on the floodplain, where the majority of pasture areas are found, typically ranges up to 0.90 m. There is little evidence that these relatively low levels of subsidence have impacted on pasture condition, as further discussed below.

A number of private and Centennial owned properties as described in **Table 31** were noted as undertaking cattle and horse enterprises. Inspections of these properties were undertaken during surveys to assess the level of subsidence related changes. No significant changes to stock levels were reported as a result of subsidence following the extraction of Longwalls 21 and 22 in 2017.

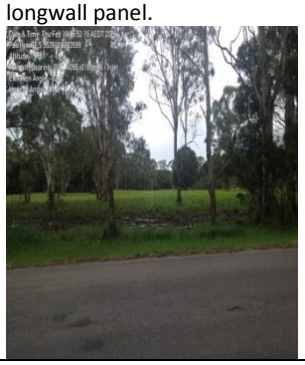
Thirty-three ponding locations have been identified by Hunter Eco and Centennial Mandalong as per the predictions in the flood modelling assessments, most of which were in open grassland and have since been drained and restored by Centennial Mandalong. **Table 32** provides a description of each ponding instance and what if any remediation was undertaken.

Table 32: Details of Ponding & Remedial Action

Remnant Ponding Remediation							
Location	**Description**	**Remediation**	**Remediation Comments**	**Ponding Predicted**	**Subsidence Completed**	**Status**	**Property Ref. Lot & DP**
Longwall 1 (P1)	Open grassland	Proposed new dam and area levelled as per PSMP	Continuing negotiations with landowner.	No	Yes	Negotiations with landowner ongoing	Ref. 6 2//557230
Longwall 2 (P2)	Open grassland	Drained	Constructed open drain and connected to nearby water course. 	Yes	Yes	Completed	Ref. 7, 8 1//557230 3//557230
Longwall 3 (P3)	Open grassland	Drained	Constructed open drain and connected to nearby water course. 	Yes	Yes	Completed	Ref. 7 1//557230

Remnant Ponding Remediation							
Location	**Description**	**Remediation**	**Remediation Comments**	**Ponding Predicted**	**Subsidence Completed**	**Status**	**Property Ref. Lot & DP**
Longwall 4 (P4)	Open grassland	Allowed to remain as a source of water for stock.		Yes	Yes	Completed	Ref. 7, 591//557230 580//733227
Longwall 5 (P5)	Open grassland	Drained	Constructed open drain and connected to nearby water course. Fenced to restrict stock access causing erosion. 	No	Yes	Completed	Ref. 59 580//733227
Longwall 6 (P6)	Open grassland	Drained	Installed sub-surface drainage and drainage to Stockton Creek. 	Yes	Yes	Completed	Ref. 56 12//582283
Longwall 6 (P6A)	Open grassland	Drained	Improved existing open drainage to ponded area. 	No	Yes	Completed	Ref. 61 903//542306

Remnant Ponding Remediation							
Location	**Description**	**Remediation**	**Remediation Comments**	**Ponding Predicted**	**Subsidence Completed**	**Status**	**Property Ref. Lot & DP**
Longwall 7 (P7)	Open grassland fringed with Cabbage Gums and *Melaleuca biconvexa*.	Drained	Open drain constructed and connected to nearby water course. Drainage designed to allow access across by farm machinery and stock. 	Yes	Yes	Completed	Ref. 56 12//582283
Longwall 7 (P7A)	Open grassland	Allowed to remain as extension of existing dam.	Extension of existing dam	Yes	Yes	Completed	Ref. 55 11/582283
Longwall 7 (P7B)	Open grassland		Regrade natural drainage line and open drain. 	No	Yes	Completed	Ref. 52 93/9632
Longwall 8 (P8)	Expansion of an already wet area having scattered Swamp Mahogany and *Melaleuca biconvexa*.	Remain as expansion of existing freshwater wetland and fenced. Included in Wetland Monitoring Program as Wetland 9.	Following a period of monitoring and limited options for drainage, a decision was made to fence the wetland to protect from stock and allow to develop as a freshwater wetland. 	Yes	Yes	Completed	Ref. 55 11/582283
Longwall 8 (P8A)	Open grassland and *Melaleuca biconvexa* Existing wetland	Expansion of existing Wetland 8.	To remain as a wetland.	No	Yes	Completed	Ref.42 25//755238

Remnant Ponding Remediation							
Location	**Description**	**Remediation**	**Remediation Comments**	**Ponding Predicted**	**Subsidence Completed**	**Status**	**Property Ref. Lot & DP**
Longwall 9 (P9)	Mixed Cabbage Gum and paperbark forest.	Remain as extension of existing freshwater wetland.	Several threatened *Melaleuca biconvexa* paperbarks are present and remediation would involve losses of these through gaining access by machinery. Consequently remediation was not undertaken.	Yes	Yes	Completed	Ref. 57 180//859434
Longwall 10 (P10)	Mixed Cabbage Gum and paperbark forest.	Remain as freshwater wetland.	Several threatened paperbarks *Melaleuca biconvexa* are present and remediation would involve losses of these through gaining access by machinery. Consequently remediation was not undertaken.	No	Yes	Completed	Ref. 57 180//859434
Longwall 11 (P11)	Mixed paperbark woodland in an already periodically inundated area. Contains threatened *Melaleuca biconvexa* paperbarks. Ponding has extended an existing wetland.	Remain as freshwater wetland	To remain as a freshwater wetland.	Yes	Yes	Completed	Ref. 44 9//800491
Longwall 13 (P13)	Open grassland and Redgum Rough-barked Apple Forest	Minor increase in low lying area. No permanent ponding.	Existing ponding has been moved towards centre of longwall panel. 	No	Yes	Completed	Ref. 44 , 50 9//800491 10//800491
Longwall 13 (P13A)	Open grassland	Minor increase in low lying area. No permanent ponding.	No impact on grazing area.	Yes	Yes	Completed	Ref. 26 10//650914

Remnant Ponding Remediation							
Location	**Description**	**Remediation**	**Remediation Comments**	**Ponding Predicted**	**Subsidence Completed**	**Status**	**Property Ref. Lot & DP**
Longwall 15 (P15)	Alluvial Tall Moist Forest and Redgum Rough-barked Apple Forest.	No remediation required.	No increase to existing ponding evident.	Yes	Yes	Completed	Ref. 67, 69 16//813385 61/755238
Longwall 16 (P16)	Redgum Rough-barked Apple Forest and Coastal Foothill Spotted Gum-Ironbark Forest.	Increase in existing ponded area remediated to pre-mining condition. Minimal impact on flora	Constructed open drain and connected to nearby water course to return existing ponding to pre-mining levels. Quarterly ecology monitoring program completed. 	Yes	Yes	Completed	Ref. 69 61/755238
Longwall 16 (P16A)	Open grassland	Filled and drain installed to restore drainage due to increase in depth and extent of ponding.		Yes	Yes	Completed	Ref.33 861/835160
Longwall 17 (P17)	Freshwater Wetland Complex EEC and Redgum Rough-barked Apple Forest EEC	No remediation required.	Marginal increase in extent and depth of wetland as predicted. No predicted long-term impact on wetland. Wetland 4 & 5 in Wetland Management Plan 	Yes	Yes	Completed Wetland monitoring ongoing	Ref. 68 22/812406

Remnant Ponding Remediation							
Location	**Description**	**Remediation**	**Remediation Comments**	**Ponding Predicted**	**Subsidence Completed**	**Status**	**Property Ref. Lot & DP**
Longwall 17 (P17A)	Open grassland and Redgum Rough-barked Apple Forest EEC	Installed open drain and pipes to reduce slight increase in area and depth of existing ponding.		Yes	Yes	Completed	Ref. 70 54/755238
Longwall 18 (P18)	Freshwater Wetland Complex EEC and Redgum Rough-barked Apple Forest EEC	No remediation required.	Marginal increase in extent and depth of wetland predicted. No predicted long-term impact on wetland. Wetland 4 & 5 in Wetland Management Plan	Yes	Yes	Monitoring	Ref. 68 22/812406
Longwall 18 (P18A)	Open grassland	Filled ponded area to restore pasture.		No	Yes	Completed	Ref. 70 54/755238
Longwall 18 (P18B)	Prickly Ridge Forest Road Hunter Valley Moist Forest Open grassland	Upgraded road and installed additional drainage lines.	Increase in length and depth of ponding along Prickly Ridge Forest Road was remediated and road upgraded as agreed by Forest Corporation NSW. 	Yes	Yes	Completed	Ref. 71, 37 45/1159229 46/755238
Longwall 18 (P18C)	Access road and open grassland	Raise access road, install pipes and regrade existing drain.		Yes	Yes	Completed	Ref. 70 54/755238
Longwall 18 (P18D)	Open grassland	Construct drain from dam overflow to the existing drain and regrade.		Yes	Yes	Completed	Ref. 70 54/755238

Remnant Ponding Remediation							
Location	**Description**	**Remediation**	**Remediation Comments**	**Ponding Predicted**	**Subsidence Completed**	**Status**	**Property Ref. Lot & DP**
Longwall 18 (P18E)	Open grassland	Constructed dam at location of existing ponding site. Overflow constructed with open drain and pipes to creek.		Yes	Yes	Completed	Ref. 70 54/755238
Longwall 18 (P18F)	Open grassland	Filled minor ponding with top soil.		No	Yes	Completed	Ref. 77 1/1063659
Longwall 19 (P19)	Farm dam and open grassland		No ponding or remediation expected with LW18 and LW19 shortened to protect property improvements.	Yes	No	Completed	Ref. 82 1/957458
Longwall 19 (P19A)	Open grassland and access road	Installed drainage to creek and upgraded access road.	Ponding against and along access road was remediated with sub-surface drainage. Upgraded access road. 	No	Yes	Completed	Ref. 82 1/957458
Longwall 19 (P19B)	Open grassland and dam	Increase in existing ponding near dam.	Monitor with potential to fill site if required by landowner.	No	Yes	Monitoring	Ref. 82 1/957458
Longwall 19 (P19C)	Open grassland	Regrade existing drain to remove remnant ponding in paddock.		No	Yes	Completed	Ref. 70 54/755238

Remnant Ponding Remediation							
Location	**Description**	**Remediation**	**Remediation Comments**	**Ponding Predicted**	**Subsidence Completed**	**Status**	**Property Ref. Lot & DP**
Longwall 20 (P20)	Open grassland	Installed four pipes at existing ponding site and minor regrading of existing drainage line. Replace open drain with 350mm diameter pipes.		Yes	Yes	Completed	Ref. 82 1/957458
Longwall 21 (P21)	Open grassland and dam	Proposed drainage works to restore dam catchment.	No indication of ponding between dams following subsidence from LW21 and settlement of LW22. Topography of dam catchment near centre of longwall affected. Proposed construction of open drain to restore catchment planned to commence in April 2018.	Yes	Yes	In progress.	Ref. 74 76/755238
Longwall 22 (P22)	Open grassland near creek		Predicted increase in existing ponding.	Yes	No	Monitoring	Ref. 73 93/755238
Longwall 22 (P22A)	Open grassland		Predicted increase in existing ponding.	Yes	No	Monitoring	Ref. 85 4/957458
Longwall 23 (P23)	Dam		Increase in ponding between dam and raised access road.	Yes	No	Monitoring	Ref. 90 11/869483

6.9 FLOODPATH MONITORING

The condition of floodpaths and stream channels are discussed in the Mandalong Mine "*Floodpath Condition Report 2018*" (Centennial Mandalong, 2018a) in **Appendix 2**. DA97/800 and the LW22-23 Extraction Plan – Water Management Plan requires the condition of major floodpaths be inspected every six months or following a flood event. This Floodpath Condition Report for 2017 has been developed to compile survey and photographic records of subsidence induced changes to Morans Creek and Tobins Creek as per the assessment methodology in **Appendix 2**.

Appendix 2 assesses the changes to the condition of floodpaths along stream reaches undermined by Longwall 21, 22 and 23 in 2017 and previously subsided longwall panels 15 to 20, identifying the effects of subsidence on the floodpaths. The pre-mining condition of the floodpaths above longwall panels 24 and 24A is also documented in this report.

On the basis of the information obtained from field surveys, the pre mining characteristics of Morans Creek and Tobins Creek can be described as having a generally poorly defined channel system, in which creek lines give way to undefined overland flow paths in several areas. The levels of predicted subsidence and associated grade changes along Morans Creek and Tobins Creek over Longwalls 21, 22 and 23 are of a similar order of magnitude to the existing creek bed slopes. The levels of predicted subsidence along Morans Creek and Tobins Creek are relatively small over Longwalls 21, 22 and 23 and it is therefore considered

that these will not significantly alter the flow conveyance capacity of the existing channels. The associated impacts on the maximum flood depths and flood hazards that have been modelled are not considered to be significant.

7 WATER MANAGEMENT

Mandalong Mine holds a water access licence (WAL39767) permitting the extraction of groundwater from the coal measures encountered during the process of mining. This water access licence permits the Mine to dewater the underground coal measures via a submersible dewatering pump located at Cooranbong. The WAL entitles the Mine to extract 1825 ML of groundwater annually for the period 1 July to 30 June from North Coast Fractured and Porous Rock Groundwater Sources. This mine water is subsequently discharged at LDP001.

Mandalong Mine extracted a total volume of 825 ML of ground water during the annual period 1 July 2016 to 30 June 2017. There are no other conditions on the Water Access Licence.

Table 33: Water Take

License #	Water Sharing Plan, source and management zone (as applicable)	Entitlement	Passive take / inflows	Active pumping	TOTAL (1 July to 30 June).
WAL39767	North Coast Fractured and Porous Rock Groundwater Sources	1825 ML	0 ML	825 ML	825 ML

7.1 SURFACE WATER MONITORING

7.1.1 Mandalong & Cooranbong Entry Site

There is an established surface water quality monitoring program for the Mandalong catchment conducted since periodic sampling commenced in 1996, with the program established on a regular frequency since August 1999. Three surface water monitoring points (SW13-15) above licenced discharge points LDP001 and LDP002 at the Cooranbong Entry Site and two monitoring points (SW16-17) in the receiving waters below the LDP's were added in late 2011. The monitoring locations are shown on **Plan MG10722b**, **Plan MG10502**, **Plan MG10722d** and are summarised below in **Table 34**.

7.1.2 Cooranbong Haul Road

The Cooranbong Haul Road crosses three ephemeral creeks in the Lords Creek sub-catchment. Six sediment basins have been constructed along the haul road to contain dirty water runoff. Monitoring of the water quality in the haul road sediment control dams was undertaken in 2017 to assess the effectiveness of water treatment prior to controlled releases.

Table 34: Summary of Monitoring Locations with Respect to Position within the Catchments

Location Reference	Creek Sub-catchment
SW008	Upper Stockton Creek
SW004	Mid Stockton Creek
SW012	Lower Stockton Creek
SW011	Upper Morans Creek
SW003	Mid Morans Creek
SW006	Lower Morans Creek
SW002	At confluence of Morans Creek and Stockton Creek
SW001	Downstream confluence on Stockton Creek
SW009	South Pourmalong Creek
SW010	North Pourmalong Creek
SW018	Mandalong Mine Site
SWMP01	Mannering Creek within Olney State Forest
SWMP02	Mannering Creek at Hue Hue Road
SWMP03	Wyee Creek at Wyee Farms Road
SWMP04	Wyee Creek at Wyee Farms Road Bridge
SWMP05	Wyee Creek at junction of Schofield Road and Manhire Road
SWMP06	Morans Creek at Mandalong Road
SWMP07	Upper catchment of Morans Creek
SW13	Muddy Lake (Unnamed tributary upstream LDP001).
SW14	Muddy Lake (Unnamed tributary upstream LDP002).
SW15	Muddy Lake (Unnamed tributary upstream LDP002).
SW16	Muddy Lake (Unnamed water body 1km downstream Simpson Rd Causeway Crossing)
SW17	Muddy Lake (North Dora Creek Village)

7.1.3 Surface Water Monitoring Results

7.1.3.1 Mandalong & Mandalong South

Surface water quality is monitored at 18 locations on a quarterly basis. These locations encompass four different catchment areas. The water is tested for pH, Total Suspended Solids (TSS) and Electrical Conductivity (EC). The annual and long-term average (LTA) results are summarised in **Table 35**.

Table 35: Average Surface Water Quality for the 12 month Period from January 2017 to December 2017 ('Annual') and the Long-term Average ('LTA').

Site Location	Catchment	pH		TSS		Specific Conductance uS/cm	
		Average	LTA	Average	LTA	Average	LTA
SW008	Stockton	6.8	6.1	12	29.6	558	866.7
SW004		6.7	6.7	17.3	18.5	434	741.8
SW012		6.4	6.1	19	31.5	350	1132
SW018		7.31	7.32	27.5	42.74	647	565.43
SW011	Moran's		6.6		50.4		559.6
SW006		6.6	6.4	15.3	17.5	322.8	307.4
SW003		6.2	6.4	17.5	14.9	400.5	473.8
SWMP06		6.55	6.48	67.25	51.81	765	662.89
SWMP07		5.86	6.74	19	13.96	384.5	542.5
SW002	Stockton and Moran's Creek (Confluence)	7.1	6.9	15	14.3	18917.8	14651.9
SW001		7.1	7.1	20	12	23677.5	29818.4
SW009	Pourmalong	6.6	6.4	15.3	17.5	322.8	307.4
SW010		5.9	6	25.5	31.2	319.5	480
SWMP01	Mannering Creek	6.37	6.75	11.5	15.45	471.5	510.03
SWMP02		6.21	6.58	7	15.91	291.16	473.43
SWMP03	Wyee Creek	6.53	6.64	11	21.57	401.5	406.81
SWMP04		6.74	6.75	21.25	15.78	619.75	662.92
SWMP05		6.61	6.57	57.67	32.77	613.33	534.61
SW013		7.7	6.4	10.5	11.2	4127.5	3212.8

Site Location	Catchment	pH		TSS		Specific Conductance uS/cm	
		Average	LTA	Average	LTA	Average	LTA
SW014	Muddy Lake	6.67	6.94	22.56	15.75	963.45	647.41
SW015		5.52	5.69	113.80	80.41	91.20	85.10
SW016		8.31	8.21	1458.67	209.33	4125.00	3170.78
SW017		8.43	8.24	16.10	324.29	3964.17	3088.59

7.1.3.2 Cooranbong Entry Site

Water quality is monitored daily as per the requirements of EPL 365 at Licenced Discharge Points (LDP) LDP001 and LDP002 located at the Cooranbong Entry Site. The water is tested for pH, Total Suspended Solids (TSS), EC and Oil and Grease (mg/L). The average annual results at LDP001 & LDP002 are summarised in **Table 37** and **Table 39**. Graphs of the LDP001 water quality results for these parameters are provided in **Figure 20**.

Table 36: LDP001 Discharge Volume

Frequency	No. of measurements made	Lowest result (kL)	Mean result (kL)	High result (kL)
Daily during any discharge	308	0	1926	4756

Table 37: Water Quality LDP001

Pollutant	Unit of Measure	No of samples required by licence	No. of samples collected and analysed	Lowest sample value	Mean of samples	Highest sample value
Oil & Grease	milligrams per litre	308	328	0	0.07	6
pH	pH	308	328	7.14	7.85	8.36
Total suspended solids	milligrams per litre	308	328	0	1.47	24

Table 38: Water Quality LDP002

Pollutant	Unit of Measure	No of samples required by licence	No. of samples collected and analysed	Lowest sample value	Mean of samples	Highest sample value
Oil & Grease	milligrams per litre	0	0	0	0	0
pH	pH	0	0	0	0	0
Total suspended solids	milligrams per litre	0	0	0	0	0

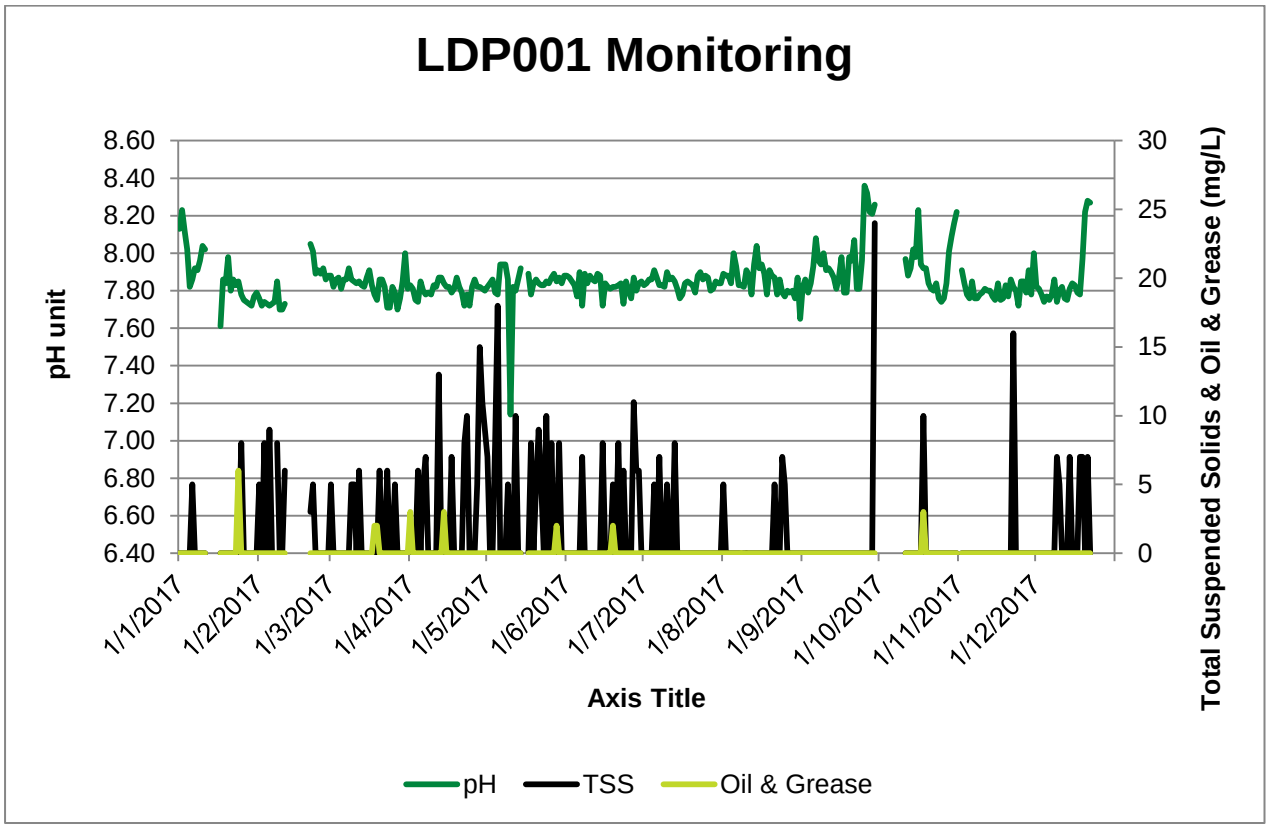


Figure 20: LDP001 Water Quality Monitoring

7.1.4 Data Interpretation

The results presented in **Table 35** are characteristic of the natural conditions of the area, particularly for Stockton, Moran's, Mannering & Wyee Creeks. Both Stockton and Morans Creek are the main drainage systems for the Mandalong area. Stockton Creek is located within the longwall mining area (LW1-16) and Morans Creek is also located within the

current longwall mining area (LW15-24A). Both Mannering and Wyee Creek are located within the Mandalong Southern Extension Area (future longwall mining).

7.1.4.1 Mandalong

Surface waters are tested for pH, Total Suspended Solids (TSS) and Specific Conductance/Electrical Conductivity (EC) and the annual and long-term average (LTA) results are summarised in **Table 35**. The Cooranbong Entry Site monitoring sites SW13, SW14, SW15, SW16 and SW17 were sampled on a monthly basis. The monitoring sites SW001, SW002, SW003, SW004, SW006, SW008, SW009, SW010, SW011, SW012, SW018 were sampled on a quarterly basis during the reporting period. The Mandalong Southern Extension monitoring sites SWMP01, SWMP02, SWMP03, SWMPO04, SWMP05, SWMP06 and SWMP07 were also sampled on a quarterly basis during the reporting period. There were no results recorded for SW011 during the monitoring period due to insufficient water at the monitoring point.

The EC (salt content) for the 2017 period shows a relatively consistent level compared with the long-term average. The average EC recorded for sites SW001, SW003, SW004, SW008, SW010, SW012, SWMP01, SWMP02, SWMP03, SWMP04, and SWMP07 for this period is lower than the long-term average.

The average total suspended solids (TSS) for 2017 are relatively low and are characteristic of natural surface water conditions in creeks. SW016 recorded the highest annual average TSS of 1458.67 mg/L in 2017. The increase in the SW016 annual average is due to a high result in October 2017. All sites, with the exception of SW016, had a 2017 annual average that was similar to the LTA.

At the majority of monitoring points, the results showed a pH annual average similar to the long-term average. SW15 had the lowest pH average of 5.52 in 2017. The highest pH average recorded during 2017 was 8.43 recorded at SW017.

7.1.4.2 Cooranbong Entry Site

Plan MG10722b shows the location of the discharge monitoring points LDP001 and LDP002. The water quality results for LDP001 (**Table 37**) show the 2017 annual average for pH, TSS and Oil & Greases is similar to the long term average. The pH annual average of 7.85 is similar to the long term average of 7.88. The TSS annual average of 1.47 mg/L is less than the long term average of 1.63 mg/L. The oils and grease annual average of 0.07 mg/L is less than the long term average of 0.12 mg/L. There was no discharge from LDP002 during the 2017 report period.

EPL 365 permits the Mandalong Mine to discharge a maximum of 5 ML/day from LDP001 and allows for exceedance of this limit if the discharge occurs solely as a result of rainfall exceeding 10 mm during the 24 hours immediately prior to the commencement of discharge. The average daily discharge volume of 1.926 ML and highest daily discharge volume of 4.756 ML was recorded at LDP001 in 2017.

7.1.4.3 Cooranbong Haul Road

Monitoring for the surface water in the six sediment control dams on the haul road was conducted to determine compliance with the EPA licence limits prior to discharge. Prior to discharge the sediment control dams were treated by adding a flocculent to the water to remove suspended solids. Prior to discharge water quality in the haul road sediment control dams is required to meet the water quality discharge criteria detailed in the EPL and the Cooranbong Haul Road Surface Water Management Plan.

7.2 WATER BUDGET

The 2017 water balance analysis was prepared by GHD (2018a) in the report titled *"Mandalong Mine 2017 Water Balance"*. The water balance for 2017 is shown in **Table 39.** In accordance with DA97/800 condition 105 (vi) the quantity of water used from water storages and details of water discharges from the Mine are discussed below.

7.2.1 Water Supply, Use & Discharge

The Mandalong Mine is connected to town water and sewer. Potable water for underground use is currently supplied by Hunter Water Corporation (HWC) via a pipeline to the Cooranbong Entry Site and to the Mandalong Mine. Potable quality water is used underground in mining equipment as; uncontaminated water is required for cooling systems on drive motors, in dust suppression sprays on miners and transfer points. The total potable water used in 2017 was 486.6 ML. A total of 443.2 ML was supplied via the Cooranbong Entry Site and Mandalong Mine Site to underground equipment. A total of 21.1 ML was used on the surface within the Cooranbong CHP and bathhouse, 11.6 ML in the Mandalong Mine bathhouse and 10.7 ML at the Delta Entry Site.

The total potable water usage (486.6 ML) for 2017 is slightly above the water usage in 2016 (483.2 ML). Potable water was primarily supplied to the longwall and underground equipment (longwall, continuous miners and conveyors) for coolant on motor transmissions and dust suppression.

GHD's (2018a) water balance model indicates 740 ML was discharged in 2017 from the Mandalong Mine, Cooranbong Entry Site and the Delta Entry Site. This consisted of 8.1 ML from the Mandalong Mine Sediment Control Dam. A total of 710.9 ML was discharged from the Cooranbong Entry Site, with 702.8ML from LDP001, nil from LDP002 (5 ML Dam) and 8.1 ML from the Construction Dam (clean water dam). 21.0 ML of surface water run off water was discharged from Delta Entry Site dams.

Table 39: 2017 Summary of Water Inputs and Outputs

Element	Transfer in 2017 (ML/year)
INPUTS	
Direct rainfall and runoff	120.0
Potable water supply	486.6
Groundwater inflows	327.6
TOTAL INPUTS (rounded)	**934**
OUTPUTS	
Evaporation	24.4
Spray irrigation	16.9

Element	Transfer in 2017 (ML/year)
Sewage to HWC	13.2
Discharge from Mandalong Mine Access Site	8.1
Discharge through LDP001 (Cooranbong Entry Site)	702.8
Discharge through LDP002 (Cooranbong Entry Site)	0.0
Discharge from Construction Dam (Cooranbong Entry Site)	8.1
Discharge from Delta Entry Site	21.0
Extracted ROM coal moisture	163.3
TOTAL OUTPUTS (rounded)	**958**
CHANGE IN STORAGE	
Cooranbong Underground Storage	-24.0
Surface water storages	0.0
TOTAL CHANGE IN STORAGE (rounded)	-24.0
BALANCE	
Inputs – outputs – change in storage	0.0

7.2.1.1 Mandalong Mine

Managing runoff from rainfall events is the only surface water management required at the Mandalong Mine Pit-Top. Clean water is diverted around the western area of the site. A dam has been constructed to capture this water. Clean water runoff from Mandalong Road, the M1 Motorway on-ramps and the car park has been diverted around the eastern perimeter of the site.

Water from all other areas of the surface is considered ‘dirty’ and is directed to sediment control systems. Surface and subsurface drainage directs dirty water to the sediment control system. This system comprises of a gross pollutant trap (GPT), a sediment control dam and a polishing lagoon. Water from the sediment control dam is used for irrigation of surrounding grassed areas as required. An oil water separator at the GPT removes hydrocarbons from potentially contaminated runoff from the refuelling bay, oil store, workshop, washdown bay and equipment yard.

7.2.1.2 Cooranbong Entry Site

Water from the hardstand area is directed to the 5 ML dam for treatment before discharge by an overflow culvert at LDP002. A dewatering pump installed in the 5 ML Dam allows low water levels in the dam to be maintained. Contaminated water from the workshop, equipment storage and washdown bay areas drain to an oil water separator used to remove hydrocarbons from waste water.

Dirty water contaminated with coal fines from the CHP, conveyor gantries and ROM stockpile is directed to dedicated sediment control sumps to remove course fines material. Dirty water is then directed to the large GPT for further settlement of fines. Treated water from the GPT is then pumped to Sediment Dam 1 or directly underground. Sediment Dams 1 and 2 have a capacity of 7.6 ML.

A sediment control dam (ROM Stockpile Dam) and GPT were constructed in 2010 to capture and treat contaminated surface water runoff from the 100 000 T ROM coal stockpile. Sediment is captured in the ROM Stockpile Dam prior to flowing via pipeline into Sediment Dam 1 (via the Export Bin Sump).

7.2.1.3 Delta Entry Site

Clean and dirty water systems have been constructed at the Delta Entry Site. Site runoff also utilises the existing stormwater infrastructure at the Wyee Coal Unloader, which includes clean water diversion drainage and two large dirty water settling ponds (9ML capacity) sufficient to treat contaminated water prior to discharge.

Another settling pond was constructed down slope of the decline portal for the pre-treatment of dirty water from the Delta Site. Sediment in runoff is settled out via the Final Sediment Sump and the decline settling pond prior to discharge into the large 9 ML settlings ponds.

7.2.1.4 Cooranbong Haul Road

Clean and dirty water are separated along the haul road. Clean water is diverted by drains away from the haul road. Dirty water from the haul road and batters, is captured and treated within six sediment basins constructed along the haul road. Dirty water contained within the sediment basins is required to meet specific water quality criteria prior to discharge.

7.2.2 Mine Water Management

7.2.2.1 Mandalong Mine

Water from the active underground mining area is pumped to a temporary settling area to reduce suspended solids. All water is then pumped to a goaf (Cooranbong underground longwall void) area in the north-west of the Cooranbong Entry Site. This void area has a significant storage capacity, and also acts as a primary settlement area for the removal of suspended solids. Dirty water from the Cooranbong Sediment Dams is also pumped or decanted via the existing infrastructure to the Cooranbong void to maintain low water levels in the surface dams.

Water in the Cooranbong void is then pumped to the surface through a borehole pump and overland to the Borehole Dam at the Cooranbong Entry Site. Water discharges via a surface pipeline directly to LDP001.

7.2.2.2 Delta Site

No mine water is discharged from the Delta Entry Site, as inseam water from the Delta underground headings and decline tunnel is pumped to the existing Mandalong Mine water system.

7.3 GROUNDWATER MANAGEMENT

7.3.1.1 Mandalong Mine

An annual review of the groundwater monitoring results was undertaken by GHD tilted *"Centennial Mandalong Annual Groundwater Monitoring Review"* (GHD, 2018b). An extensive groundwater monitoring network has been developed at Mandalong Mine with monitoring undertaken on many of the bores since August 1997. This program has been established to provide timely warnings of deviations from natural or background levels, so that if necessary, remedial measures and/or management strategies can be put in place.

The network consists of standpipe monitoring bores installed in alluvial and fractured rock groundwater sources. Locations were monitored monthly for groundwater level and limited water quality parameters (electrical conductivity and pH).

Monitoring data for Mandalong South presented herein is limited to MSGW04 series, given their proximity to current mining of Longwalls 24 and 24A. Two private bores, GW105311 and GW078043, were identified within 1 km of Longwalls 24 and 24A. On inspection, GW105311 was found to be blocked at 12.6 m below top of casing. GW078043 has been incorporated within the monitoring program since July 2017 (GHD, 2018b).

Details of the groundwater monitoring bores in the current groundwater monitoring program are summarised in **Table 40.** The location of the groundwater monitoring bores is shown in **Figure 21**.

Table 40: Groundwater Monitoring Bore Details

Bore	Monitoring Period	Lithology	Longwall Area
BH01	Aug 1997 – present	Alluvium	–
BH02A	Oct 2005 – present	Sandstone	LW3
BH03	Aug 1997 – present	Alluvium	–
BH03A	Nov 2005 – present	Alluvium	–
BH03B	Dec 2005 – present	Sandstone	–
BH04	Aug 1997 – present	Alluvium	–
BH05	Aug 1997 – present	Alluvium	–
BH06A	Nov 2005 – present	Sandstone	LW7

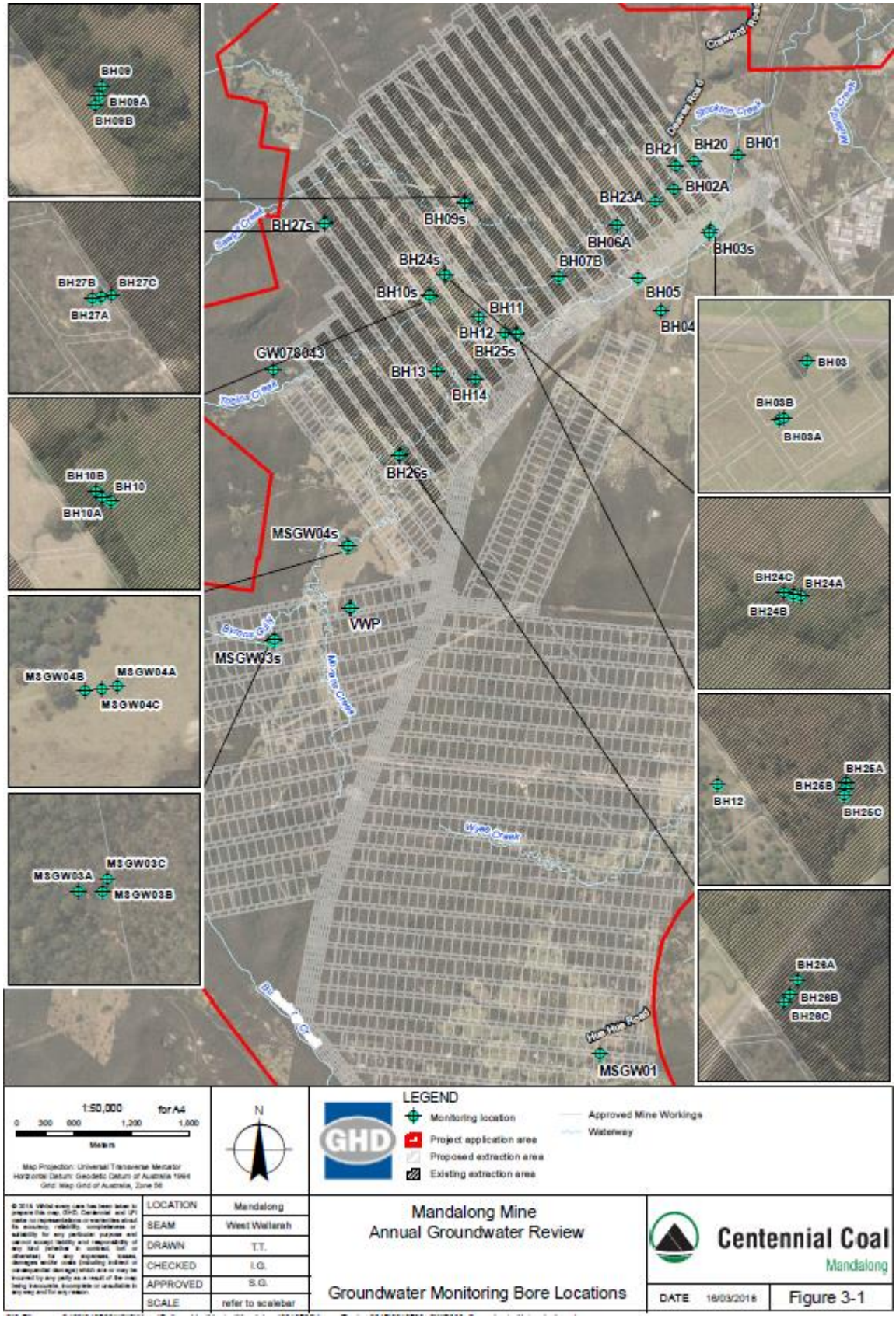
Bore	Monitoring Period	Lithology	Longwall Area
BH07B	Jan 2006 – present	Siltstone	LW10/11
BH09	Aug 1997 – present	Alluvium	LW12
BH09A	Jun 2010 – present	Mudstone/sandstone	LW12
BH09B	July 2010 – present	Mudstone/sandstone	LW12
BH10	Aug 1997 – present	Alluvium	LW16
BH10A	Jun 2010 – present	Mudstone/sandstone	LW16
BH10B	Jun 2010 – present	Sandstone	LW16
BH11	Aug 1997 – present	Alluvium	LW15
BH12	Aug 1997 – present	Alluvium	LW14/15
BH13	Aug 1997 – present	Alluvium	LW18
BH14	Aug 1997 – present	Alluvium	LW17
BH20	Dec 2003 – present	Conglomerate	LW1
BH21	Dec 2003 –present	Conglomerate	LW2
BH23A	Jan 2006 – present	Mudstone	LW4/5
BH24A	Jun 2010 – present	Alluvium	LW15
BH24B	Jun 2010 – present	Sandstone	LW15
BH24C	Jun 2010 – present	Mudstone/sandstone	LW15
BH25A	Jun 2010 – present	Alluvium	LW14
BH25B	Jun 2010 – present	Sandstone	LW14
BH25C	Jun 2010 – present	Mudstone/sandstone	LW14
BH26A	Oct 2011 – present	Alluvium	LW22

Bore	Monitoring Period	Lithology	Longwall Area
BH26B	Oct 2011 – present	Sandstone	LW22
BH26C	Oct 2011 – present (blocked at 35 m at Jan 2018)	Conglomerate	LW22
BH27A	Oct 2011 – present	Alluvium	LW18/19
BH27B	Oct 2011 – present	Sandstone	LW18/19
BH27C	Oct 2011 – present	Conglomerate	LW18/19
MSGW04A	Sept 2011 – present	Morans Creek alluvium	-
MSGW04B	Sept 2011 - present	Sandstone (Tuggerah)	-
MSGW04C	Sept 2011 – present	Conglomerate (Munmorah)	-
GW078043	August 2017 – present	Sandstone/Conglomerate	-

Source: (GHD, 2018b)

7.3.1.2 Delta Entry Site

Groundwater monitoring at the Delta site was finalised at the completion of construction in December 2005. No groundwater is discharged at the Delta site. The Delta underground workings are limited to two Maingate roadways therefore, inseam groundwater make is minimal and is pumped via the existing inseam dewatering system to the Cooranbong longwall void area and discharged via LDP001 at the Cooranbong Entry Site.



Source: (GHD, 2018b)

Figure 21: Mandalong Mine Groundwater Monitoring Locations.

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7.3.2 Groundwater Levels

7.3.2.1 Alluvial Groundwater Sources

Groundwater levels fell after undermining at BH24A from approximately 16.8 m AHD in January 2014 to 14.8 m AHD in August 2014. Analysis of post-August 2014 indicates that the increasing trend in groundwater levels is independent of rainfall (GHD, 2018b).

The decreasing trend in groundwater level at BH25A is not completely attributable to mining. Post-mining groundwater levels have generally been within the observed range of pre-mining levels and continued to respond to Cumulative Rainfall Departure (CRD) (GHD, 2018b). The variation in groundwater levels at BH25A is assumed to be a result of the development of shallow tensile and compressive cracks resulting in localised increases in hydraulic conductivity and porosity. GHD (2018b) expected that such voids will fill over time and the hydraulic conductivity and porosity should return to pre-mining values. Supporting evidence has been observed at BH22A, and now also in the rising levels at BH24A (GHD, 2018b).

The low predictive capacity of rainfall at BH27A is attributed to too few observed water level records (limited to four within 2012 only). The bore has been dry post 2012 (GHD, 2018b).

Alluvial groundwater levels have generally fluctuated over time within a range of 2 m to 3 m below ground level. A statistically significant relationship exists between alluvial groundwater levels and rainfall at most monitoring locations. No long term changes in alluvial groundwater levels attributable to mining at Mandalong are evident. Short term reductions in groundwater level are evident at a few locations in recent years, however recovery in levels have been observed (GHD, 2018b).

7.3.2.2 Fractured and porous rock aquifers

All deeper monitoring bores, with the exception of MSGW04B and MSGW04C, have been directly undermined by longwall panels. These bores are screened within Triassic sandstone and conglomerate.

Monitoring bores BH02A, BH03B, BH06A, BH07B, BH09A, BH09B, BH10A, BH10B, BH23A, BH24B, BH24C, BH25B, BH25C and BH27B are screened within the sandstone and siltstone of the Tuggerah Formation approximately 120 m to 230 m above the coal seam. A consistent drop in groundwater pressure at most of these locations (with the exception of BH07B and BH27B), has been observed post undermining. The gradual drop in groundwater pressure suggests that discontinuous fractures have developed in the rock overlying the mine workings at these locations (GHD, 2018b).

A number of these locations (including BH02A, BH03B, BH07B, BH09A, BH09B and BH23A) have had levels re-stabilise to between 2 m AHD and -12 m AHD or have shown slight increases towards pre-mining levels three to five years post-undermining.

Monitoring bores BH20, BH21 and BH27C are screened within the Munmorah Conglomerate, underlying the sandstone of the Tuggerah Formation. All have recorded decreasing groundwater elevations over the monitoring period. Groundwater elevations at BH20 and BH21 initially dropped suddenly and have fluctuated between approximately -40 m AHD and - 50 m AHD since. Groundwater levels at BH27C showed a decreasing pre-mining trend including a sudden drop in levels in November 2014 related to purging and sampling. BH27C was undermined in July 2015, resulting in the bore becoming dry. Continued monitoring at this location has been prevented due to shortening of the bore (originally 165 m BGL, now registering a depth of 125 m BGL). Most likely post-mining movement of the strata has caused damage to the bore. Movement of strata may explain the temporary increase in groundwater level at adjacent bore BH27B following undermining. The

sources monitored by these bores are approximately 100 m to 170 m above the coal seam (GHD, 2018b).

7.3.3 Groundwater Quality

7.3.3.1 Alluvial Groundwater Sources

The GHD (2018b) review of alluvial groundwater quality indicates that at most alluvial bores the groundwater pH is consistently within the range of 5 to 8 and groundwater EC varies considerably within the alluvium across the mining area, ranging from less than 1,000 µS/cm to over 10,000 µS/cm.

As discussed by AGE (2014), there is variability in groundwater EC at a number of alluvial monitoring bores at Mandalong Mine. As part of the Mandalong Mine Southern Extension Project response to submissions process it was identified that this variability in EC was attributable to sampling of bores by bailing without initial purging and surface water ingress (BH05 and BH13). Since January 2015, alluvial monitoring bores at Mandalong Mine have been sampled by low flow techniques where possible (i.e. peristaltic pump) with purging continuing until pH and EC parameters show stabilisation. Following the update of the groundwater monitoring methodology, variability in observed EC within individual location datasets has generally reduced. However, salinity between locations continues to range fresh to saline (GHD, 2018b).

Notable water quality trends for 2017 include:

- Elevated EC at BH03, BH12 and BH25A
- Rising EC at BH10
- Continued decreasing pH at BH03, BH12, BH25A and BH26A.

7.3.3.2 Fractured and porous rock groundwater sources

Rock aquifer groundwater is generally characterised by a pH range of 7 to 8 and an EC range of 6,000 to 10,000 µS/cm. The EC range was notably broader at locations BH03B, BH06A, BH07B, BH20 and BH21 during 2017. In addition to the high degree of temporal variability considerable spatial variability is also evident (GHD, 2018b). Post-review of 2017 results and historical trends, the following are of note:

- An overall decreasing pH trend at BH07B, EC has slightly increased at this location since 2013;
- An increasing EC trend at BH10A;
- High variability in both pH and EC at BH20 with seemingly increasing trends; and
- Increasing pH at BH21 and increasing variability in EC.

Monitoring locations BH20 and BH21 are bailed on account of insufficient well volumes to allow other sampling methods. Water volumes are less than one bail, no purging is undertaken given the low recharge rates and therefore the samples are not considered representative of the aquifer (GHD, 2018b).

pH and EC are variable temporally and spatially within alluvial and rock aquifers. Elevated pH levels were identified as isolated occurrences in 2017 at MSGW04B. However, it is noted mining has not occurred proximal (within 1 km) to MSGW04B and therefore this trend is not considered to be the result of extraction (GHD, 2018b).

Increasing EC levels in BH26A and BH26B are considered to be associated with drying (climate and groundwater) conditions (GHD, 2018b).

8 REHABILITATION

A new Rehabilitation Management Plan / Mining Operations Plan (MOP) was prepared in 2016 for the period 1 December 2016 to 30 November 2023 in accordance with SSD-5144 Schedule 3 Condition 33. The MOP was approved by DRG on 29 November 2016 and by DPE on 2 February 2017.

A MOP amendment (Amendment A) was prepared following the approval a modification (MOD 4) to SSD-5144 in 2017. The MOP Amendment A was approved by DRG on 12 April 2017 and by DPE on 23 June 2017.

As described in the MOP, the conceptual long term mine rehabilitation objective is to provide a low maintenance, geotechnically stable and safe landform. Specific conceptual long-term objectives include:

- Prevent public access to former underground workings;
- Re-establishing land disturbed by the operations of Centennial Mandalong to an appropriate final land use;
- Provide habitat for fauna and corridors for fauna movement within the final landform;
- Monitor rehabilitation success in terms of physical and biological parameters;
- Relinquishment of the surface leases as rehabilitation objectives are achieved; and
- Compliance with appropriate Centennial and regulatory policies and guidelines.

Post mining land use options for the Mandalong Mine (MMAS and MSSS) were assessed in the *Mandalong Southern Extension Project Decommissioning and Rehabilitation Strategy* (SLR, 2013) which was prepared for the Mandalong Southern Extension Project EIS. Post mining land use options for the CES were assessed in the *Northern Coal Logistics Project Decommissioning and Rehabilitation* (SLR, 2014) which was prepared for the Northern Coal Logistics Project EIS.

It is intended to re-develop the Mandalong Mine Access Site and the Cooranbong Entry Site for an industrial based land use(s). The option of leaving this infrastructure in the final landform will be discussed in consultation with DRE and after discussions with potential buyers have been held.

The intended post-mining land use for the MSSS is native bushland commensurate with the pre-mining conditions.

Post-mining land use for the Delta Entry Site will be addressed in consultation with Delta Electricity with the intended post-mining land use being native bushland commensurate with the pre-mining conditions.

As Mandalong is an underground mine, the majority of the MOP Area will not be disturbed. The exception to this might be areas impacted by subsidence which will be addressed and managed on an ongoing basis through the approved SMP or Extraction Plan. As there will be limited disturbance, the pre-mining land use(s) will not be significantly impacted and therefore the post-mining land use(s) will be consistent with pre-mining conditions.

Table 41: Rehabilitation and Disturbance Rates during the MOP Term

Year	Total Disturbance Area (ha)	Total Rehabilitation Area (ha)	Cumulative Rehabilitation Area (ha)
Start of MOP*	33.4	2.7	200.9
2017	13.2	0	200.9
2018	6.8	0	200.9
2019	0	0	200.9
2020	0	0	200.9
2021	0	0	200.9
2022	0	0	200.9
2023	0	0	200.9
End of MOP*	53.4	2.7	200.9

Note: Start of MOP is 1 December 2016 and end of MOP is 30 November 2023. Cumulative rehabilitation area includes the Biodiversity Offset Area to the north and east of the Mandalong Mine Access Site ventilation and gas management facilities and the MSSS and TL24 offset areas.

8.1 PROGRESSIVE REHABILITATION AND COMPLETION

Since the Mandalong Mine is an underground mine, the relatively small disturbance footprint associated with surface infrastructure means that there are limited opportunities for progressive rehabilitation. To what extent is appropriate, rehabilitation will be undertaken progressively on areas that cease to be used for mining or mining related activities as soon as is reasonably practicable.

Rehabilitation activities forecast for the current MOP term (2016-2023) include:

- Rehabilitation of areas disturbed during the construction of the MSSS and access road;
- Progressive rehabilitation of exploration and/or groundwater monitoring sites;
- Rehabilitation of areas affected by subsidence, as required, in accordance with an approved SMP or Extraction Plan;
- Maintenance and monitoring of the VAM-RAB offset area which was established in 2012 at the Mandalong Mine;
- Maintenance and monitoring of the MSSS and TL24 offset areas; and
- Maintenance and monitoring of areas of existing rehabilitation.

Following the construction of the relocated TL24 transmission line and demolition of the redundant section, disturbance around the new and redundant tower sites and any temporary access tracks established to the redundant tower sites will be rehabilitated in accordance with TransGrid's rehabilitation objectives and in consultation with landholders. The new towers, easement and access tracks will remain in place to allow TransGrid to operate and maintain the transmission line.

TransGrid will be responsible for extinguishing the redundant easement in consultation with relevant stakeholders.

8.2 MANDALONG MINE REHABILITATION

The majority of Mandalong Mine Access Site has been rehabilitated following the completion of construction activities in 2005. Rehabilitated sections of the Mine's surface area are well established and have provided vegetation cover to effectively minimise the potential for erosion.

Centennial Mandalong received approval in 2011 (DA97/800 Modification 7) for the trial installation of a ventilation air methane regenerative afterburner unit (VAM-RAB) that would remove and breakdown the exhaust methane. Installation of the VAM-RAB unit in 2012 necessitated clearing of some native vegetation. Two endangered ecological communities (EEC) listed in Schedule 3 of the NSW Threatened Species Conservation Act 1995 were included in the areas to be cleared. These were: Swamp Sclerophyll Forest (SSF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; and River-Flat Eucalypt Forest (RFEF) on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

DA97/800 Condition 76A included a requirement for a 1.25 hectare rehabilitation off-set area to be established on cleared land adjoining the VAM-RAB construction site. These EEC were represented by communities described in the regional vegetation mapping and classification (NPWS 2000) as: MU37 Swamp Mahogany Paperbark Forest (SSF); and MU38 Redgum – Rough-barked Apple Swamp Forest (RFEF).

An ecology survey (Hunter Eco, 2011) prepared for the VAM-RAB project application described the area to be rehabilitated as mostly dominated by weeds. This being the case, active regeneration was required and this was commenced in January 2012. Further to the requirement to rehabilitate, DA97/800 Condition 76A also requires that the progress of the rehabilitation be monitored annually for five years. This monitoring was conducted by Hunter Eco in November 2017 and is described in **Section 6.4.4** of the Annual Review.

8.2.1 Longwall Mining Area

The surface areas above the completed longwall mining panels are inspected as per the schedules prescribed in the approved Environmental Monitoring Plan (EMP) for LW18-21 and the Subsidence Monitoring Program and the LW22-23 Extraction Plan Water Management Plan (WMP). The LW18-21 EMP and the LW22-23 Extraction Plan WMP require that the floodpaths are to be inspected every six months or after a flood event (refer to **Appendix 2**) and the SMP requires surface inspections during surveying of monitoring lines. During the course of these inspections observations are made on the progress of remedial measures implemented to minimise subsidence related effects (refer **Table 32**).

An update on ponding remediation completed in 2017 is provided in **Table 32**.

8.2.2 Exploration Sites

Four surface exploration drill sites were prepared in 2017. The sites were located on private property and within the Olney State Forest and were rehabilitated following the sealing of the borehole. Existing tracks were utilised to gain access to the exploration drill site where possible and required no vegetation clearing. The sites were seeded with sterile grass species to stabilise the drill site following the re-instatement of the land surface. Landholder sign-off was received for rehabilitated sites on private property.

Ongoing rehabilitation of exploration sites will be conducted in 2018 and reported in the Annual Review.

8.2.3 Delta Entry Site

Construction of the Delta coal clearance system was largely completed in 2005 and rehabilitation of the site was completed in 2006. Rehabilitation at the Delta Entry Site was inspected in 2017 to assess the effectiveness of the works to stabilise disturbed

areas onsite. The direct seeding rehabilitation methods used have been successful in establishing a substantial area of the site with pasture and tree groundcover. Ground cover on the direct tree seeded areas is approximately ninety percent similar to those recorded in 2017. Ninety-five percent ground cover has been achieved in rehabilitated pasture seeded areas. The area is slashed to maintain access to infrastructure and as part of the asset protection zone.

8.2.4 Cooranbong Entry Site

A total of 3.9 hectares have been disturbed from the construction of the upgrades to the CHP and haul road at the Cooranbong Entry Site in 2009. Construction activities were completed in May 2010 with all disturbed areas rehabilitated by the Contractor shortly after. No further rehabilitation works were undertaken in 2017.

8.2.5 Cooranbong Haul Road

The haul road construction resulted in approximately 18 hectares of disturbance. Of this 3.9 hectares of disturbed land associated with the CHP upgrades (stockpile and conveyor) and haul road are located on Mandalong Mine's Mining Lease. 1.25 hectares of disturbed area not occupied with haul road and CHP infrastructure was rehabilitated in 2010. The remaining areas are located on the Newstan Colliery Mining Lease CCL764. Of this, nine hectares along the haul road was rehabilitated in 2009. Six hectares of land will not be rehabilitated as it is occupied by the haul road infrastructure.

As per the requirement of the Mandalong Haul Road Landscape and Rehabilitation Plan, the Mandalong Environment & Community Coordinator audited the rehabilitation on the haul road in October 2017. The audit assessment required the following issues be addressed: -

- An *assessment of surface and slope stability.*
- *Properties of the soil or root zone media (such as chemistry, fertility and water relations).*
- *Plant community structural attributes (such as cover, woody species, density and height).*
- *Plant community composition (such as presence of desirable species, weeds).*
- *Selected indicators of ecosystem functioning analysis (such as soil microbial biomass).*

The 2017 audit focused on identifying sites where remedial action or maintenance is required to bring sites to an acceptable standard. The inspection strategy involved one person inspecting the full length of the Haul Road to access 100% of the disturbed area.

In total seven sites were inspected and recorded an action priority from highest to lowest. The highest priorities included maintenance of sediment and erosion controls along the Haul Road drains and at the dam inlets.

The audit provides a useful assessment of baseline rehabilitation completed to date on the haul road following the completion of all construction activities in 2011. In general rehabilitated sections of the haul road are well established and continued growth occurred in 2017. Maintenance and effectiveness of the haul road rehabilitation will be assessed in 2018 and reported in the next Annual Review.

8.3 BUILDINGS

8.3.1 Mandalong Mine

No buildings or infrastructure were removed or decommissioned in 2017.

8.3.2 Delta Entry Site

All buildings at the Delta Entry Site are associated with the coal conveying system and as such are a permanent fixture. The buildings associated with the construction of the site were decommissioned and removed prior to the site being rehabilitated in 2006. No decommissioning of buildings occurred at the Delta Entry Site in 2017 and as such no rehabilitation of buildings was undertaken.

New portable buildings were installed in 2017 at the Delta Entry Site which included office and lunchroom facilities.

8.3.3 Cooranbong Entry Site

To ensure continuation of coal handling operations and mine support infrastructure, surface buildings and mine related infrastructure have been retained at the Cooranbong Entry Site. The Cooranbong Entry Site, CHP and supporting infrastructure were used in 2017 to supply coal to the Eraring Power Station and to Newstan.

No buildings or infrastructure at the Cooranbong Entry Site were removed or decommissioned in 2017.

8.4 REHABILITATION TRIALS AND RESEARCH

8.4.1 Use of Analogue Sites

Data from analogue rehabilitation sites is an integral part of the monitoring procedure throughout the monitoring process. The purpose of analogue sites is to provide a reference against which to document the progress of rehabilitation towards reaching ecosystem health, structure and composition consistent with undisturbed areas.

During the MOP term (2016 - 2023) in 2020, Centennial Mandalong will engage a suitably qualified person to select and monitor analogue sites to assess whether they are suitable in the context of the proposed final land use and to suggest the species that will be appropriate for revegetation.

Analogue sites are proposed with undisturbed areas in the vicinity of the proposed Mandalong South Surface Site (MSSS) and the Delta Entry Site corresponding with the intended post mining land use of native bushland, commensurate with pre-mining conditions.

The majority of the Mandalong Mine Access Site and the Cooranbong Entry Site are proposed to be retained as infrastructure and therefore no reference monitoring in the vicinity is deemed necessary.

Specific analogue sites will be selected based on the following general criteria:

- Contain vegetation types similar to the rehabilitation sites;
- Secure from future mining related disturbance; and
- Contain vegetation and conditions suitable as a basis for rehabilitation performance criteria.

The monitoring results from analogue sites will provide the basis for comparison to measure the success of the rehabilitation against the relevant closure criteria. Results of analogue site monitoring will be reported in future Annual Reviews.

8.4.2 Mandalong Mine VAM-RAB Offset Area

Refer to **Section 6.4.4** of the Annual Review for details on the Mandalong Mine VAM-RAB Offset Area.

8.4.3 Land Management Strategy for the MSSS and TL24 Offset Areas

Refer to **Section 6.4.2** of the Annual Review for details on the Mandalong Mine Land Management Strategy for the MSSS and TL24 Offset Areas.

8.4.4 Moran's Creek Rehabilitation Trial

During consultation with local landowners, concerns were raised regarding historical land management practices which have resulted in extensive clearing of native vegetation and severe erosion of creek banks and drainage lines across the Mandalong Valley. The Moran's Creek rehabilitation trial was initiated in 2007 to respond to local landowner concerns in particular the historical erosion on Morans Creek caused by flood flows and stock accessing creek areas. Local landowner's sited evidence that excavation of the creek in the 1950's caused the creek to widen as a result of the creek banks eroding.

In November 2007 a trial commenced to rehabilitate a section of Morans Creek on a Centennial owned property. The objective of the trial is to assess the effectiveness of direct seeding and tube stock planting to re-establish a native vegetation community on a degraded section of Moran's Creek.

Direct seeding of the trial area commenced in January 2008 with annual inspections since 2011 concluding that the direct seeding method has been successful in establishing tree cover over the majority of the area. Juvenile species including *Eucalyptus tereticornis*, *E. robusta* and *Casuarina glauca* have successfully established on the trial area. The trial direct seeding area has been largely successful in re-establishing the native vegetation found along Morans Creek. Further weed spraying was conducted in 2016 to control Tobacco weed (*Elephantopus mollis*), Scotch Thistle (*Onopordum acanthium*) and Blackberry (*Rubus fruticosus*).

The 2,000 tube stock planted in November 2008 along the fenced Morans Creek rehabilitation corridor are now established along Moran's Creek with trees heights of up to 4 to 5 m. The rehabilitation site is a reference site for the Catchment Management Authority (CMA) vegetation monitoring report. The monitoring has recorded the baseline vegetation conditions and will evaluate the rehabilitation measures implemented at Moran's Creek.

A Macquarie University Research Project was completed in November 2013 titled "*How has the Water Quality of Morans Creek Changed Since Rehabilitation*?" A variety of methods were employed in order to answer the questions regarding the health of Morans Creek, including water quality sampling and counting of macroinvertebrates. The study concluded that:

- Riparian vegetation and bank stability had increased at the rehabilitation site; and
- Banks remain unstable and riparian zones small if they exist at all within the fences area beyond the rehabilitation site.

9 COMMUNITY CONSULTATION

Mandalong Mine consults with the community through forums such as, the Mandalong Mine Community Consultative Committee and community organised events.

Meetings of the Mandalong Mine Community Consultative Committee (CCC) were held in February, June and October 2017. Representatives of the Mandalong community, a Dora Creek community representative, appointed community representatives; relevant government organisations and company representatives attended the meetings. A detailed presentation was provided to attendees at each CCC meeting on the Mine's production, geological update, subsidence results, environmental monitoring, Extraction Plan update and sponsorship.

Additional agenda items discussed in 2017 included the Rehabilitation Management Plan, Mandalong South Extension Project, MSSS construction and traffic management, TL24 Relocation Project, Ausgrid 33Kv Extension Project, LW22-23 Extension (MOD 4), LW24-24A Extension (MOD 5), the Cooranbong Modification (SSD-5145 MOD 1), Delta Modification (DA 35-2-2004 MOD 1) the Mine's exploration drilling program and Centennial's land management programs.

9.1 SMP & EXTRACTION PLAN CONSULTATION

Extensive community consultation with landowners in the Mandalong mining area is undertaken for the purpose of monitoring and assessing subsidence effects on private properties. In general, the Mandalong Mine community consultation has included:

- Community consultation in line with the Stakeholder Engagement Strategy;
- Individual landowner notification and consultation associated with the development of Extraction Plan LW22-23, Extraction Plan LW24-24A and their associated PSMP's;
- Consultation and general communication with all relevant government agencies and infrastructure owners during the development of the Extraction Plan LW22-23 and Extraction Plan LW24-24A;
- Individual landowner consultation and implementation of PSMPs during mining of Longwalls 21, 22 and 23;
- Individual landowner consultation for rehabilitation of remnant ponding and subsidence related repairs to property;
- Three meetings of the Mandalong Mine Community Consultative Committee (MMCCC) chaired by Margaret MacDonald-Hill delivered updates on the status of Development Consent modifications, Extraction Plan approvals, Mining Operations Plan, subsidence monitoring and subsidence management on Centennial property, private property and public infrastructure.
- The MMCCC attended a site inspection of the Mandalong South Surface Site during construction;
- Ongoing consultation with relevant stakeholders on the development and implementation of Infrastructure Management Plans including Public Roads (LMCC), powerlines (Ausgrid), communication lines (Telstra) and high voltage transmission lines (TransGrid);
- One month mining notifications were provided to landowners prior to mining beneath their property, with follow-up meetings and inspections undertaken;
- Fortnightly Subsidence Management Status Reports prepared during extraction of Longwall 21 (13 reports); and

- A Six-monthly Report was prepared and provided to DRE, DPE, CCC and stakeholders in October 2017 as required by the Extraction Plan LW22-23.

9.2 COMMUNITY SPONSORSHIP

The Mandalong Mine continues to support the local community through various sponsorship avenues to the following community activities, groups and associations in 2017 –

- Sponsorship of Morisset Agricultural Society Show held in February 2017;
- Supported Eastlakes NAIDOC Day in July 2017;
- St. John Vianney Morisset & Cooranbong Public School end of year awards presentations;
- Sponsored Cooranbong Public School Family Fun Day in October 2017;
- Support provided for local community service - Cooranbong Pre-school;
- Lake Macquarie Heritage College Country Fair & Fun Day;
- LMCC 2017 School Environment Awards;
- Lotus Education Fund
- Mandalong Community Association;
- Morisset High School Community Youth Project;
- Morisset Meals on Wheels;
- Morisset Junior Golf Academy;
- 2017 Morisset Country Club Pro-Am Event;
- Morisset United Soccer Club;
- Morisset Public School Raffle;
- Morisset PCYC;
- South Lakes Carers Christmas day lunch;
- Wangi Wangi Fire Station; and
- Watagan Mountains Camp-draft Event.

9.3 COMMUNITY COMPLAINTS

Three complaints were received by Centennial Mandalong from the community during the period January 2017 to December 2017, as described in **Table 42**.

Table 42: 2017 Community Complaint Details.

Mandalong Complaint Log Number	Date Complaint Logged	Type of Complaint	Comments
4/2017/ccapp1000365	28/2/2017 1:30 PM	Mandalong Mine received a complaint from a resident of Gradwells Road at Dora Creek on 28 February 2017. The resident stated that mine vehicles have been observed speeding whilst proceeding to and from the Cooranbong Entry Site.	A Tool Box Talk was provided to all Mandalong and Cooranbong employees and contractors regarding the importance of driving safely on Gradwells Road.
4/2017/ccapp1000366	7/3/2017 6:00 PM	The Mandalong Mine received a complaint from a resident of Mandalong on 7 March 2017. The resident stated that a large truck had blocked Mandalong Road whilst turning around at the entrance to the Mandalong South Surface Site. The resident was also concerned with the lack of signage at the entry to the construction site for the Mandalong South Surface Site access road.	An investigation was completed which determined that the truck identified was not associated with the Mandalong Mine operations. The owners of the truck were informed of the complaint. Regarding signage, Daracon installed additional signs to cover for the period until the intersection signage and traffic lights were installed.
4/2017/ccapp1000369	16/3/2017 11:40 AM	The Department of Planning & Environment (DPE) received a complaint from a Mandalong resident on 16 March 2017. The resident claimed that Centennial Mandalong was clearing outside of the approved area, during the construction of the Mandalong South Surface Site access road.	A site inspection was completed by an Officer from the DPE on 17 March 2017. Following the site inspection correspondence was provided by DPE on 20 March 2017 which stated; "*...In regard to the original complaint in relation to clearing, I have updated the complainant that the works being conducted are in accordance with the project approval*".

A total of three community complaints were received in 2017, showing an increase of one complaint compared with the previous reporting period, as detailed in **Table 43**.

Table 43: Record of annual community complaints for 2016 & 2017

Community Complaints						
Year	**Air**	**Water**	**Noise**	**Waste**	**Other**	**Total**
2016	0	0	1	0	1	2
2017	0	0	0	0	3	3

Figure 22 shows a general decrease in the number of community complaints received since 2011 with only one complaint received in 2013, 2014 and 2015. There has been a slight increase in complaints received since 2015 with two complaints in 2016 and three in 2017. Since 2011 no community complaints have been received regarding air quality, water or waste.

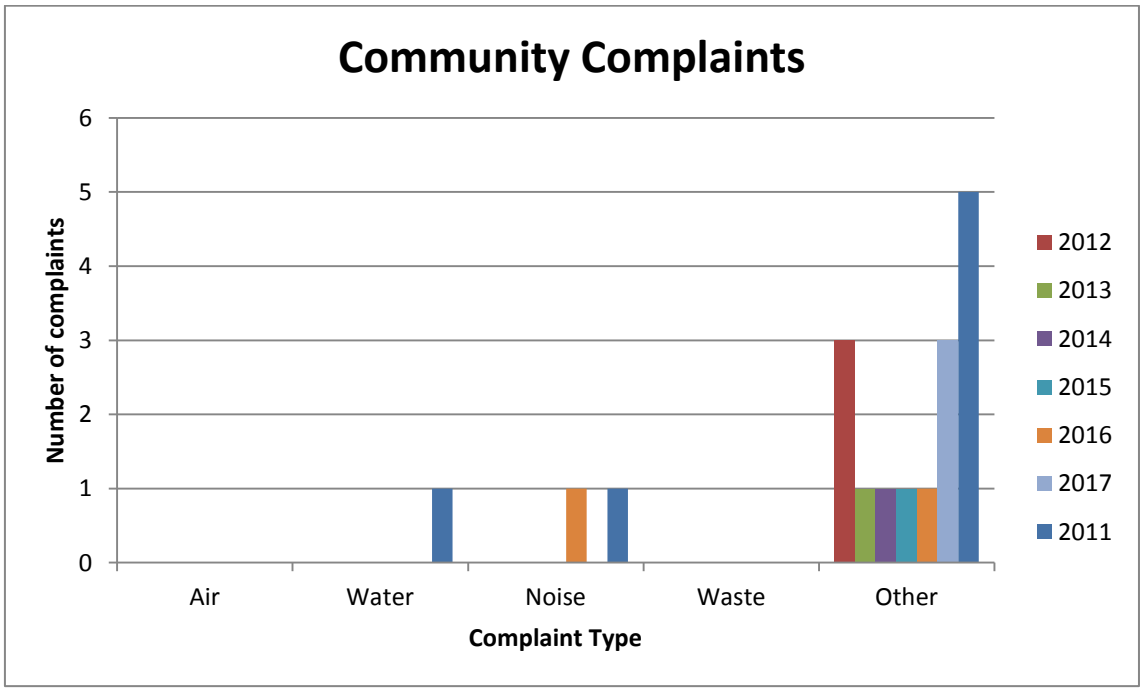

Figure 22: Annual community complaints

10 INDEPENDENT ENVIRONMENTAL AUDIT

An Independent Environmental Audit of the Mandalong's operations was completed by MCW Environmental in July 2016. The audit report is publically available on the Centennial Mandalong website, and a copy was provided to CCC members and the DPE in July 2016.

The Mandalong Mine action plan prepared in response to the non-compliances and recommendations listed in the 2016 Independent Environmental Audit was provided to DPE in July 2016 and an updated version is included in **Appendix 3**.

The next Independent Environmental Audit of the Mandalong Mine operations in accordance with SSD-5144 Schedule 6 Condition 13 and DA97/800 (MOD10) Condition 108 is required to be commissioned prior to March 31, 2019.

11 NON-COMPLIANCES DURING THE REPORTING PERIOD

Table 44: Non-Compliance 1

Nature of the incident/non-compliance	An incident occurred on Monday 3 April 2017 at the MSSS access road construction site. A Daracon excavator inadvertently struck and broke a branch of an individual *Melaleuca biconvexa* specimen whilst installing ballast on the existing access track.
Date of incident/ non-compliance (if known; if not known state not known)	Monday 3 April 2017
The location of the incident/ non-compliance (include a figure if appropriate), if known	MSSS Access Road construction site.
Detail the cause of the incident/non-compliance	A 22T Dararcon excavator was working on the Moran's creek temporary crossing. The excavator was installing additional pipes and ballast into the creek crossing to provide access to the works. The area is constrained by vegetation, including a threatened species (*Melaleuca biconvexa*) both upstream and downstream and is also situated beneath overhead powerlines. While positioned on the eastern side of the creek, the excavator slewed with the boom extended to avoid the overhead powerlines. The excavator bucket struck a low hanging branch of the downstream *Melaleuca biconvexa* breaking the branch at the main trunk, the tree was otherwise undamaged.
Detail action that has been, or will be, taken to mitigate any adverse effects of the incident/ non-compliance	Installation of increased visual delineation incorporating buffer zone (as per photograph below) to prevent future damage to the *Melaleuca biconcexa* specimen.
Detail action that has been, or will be, taken to prevent recurrence of the incident/ non-compliance	The following preventative actions were undertaken- 1. Installation of increased visual delineation incorporating buffer zone (as per photograph below).  2. Task Specific SWMS was prepared for repairing the creek crossing. SWMS included

	working close proximity to threatened species and overhead powerlines. 3. Toolbox talk completed to discuss the incident. Importance of maintaining No Go Zones reinforced. Refresher on how to identify the Melaleuca Biconvexa 4. Prior to commencement of works in new areas of biconvexa , additional controls to be installed to delineate work areas.

12 ACTIVITES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Table 45: Forecast Operations for 2018

Centennial Mandalong
Implement Environmental Management Plans required by SSD-5144. Implement LW22-23 and LW24-24A Extraction Plan Management Plans Complete LW25-37 Extraction Plan
Mandalong Mine Access Site
Complete Mandalong Mine Dam upgrade within existing disturbance footprint.
Cooranbong Entry Site
Nil major targets for 2018.
Delta Entry Site
Complete upgrade to Delta Screening Plant.
Mandalong South Surface Site
Continue construction of the Mandalong South Surface Site and commence shaft sinking. TransGrid to complete TL24 relocation.

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PLANS

APPENDICES

Appendix 1: Bank Guarantee – DA97/800 CC24

Appendix 2: Floodpath Condition Report - 2017

Appendix 3: 2016 Independent Environmental Audit Action Plan

Appendix 4: Centennial Mandalong Rehabilitation Security Estimate

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